

SEA TURTLES

A SeaWorld Education Department Publication

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SEA TURTLES

SCIENTIFIC CLASSIFICATION

A. Class – Reptilia.

1. Reptiles are a class of cold-blooded vertebrates – their body temperature varies with their environment. Reptiles include snakes, lizards, crocodiles, and turtles.
2. Reptiles have scaly skin, breathe air with lungs, and have a three-chambered heart.
3. Most reptiles lay eggs, although some produce eggs that hatch internally.

B. Order – Testudines.

This order includes all turtles and tortoises. It is divided into three suborders: Pleurodira (side-necked turtles), Cryptodira (freshwater turtles, snapping turtles, tortoises, soft-shelled turtles, and sea turtles), and Amphichelydia (a suborder of turtles that is now extinct).

C. Families.

Most scientists recognize two families of sea turtles:

1. Family Cheloniidae includes all sea turtles with *scutes* (horny plates) covering their shells.
2. Family Dermochelyidae are scuteless turtles with only one modern species; the leatherback turtle. A leatherback turtle is covered with leathery skin. It is the only marine turtle whose backbone is not attached to the inside of its shell.

D. Genus, species.

Most scientists recognize seven species and one subspecies of sea turtles:

1. green (*Chelonia mydas*); two subspecies the black or Eastern Pacific green turtle (*Chelonia mydas agassizii*) and the green (*Chelonia mydas mydas*).
2. loggerhead (*Caretta caretta*)
3. Kemp's ridley (*Lepidochelys kempii*)
4. olive ridley (*Lepidochelys olivacea*)
5. hawksbill (*Eretmochelys imbricate*)
6. flatback (*Natator depressus*)
7. leatherback (*Dermochelys coriacea*)

E. Fossil record.

1. The first turtles appeared during the Triassic period, 245 to 209 million years ago.
2. The earliest known sea turtles appear in the fossil record in the Late Jurassic period, 208 to 144 million years ago. Scientists believe that modern sea turtles

are derived from marsh-inhabiting ancestors that lived during the Late Triassic period.

3. Fossil records show that the now-extinct sea turtle *Archelon ischyros*, which lived 144 to 65 million years ago, was one of the largest turtles that ever lived. It reached a length of 3 to 4 m (9.8–13 ft.).
4. Sea turtles, saltwater crocodiles, sea snakes, and marine iguanas are the only surviving reptiles that depend on the sea.

DISTRIBUTION AND HABITAT

A. Distribution.

Various species of sea turtles are found in warm and temperate seas throughout the world. (See the table on page 4 for more information.)

B. Habitat.

1. Adults of most species are found in shallow, coastal waters, bays, lagoons, and estuaries.
2. Some also venture into the open sea.
3. Juveniles of some species may be found in bays and estuaries, as well as at sea. (See table on page 4 for descriptions of each species habitat.)

C. Migration.

1. Some sea turtle populations nest and feed in the same general areas; others migrate great distances.
2. Migration habits differ not only among species but also among different populations of the same species.
 - a. Green sea turtle populations migrate primarily along the coasts from nesting to feeding grounds. However, some populations travel 2,094 km (1,300 miles) across the Atlantic Ocean; from Ascension Island nesting grounds (in the middle of the South Atlantic) to Brazilian coast feeding grounds.
 - b. Loggerheads leave foraging areas and travel on breeding migrations that can be a few thousand kilometers (1 kilometer = 0.62 miles) each way.
 - c. Kemp's ridley turtles follow two major routes in the Gulf of Mexico: one northward to the Mississippi area, and the other southward to the Campeche Bank, near the Yucatan Peninsula.
 - d. Populations of olive ridleys have been observed in large flotillas traveling between feeding and nesting grounds in the Eastern Pacific and Indian Oceans.

<i>species</i>	<i>distribution</i>	<i>habitat</i>
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green sea turtle (<i>Chelonia mydas mydas</i>)	Atlantic Ocean, Gulf of Mexico, along Argentine coast, Mediterranean Sea, and Indo-Pacific	tropical and subtropical areas near continental coasts and around islands
black sea turtle (<i>Chelonia mydas agassizii</i>)	West coasts of North and South America, from central Baja California to Peru.	bays and protected shores; not commonly seen in the open ocean
loggerhead sea turtle (<i>Caretta caretta</i>)	Worldwide	coastal tropical and subtropical; ventures into temperate waters, to boundaries of warm currents; prefer coastal bays, but found in coastal streams, creeks, and open ocean
Kemp's ridley sea turtle (<i>Lepidochelys kempii</i>)	Adults usually occur in the Gulf of Mexico. Juveniles and immatures range between temperate and tropical coastal areas of the northwestern Atlantic Ocean. Occasionally young turtles reach northern European waters and as far south as the Moroccan coast.	shallow areas with sandy or muddy bottoms rich in crustaceans
olive ridley sea turtle (<i>Lepidochelys olivacea</i>)	Tropical regions of the Atlantic, Indian, and Pacific Oceans (rarely to central California); nearly unknown around oceanic islands.	mostly coastal; traveling or resting in surface waters
hawksbill sea turtle (<i>Eretmochelys imbricata</i>)	Throughout central Atlantic and Indo-Pacific regions; most tropical of all sea turtles.	near coral reefs and rocky outcroppings in shallow coastal areas
flatback sea turtle (<i>Natator depressus</i>)	Indigenous to northwestern, northern, and northeastern regions of Australia; the most restricted range of all sea turtle species.	completely coastal; does not go beyond the continental shelf
leatherback sea turtle (<i>Dermochelys coriacea</i>)	The most widely distributed of all sea turtles; found in the Gulf of Alaska and south of the Bering Sea in the northeastern Pacific to Chile in the southeastern Pacific. In the Barents Sea, Newfoundland and Labrador in the North Atlantic; around Argentina and South Africa in the South Atlantic. Throughout the Indian Ocean; and to Tasmania and New Zealand in the southwestern Pacific. This species is found farther north than any other reptile, marine or terrestrial.	highly oceanic, approach coastal waters only during breeding season

Table: Sea turtle distribution and habitat

- e. Hawksbill migration studies have been limited. Evidence suggests that some hawksbill populations show cyclic nesting migrations. Other

researchers have documented nonmigratory and short-distance migratory populations.

- f. Flatbacks move from their nesting grounds on the northern coast of Australia and its islands to feeding grounds in shallow waters of northeastern Australia. Distance covered ranges from 215 to 1,300 km (134–807 miles).
 - g. Leatherbacks have the longest migration of all sea turtles. They have been found more than 4,831 km (3,000 miles) from their nesting beaches.
3. Historically, scientists tracked a free-ranging sea turtle by tagging a flipper and documenting where the turtle was sighted. Although this method yields information on migration destinations, it does not reveal travel routes.
 4. Most recently radio and satellite tracking have become more common in successfully monitoring sea turtle movements.
 5. Hubbs-SeaWorld Research Institute has developed a radio/satellite transmitter harness for leatherback turtles. Its design allows secure attachment of a transmitter without affecting turtle mobility. The harness was designed to release within several months.

D. Population.

1. Total population figures are often unknown because juvenile and male sea turtles do not come ashore and are difficult to count.
2. Population data are usually based on the numbers of adult females that come ashore to nest. Even then, the numbers are ambiguous – some females nest every two to three years; some may nest more than once on the same beach in a season; and some visit more than one nesting beach in a season.
3. Researchers rely on the changing numbers of nesting females from year to year to determine population trends. Because broad year-to-year fluctuations in numbers of nesting females make short-term data misleading, surveys of a decade or less may be insufficient to determine a population trend.
 - a. The Kemp's ridley is the most endangered sea turtle. In 1947, 42,000 nests were counted in a single day. The numbers declined dramatically until the 1980s. Currently, because of protection of nesting beaches and the use of turtle excluder devices in commercial shrimp fishing, Kemp's ridley populations seem to be slowly increasing.
 - b. Nesting populations of green sea turtles have not been surveyed long enough to determine worldwide population numbers. Experts estimate that in the past 120 to 140 years green sea turtle numbers have declined by 48 to 67 percent (IUCN 2004). Between 200 and 1,000 green sea turtles nest on beaches in the continental U.S.
 - c. Little data are available on hawksbill populations. Probably about 15,000 female hawksbills nest each year worldwide, although accurate estimates of population sizes are difficult by aerial assessment. Tracks

in the sand do not last long and are difficult to see, and nests are often obscured by beach vegetation.

- b. The major loggerhead nesting grounds are in the southeastern U.S. Population trends of loggerheads show a decline in Georgia and South Carolina nesting areas, but no decline or a possible increase in southern Florida nesting areas. More years of nesting data and population biology studies are needed to assess the Florida trends. In the U.S., total estimates for loggerhead nests per year range from 68,000 to 90,000. The worldwide population is unknown, although most populations outside of U.S. waters are declining.
- d. The olive ridley is the most abundant sea turtle in the world. There are probably more than several hundred thousand adult female olive ridleys. In 1991, an estimated 610,000 turtles nested in a single week on a beach in India.
- f. The current population of flatback turtles is unknown. Because of its restricted distribution, the flatback is the most vulnerable of all sea turtles to habitat change or exploitation.
- g. There are probably 26,000 to 43,000 adult female leatherbacks worldwide. Their numbers do not appear to be declining in the U.S.

PHYSICAL CHARACTERISTICS

A. Size.

Adult male and female sea turtles are equal in size.

- 1. The leatherback is the largest of all living sea turtles. Mature leatherbacks reach about 1.2 to 1.9 m (3.9–6.2 ft.) and 200 to 506 kg (441–1,116 lb.). The largest leatherback recorded weighed 916 kg (2,019 lb.).
- 2. The Kemp's ridley and olive ridley are the smallest species, and reach about 55 to 75 cm (22–30 in.) and 30 to 50 kg (66–110 lb.).
- 3. Green sea turtles reach about 78 to 112 cm (31–44 in.) and 68 to 186 kg (150–410 lb.). The largest individual collected was 1.5 m (4.9 ft.) and 395 kg (871 lb.).
- 4. Loggerheads reach about 82 to 105 cm (32–41 in.) and 66 to 101 kg (146–223 lb.).
- 5. Hawksbills reach about 53 to 114 cm (21–45 in.) and 27 to 86 kg (60–190 lb.).
- 6. Flatbacks reach about 81 to 97 cm (32–38 in.) and 60 to 84 kg (132–185 lb.).

B. Body shape.

Sea turtles are characterized by a large, streamlined shell.

C. Coloration.

1. Depending on the species, sea turtles range can be olive-green, yellow, greenish-brown, reddish-brown, or black in color.
2. The green sea turtle gets its name from the color of its body fat.

D. Flippers.

1. Limbs are flippers adapted for swimming. Sea turtles are awkward and vulnerable on land.
2. Forelimbs are long and paddle like.
 - a. Long digits are fused throughout the flipper.
 - b. Only one or two claws are present on each fore flipper.
 - c. A sea turtle swims with powerful wing like beats of its fore flippers.
3. Hind flippers serve as rudders, stabilizing and directing the animal as it swims. The hind flippers of some species are quite dexterous at digging nests in the sand.
4. A sea turtle cannot retract its limbs under its shell as a land turtle can.

E. Head.

1. A sea turtle cannot retract its head under its shell as a land turtle can.
2. Sea turtles have large upper eyelids that protect their eyes.
3. Sea turtles do not have an external ear opening.
4. Like other turtles, sea turtles lack teeth. Jaw shape varies among species. Each species has a jaw shape adapted for its diet.

F. Shell.

1. The dorsal (top) side of the shell is called the *carapace*.
 - a. Depending on species, the adult carapace ranges in shape from oval to heart-shaped.
 - b. In all species except the leatherback, the bony shell is composed of broadened, fused ribs, and the backbone is attached to the carapace.
2. The ventral (bottom) side of the shell is called the *plastron*.
3. In all species except the leatherback, the shell is covered with a layer of horny plates called scutes.
 - a. Scutes are firm but flexible, not brittle.
 - b. Scientists can identify sea turtle species by the number and pattern of scutes.
 - c. The leatherback turtle has a thick and oil-suffused skin, which is an excellent insulator, allowing this species to venture into cold water.
 - c. The leatherback's carapace is composed largely of cartilage raised into prominent longitudinal ridges. A layer of thousands of small dermal bones lies just below the leathery skin.

4. A sea turtle's large, bony shell provides protection from predation and abrasion.
- G. Sexual dimorphism.
1. Male and female sea turtles do not differ externally until they approach maturity.
 2. Adult males have longer, thicker tails than females, because the male reproductive organ is housed in the base of the tail. In males, the tail may extend beyond the hind flippers.
 3. With the exception of the leatherback turtle, the claws on the fore flippers of sea turtle males are elongated and curved, which may help them grasp a female's shell during mating.

SENSES

- A. Hearing.
All reptiles, including sea turtles, have a single bone in the middle ear that conducts vibrations to the inner ear. Researchers have found that sea turtles respond to low frequency sounds and vibrations.
- B. Eyesight.
1. Sea turtles can see well under water but are shortsighted in the air.
 2. Under experimental conditions, loggerhead and green sea turtle hatchlings exhibited a preference for near-ultraviolet, violet, and blue-green light.
- C. Tactile.
A sea turtle is sensitive to touch on the soft parts of its flippers and on its shell.
- D. Taste.
Little is known about a sea turtle's sense of taste.
- E. Smell.
1. Most researchers believe that sea turtles have an acute sense of smell in the water. Experiments show that hatchlings react to the scent of shrimp. This adaptation helps sea turtles to locate food in murky water.
 2. A sea turtle opens its mouth slightly and draws in water through the nose. It then immediately empties the water out again through the mouth. Pulsating movements of the throat are thought to be associated with smelling.

ADAPTATIONS FOR AN AQUATIC ENVIRONMENT

A. Swimming.

1. Sea turtles are strong swimmers. The cruising speed for green sea turtles is about 1.5 to 2.3 kph (0.9–1.4 mph). Leatherbacks have been recorded at speeds of 1.5 to 9.3 kph (0.9–5.8 mph).
2. Forelimbs are modified into long, paddle-like flippers for swimming.
3. Neck and limbs are nonretractile. The shell adaptations necessary for retractile limbs would impede rapid swimming.

B. Diving.

1. Sea turtles are excellent divers. Leatherbacks routinely dive more than 305 m (1,000 ft.). They may reach depths of more than 1,190 m (3,900 ft.) seeking jellyfish for prey.
2. Since they are cold-blooded, sea turtles have a slow metabolic rate. This slowed metabolism allows them to stay submerged for long periods of time.
 - a. Hawksbill turtles have been known to remain submerged for 35 to 45 minutes.
 - b. Green sea turtles can stay under water for as long as five hours. Their heart rate slows to conserve oxygen: nine minutes may elapse between heartbeats.
 - c. In the north-central Gulf of California, black sea turtles return each year to specific areas. They bury themselves in sand or mud under water and may remain dormant from November to March.
3. During long dives, blood is shunted away from tissues tolerant of low oxygen levels toward the heart, brain, and central nervous system.
4. Leatherbacks have high concentrations of red blood cells; therefore, their blood retains more oxygen. The muscle of leatherbacks has a high content of the oxygen-binding protein myoglobin. Myoglobin transports and stores oxygen in muscle tissue.

C. Respiration.

In studies conducted on green sea turtles, lung capacity exchange in one breath exceeded 50%.

D. Salt secretion.

1. Sea turtles can live in seawater with no need for a freshwater source. They obtain sufficient water from their diet and from metabolizing seawater.
2. Like other marine reptiles and seabirds, sea turtles have a salt gland to rid their bodies of excess salt. This gland empties into the sea turtles' eyes. The secretion of salt and fluid makes them look as if they are "crying" when they come ashore. These "tears" also help keep the eyes free of sand while females dig their nests.

E. Sea turtles on land.

1. For the most part, the only time sea turtles leave the sea is when females haul out to lay eggs. On some uninhabited or sparsely-inhabited beaches, turtles have been observed basking on land.
2. Many adaptations that make sea turtles successful in the sea make them slow and vulnerable on land.

BEHAVIOR

A. Social behavior.

1. Sea turtles are not generally considered social animals; however, some species do congregate offshore.
2. Sea turtles gather together to mate. Members of some species travel together to nesting grounds.
3. After hatchlings reach the water they generally remain solitary until they mate.

B. Individual behavior.

Little is known about the individual behavior of sea turtle species.

1. In the ocean, flatback turtles may spend hours at the surface floating, apparently asleep or basking in the sun. Frequently, seabirds perch on the backs of the flatbacks.
2. Hawksbill turtles spend some time resting or sleeping wedged into coral or rock ledges.
3. Olive ridleys have been observed basking on beaches, and it is not unusual to see thousands of olive ridleys floating in front of the nesting beaches.
4. Leatherback turtles tend to dive in a cycle that follows the daily rising and sinking of the dense layer of plankton and jellyfish. The turtles probably feed in the upper layers of water at night. As dawn approaches, their dives become deeper as the plankton and jellyfish retreat to deeper water, away from the light of day. The turtles bask at the surface at midday when the layer sinks beyond their typical diving range. As dusk approaches, the turtles' dives become shallower as the layer rises.
5. Green sea turtles are considered solitary, but occasionally form feeding aggregations in shallow waters abundant in seagrass or algae.

FOOD AND FORAGING

- A. Food preferences and resources.
1. Depending on the species, sea turtles may be *carnivorous* (meat eating), *herbivorous* (plant eating), or *omnivorous* (eating both meat and plants). The jaw structure of many species is adapted for their diet.
 2. Green sea turtles have finely serrated jaws adapted for a vegetarian diet of sea grasses and algae. As adults, these are the only herbivorous sea turtles.
 3. Some species change eating habits as they age. For example, green sea turtles are mainly carnivorous from hatching until juvenile size; they then progressively shift to an herbivorous diet.
 4. A hawksbill has a narrow head with jaws meeting at an acute angle, adapted for getting food from crevices in coral reefs. They eat sponges, tunicates, shrimps, and squids.
 5. Loggerheads' and ridleys' jaws are adapted for crushing and grinding. Their diet consists primarily of crabs, molluscs, shrimps, jellyfish, and vegetation.
 6. Leatherbacks have delicate scissor-like jaws that would be damaged by anything other than their normal diet of jellyfish, tunicates, and other soft-bodied animals. The mouth cavity and throat are lined with *papillae* (spine-like projections) pointed backward to help them swallow soft foods.
 7. Researchers continue to study the feeding habits of flatbacks. There is evidence that they are opportunistic feeders that eat seaweeds, cuttlefish, and sea cucumbers.
 8. In a zoological environment all sea turtle species can be maintained on a carnivorous diet.

REPRODUCTION

- A. Sexual maturity.
1. Estimates of sexual maturity in sea turtles vary not only among species, but also among different populations of the same species. Maturity may range from as early as three years in hawksbills to 12 to 30 years in loggerheads to 20 to 50 years in green sea turtles.
 2. Sexual maturity often is related to carapace size. Studies have shown that hawksbills reach sexual maturity at a carapace size of 60 to 95 cm (24–37 in.); loggerheads reach maturity at a carapace size of 79 cm (31 in.); and green sea turtles reach maturity at 69 to 79 cm (27–31 in.).
 3. Evidence suggests that some turtles continue to grow after reaching sexual maturity, while some stop growing after reaching maturity.
- B. Mating activity.
1. For most species, courtship activity usually occurs several weeks before the nesting season.

2. Two or more males may court a single female.
 3. Male sea turtles of all species except leatherbacks have enlarged claws on their front flippers. These help grasp the shells of the females during mating.
 4. Fertilization is internal. Copulation takes place in the water, just offshore.
- C. Nesting behavior.
1. Like other turtles, sea turtles lay eggs.
 2. Females come ashore on a sandy beach to nest a few weeks after mating.
 - a. Females usually nest during the warmest months of the year. The exception is the leatherback turtle, which nests in fall and winter.
 - b. Females of most species usually come ashore at night, alone, most often during high tide. A female sea turtle crawls above the high tide line and, using her front flippers, digs out a "body pit." Then using her hind flippers, she digs an egg cavity. The depth of the cavity is determined by the length of the stretched hind flipper.
 - c. A female deposits 50 to 200 (depending on the species) Ping Pong ball shaped eggs into the egg cavity. The eggs are soft-shelled, and are papery to leathery in texture. They do not break when they fall into the egg cavity. The eggs are surrounded by a thick, clear mucus.
 - d. The female covers the nest with sand using her hind flippers. Burying the eggs serves three purposes: it helps protect the eggs from surface predators; it helps keep the soft, porous shells moist, thus protecting them from drying out; and it helps the eggs maintain proper temperature. Experts can identify the species of turtle by the type of mound left by the nesting female and by her flipper tracks in the sand.
 - e. Females may spend two or more hours out of the water during the entire nesting process.
 - f. It is possible that through the storage of sperm from one or several males in the oviducts of the females, all clutches of the current nesting season may be fertilized without repeated mating.
 3. Female Kemp's ridley and olive ridley sea turtles form masses called *arribadas* (Spanish for "arrival"). *Arribadas* contain thousands of egg-bearing females that come ashore at the same time to lay eggs.
 4. Most females return to the same beach where they hatched to nest each year.
 - a. Recent studies suggest that some females of some species will visit more than one nesting beach (other than the original beach) in a season.
 - b. Females usually lay between one and nine *clutches* (groups) of eggs per season.
 - c. Females may nest every two or three years.

HATCHING AND HATCHLINGS

- A. Incubation.
1. Incubation time varies with species, clutch size, and temperature and humidity in the nest.
 2. The incubation time for most species is 45 to 70 days.
 3. Research indicates that the sex of an embryo is determined sometime after fertilization, as the embryo develops, and may be temperature dependent. Lower nest temperatures produce more males; higher temperatures produce more females.
- B. Hatching.
1. Sea turtles hatch throughout the year but mostly in summer.
 2. Hatchlings use a *carbuncle* (temporary egg tooth) to help break open the shell.
 3. After hatching, the young turtles may take three to seven days to dig their way to the surface.
 4. Hatchlings usually wait until night to emerge from the nest. Emerging at night reduces exposure to daytime predators. They leave the nest and head to the water in groups. Studies have shown that some nests will produce hatchlings on more than one night.
- C. Reaching the ocean.
1. There are several theories as to how hatchlings find the sea.
 - a. Hatchlings may distinguish light intensities and head for the greater light intensity of the open horizon.
 - b. During the crawl to the sea, the hatchling may set an internal magnetic compass, which it uses for navigation away from the beach.
 2. When a hatchling reaches the surf, it dives into a wave and rides the undertow out to sea.
 - a. A “swim frenzy” of continuous swimming takes place for about 24 to 48 hours after the hatchling enters the water.
 - b. This frantic activity gets the young turtle into deeper water, where it is less vulnerable to predators.
 - c. There have been reports of swimming hatchlings diving straight down when birds and even airplanes appear overhead. This diving behavior may be a behavioral adaptation for avoiding predation by birds.
- D. The first year.
1. During the first year, many species of sea turtles are rarely seen. This first year is known as the “lost year.”
 2. Researchers generally agree that most hatchlings spend their first few years living an oceanic existence before appearing in coastal areas. Although the migratory patterns of the young turtles during the first year has long been a

puzzle, most researchers believe that they ride prevailing surface currents, situating themselves in floating seaweed where they can find food.

3. Research suggests that flatback hatchlings do not go through an oceanic phase. Evidence shows that the young turtles remain inshore following the initial swim frenzy. Most remain within 15 km (9.3 miles) of land.

LONGEVITY AND THREATS TO SURVIVAL

A. Longevity.

Scientists are still researching sea turtle longevity. Once sea turtles reach sexual maturity, they may have an estimated reproductive life of about 30 years. Given that some species reach maturity at 50 years, an 80-year lifespan is feasible.

B. Aging.

Currently there is not an adequate method of aging sea turtles. The most accepted method is to study growth rings of the scales on the carapace and plastron. Scientists count the rings and use a mathematical formula to estimate a turtle's age.

C. Natural predators.

1. Adult sea turtles have a few predators, mostly large sharks. Tiger sharks, in particular, are known for eating sea turtles. Killer whales have been known to prey on leatherback turtles.
2. Fishes, dogs, seabirds, raccoons, ghost crabs, and other predators prey on eggs and hatchlings. More than 90% of hatchlings are eaten by predators.
3. Flatback turtle nests are susceptible to predation by monitor lizards, dingoes, and introduced foxes.

D. Fibropapillomas.

Green sea turtles may develop lobed tumor like growths (*fibropapillomas*) on the skin. These growths can reduce vision, obstruct normal swimming and feeding, and increase susceptibility to secondary parasitism and infection.

E. Natural disasters.

1. Hurricanes can severely impact sea turtle nesting success. Almost 90 percent of sea turtle nesting in the continental U.S. occurs on Florida's beaches. Scientists estimate that more than half of the sea turtle nests on the coast of Florida were washed away by the four hurricanes hitting the coast in 2004.

F. Human impact.

1. Sea turtle nesting areas are becoming scarce due to beach development and disturbances. Kemp's ridleys mainly nest on a remote beach in Mexico near the village of Rancho Nuevo (about 161 km, or 100 miles, south of the Texas border). In 1947, scientists witnessed an arribada of more than 42,000 Kemp's ridley turtles in one day. In the 1960s numbers were reduced to less than 5,000 turtles. In 1973, the largest arribada contained only 200 individuals. More recently, a small but growing number of Kemp's ridleys have nested on some beaches along the coast of Texas.

2. Nesting females and hatchlings are disturbed by the presence of trash on nesting beaches. If trash impedes its crawl up the beach, a female returns to the sea instead of nesting.
3. The noise and activity of people on the beach also may cause females to return to the sea instead of nesting.
4. Some sea turtles die when they ingest trash. Leatherbacks are especially susceptible to ingesting plastic, mistaking it for jellyfish.
5. Thousands of sea turtles drown in commercial shrimp nets each year. Shrimpers accidentally entangle turtles that are foraging where trawlers are working. This mortality may be increasing. In 1947, 5,000 U.S. shrimping trawlers worked in the Gulf of Mexico. That number increased to 15,000 full-time and 40,000 part-time trawlers by 1989.
6. Artificial lighting on beaches may misrepresent the time of day to turtles attempting to nest. Most turtles are nocturnal nesters, and to a turtle that has not yet come ashore to nest, a brightly lighted beach may signify daylight and inhibit nesting.
7. Hatchlings can become disoriented by city and street lights when trying to find the surf. Many young turtles actually head away from the ocean and toward parking lots. These animals may be eaten by predators or crushed by cars. Some die from exposure.
8. Some people illegally collect turtle eggs for food and for their alleged aphrodisiac effect.
9. Sea turtles are hunted (illegally in this country and, in some cases, legally elsewhere) for their meat and shells, which are used to make combs, eyeglass frames, aphrodisiacs, and curios. The fat of green sea turtles, boiled with cartilage, made a popular soup called *calipee*, which led to the decline in green sea turtle population numbers.
10. Deforestation may indirectly threaten sea turtle nests. Costa Rica has one of the highest deforestation rates in the world. Some researchers fear that without the forest to draw up ground water, the water table will rise beneath beaches and drown nests.
10. Propeller and collision injuries from boats are not uncommon. These types of injuries are more frequent in areas with a high level of recreational boating, such as southern Florida, the Florida Keys, and the United States Virgin Islands.

CONSERVATION

- A. Legal protection for sea turtles.
1. The Endangered Species Act, 1973 (ESA).
 - a. The Endangered Species Act of 1973 (ESA) is administered by the U.S. Departments of Interior and Commerce. It seeks to stop the extinction of wild animals and plants in the United States, other nations, and at sea. All sea turtles except the flatback are listed as threatened or endangered on the U.S. Endangered and Threatened Wildlife and Plants List. It is illegal to harm, or in any way interfere with, a sea turtle or its eggs.
 - b. Under the ESA, the hawksbill, Kemp's ridley, leatherback, populations of green sea turtles (along Florida and the Pacific coast of Mexico), and breeding populations of olive ridleys (on the Pacific coast of Mexico) are listed as "endangered" (species face a very high risk of extinction).
 - c. The loggerhead, green (except the populations listed above), and olive ridley (except the populations listed above) sea turtles are listed as "threatened" (species face a high risk of extinction).
 2. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
 - a. CITES is an international treaty, developed in 1973, to regulate trade in certain wildlife species.
 - b. CITES Appendix I includes species identified as endangered (species faces a very high risk of extinction). All sea turtle species are listed under Appendix I in CITES.
 3. IUCN/The World Conservation Union is a worldwide conservation organization.
 - a. This organization links together government agencies, non-government agencies, and independent states to encourage a worldwide approach to conservation.
 - b. The hawksbill and Kemp's ridley sea turtles are both listed as critically endangered (the species faces an extremely high risk of extinction) by the IUCN.
 - c. The green, loggerhead, and olive ridley sea turtles are all listed as endangered (species faces a very high risk of extinction).
- B. Turtle Excluder Device.
1. At a cost of millions of dollars, the U.S. National Marine Fisheries Service developed the Turtle Excluder Device (TED).
 2. The TED is a small, metal grid trapdoor inside a trawling net that allows shrimp to pass to the back while the turtles escape to safety before becoming entrapped or entangled.
 3. Since 1989, federal law requires that this device be installed on the nets of all U.S. fishing trawlers working in areas populated by sea turtles.

C. Protecting nests.

1. Sometimes field biologists protect sea turtle nestlings from predators by placing screens over them. They may also relocate eggs laid too close to the water or in erosion zones to safer areas.
2. In a bold conservation program, the townspeople in one small Costa Rican beach village are allowed to gather eggs during the first two nights of each olive ridley arribada. Scientists have calculated that a controlled harvest would leave enough protected eggs to rejuvenate the population (in one nesting season, 20 to 30 million olive ridley eggs may be laid in this beach village) while allowing villagers to maintain a livelihood. The program has the potential to stop egg poachers on other beaches by keeping the prices of the “legal” eggs too low for poachers to compete.

D. Lighting.

Although eliminating beach lighting would be the most effective way to reduce disorientation of hatchlings, studies have shown that low pressure sodium vapor lights have a lesser effect on loggerhead and green sea turtle hatchlings. Many beach communities have encouraged the use of these lights.

E. Wildlife refuges.

1. In 1991, Congress established the Archie Carr National Wildlife Refuge on the east coast of Florida. After completion of the acquisition of privately-owned, mostly undeveloped lands, the refuge will cover 900 acres, including 33 km (20.5 miles) of important sea turtle nesting habitat between Melbourne Beach and Wabasso Beach. Federal, state, and local agencies and private groups are sharing the projected \$80 million cost to obtain the lands to complete the reserve.
 - a. This 33-km (20.5-mile) section of beach is the most important nesting site for loggerheads in the Western Hemisphere.
 - b. The refuge is also the most important nesting beach in the United States for the green sea turtle.
 - c. The refuge is the northernmost point on the Atlantic coast for leatherback nesting – in 1996 only ten nests were counted in or just adjacent to the refuge, in 2001 the number of nests counted steadily increased to 39.
 - d. The refuge is also considered prime real estate for commercial development, making government funding essential to its preservation.
2. The governments of Nicaragua and Costa Rica have established, and are striving to expand, national parks and biological reserves where sea turtles forage and nest. Tortuguero, Costa Rica maintains the largest green sea turtle rookery in the Caribbean. Local economics is no longer based on turtle harvests, but on tourism. More than 15,000 visitors are expected each year.

F. Managing sex ratios.

Most conservationists believe that abundant nesting females are desirable to rejuvenate sea turtle populations. Researchers with Reptile Conservation International have developed and patented a technique of applying an estrogen solution onto eggs to produce a higher number of females under normal incubation.

G. In zoological environments.

1. Having sea turtles at marine zoological parks provides an opportunity for the public to learn, up-close, about these animals and how human activities may impact their survival. SeaWorld San Diego, SeaWorld Orlando, SeaWorld San Antonio, and Busch Gardens Tampa all offer a **Saving a Species Tour** in which guests can learn about endangered animals including sea turtles. A portion of the tour proceeds goes to the **SeaWorld-Busch Gardens Conservation Fund** – a non-profit charitable organization that sponsors sea turtle research along with other projects.
2. In the protected environment of a marine zoological park, scientists can examine aspects of sea turtle biology that are difficult or impossible to study in the wild. In June of 2003, aquarists at SeaWorld San Diego made history by successfully incubating and hatching 21 sea turtle eggs that were laid by a female green sea turtle at the park.
3. SeaWorld Parks rehabilitates an average of 45 to 50 rescued green, hawksbill, Kemp’s ridley, leatherback, loggerhead, and olive ridley sea turtles each year. Depending the severity of their injuries, rehabilitated sea turtles are released. In 2004, SeaWorld released its 800th rehabilitated sea turtle.
 - a. Sea turtles are often rescued after a cold weather snap. Low water temperatures cause a sea turtle’s metabolism to slow – the hypothermic turtles become sluggish and are unable to feed. Marine patrol officers may find the turtles floating at the surface of the water in a semi-dormant state. In December 1989, 95 hypothermic green sea turtles were rescued from Florida’s Merritt Island. These turtles were housed in recovery pools at SeaWorld of Florida for about 10 weeks. Once the weather warmed up, the turtles were released in the same area that they were rescued.
 - c. SeaWorld has rescued other sea turtles with injuries resulting from entanglement, motorboat collisions, ocean dredging, or ingestion of non-food items.
4. Data gathered through the SeaWorld Animal Rescue and Rehabilitation Program and similar programs can help scientists more accurately assess and recommend sea turtle population management programs in the wild.
5. By fitting sea turtles with satellite tracking devices, scientists at HSWRI (Hubbs-SeaWorld Research Institute) and SeaWorld have sought to gain a greater understanding of turtle navigation and biology in the face of threats to the species from fishing, pollution, and habitat destruction.

- a. After living 30 years at SeaWorld San Diego, three mature Pacific loggerhead sea turtles were released and tracked off the Californiacoast in October 2000.
 - (1) As of August 2001, Bubba, a male Pacific Loggerhead sea turtle, had reached Japanese waters – the first of the turtles to do so. He traveled an average of 30 to 40 km (18-24 mi.) per day since his release.
 - (2) As of Sept. 25, 2001, Crackers was 430 km (267 mi.) from Japan.
 - (3) As of April 18, 2002, Mihali had made a run for a nesting beach about 200 km (124 mi.) from Yakushima, which put her right on schedule for mid-summer nesting that year.
 - (4) Information gathered from this study will help close an important gap in past research because it has been difficult to study sea turtles away from their nesting colonies, where they spend only 10 percent of their time.
 - b. Scientists with HSWRI along with colleagues at The University of Central Florida, the Caribbean Conservation Corporation, and the Marinelifelife Center of Juno Beach have initiated a study on post-nesting migrations of leatherbacks that nest in the Archie Carr National Wildlife Refuge and Juno Beach in Florida, and Tortuguero Beach in Costa Rica.
 - (1) In 2003, ten leatherback sea turtles were equipped with satellite-linked radio transmitters.
 - (2) Data collected from this study will help advance U.S. and international efforts to protect the leatherbacks and the critical habitats they rely on for survival.
6. The **SeaWorld-Busch Gardens Conservation Fund (SWBGCF)**, a non-profit charitable organization, sponsors projects involving marine and terrestrial animals including sea turtles. Sea turtle projects include:
- a. Project: "Loggerhead Turtle Tracking"
Partner: National Oceanic & Atmospheric Administration
Location: Cape Verde archipelago, western Africa
 The Cape Verde archipelago represents one of the largest loggerhead nesting populations in the Atlantic Ocean and is likely the largest nesting population in western Africa. Although some areas of the archipelago are protected, human predation of sea turtles is significant. Satellite tracking technology allows NOAA to track turtles from Cape Verde to identify important life history information, migratory pathways, and feeding grounds. This information will provide the support required for increased protection of the loggerhead turtle. The **SWBGCF** grant allowed NOAA to purchase satellite transmitters needed to conduct this study.
 - b. Project: "Environmental Co-Factors and Fibropapillomatosis in the Green Sea Turtle"
Partner: University of Central Florida

Location: Florida, USA

Fibropapillomatosis (FP) is an infectious disease threatening endangered Florida populations of green sea turtles (*Chelonia mydas*).

Fibropapillomatosis is prevalent in degraded marine environments, but the environmental cofactors that increase incidence of FP remain unknown. The University of Central Florida study uses novel bio-molecular technology - a cellular-diagnostic system (CDS) - to identify environmental stressors - associated with FP among 3 populations with differing occurrences of the disease. The SWBGCF grant partially funds the study.

- c. Project: "Reducing Marine Turtle Bycatch in the Fisheries of the Eastern Pacific Ocean through Improvement in Fishing Gear and Techniques"

Partner: World Wildlife Fund

Location: Eastern Pacific Ocean

The future survival of leatherback and loggerhead sea turtles is threatened by fisheries bycatch, particularly bycatch in longline and coastal gill net fisheries. Fortunately, advances in fishing equipment and methods could dramatically reduce this bycatch. Recent research has demonstrated that turtle bycatch can be reduced by as much as 90 percent through changes to longline fishing gear and techniques, including the use of circle hooks instead of traditional "J" hooks. Acting on these findings, WWF is promoting widespread improvement in fishing gear and techniques by engaging industry and governments in testing and promoting circle hooks and other improvements, turning a lose-lose situation into a win-win. WWF is also exploring ways in which gill net fishing might be improved. The SWBGCF grant helps support this industry and government outreach campaign.

- d. Project: "Movements and Habitat Preference of the Kemp's Ridley Sea Turtle"

Partner: Texas A&M University of Galveston

Location: Northwestern Gulf of Mexico

The critically endangered Kemp's ridley sea turtle is experiencing a modest recovery from less than 300 nesting females in 1985. Continued species recovery and eventual downlisting to threatened status require researchers to update the Kemp's Ridley Recovery Plan, currently lacking information about the ocean life of this species. This project helps rescue, rehabilitate and track Kemp's ridley sea turtles accidentally caught by recreational fishermen. The satellite-tagged animals are tracked to monitor post-release behavior and survival rates. Data collected from this study helps researchers understand the turtle's use of near shore Gulf waters, habitat preferences, short-term movements, long-term migratory behavior and potential for exposure to fisheries interactions. The SWBGCF grant helps ensure a continuance of the western Gulfs only in-water monitoring program for Kemp's ridley sea turtles.

- e. Project: "Abatement of egg poaching in a Pacific leatherback nesting site"

Partner: World Wildlife Fund

Location: Costa Rica

This project aims to increase the percentage of hatchlings from

leatherback and black sea turtle nests occurring on an unprotected Costa Rica beach. Pacific leatherbacks are at risk of extinction unless drastic measures are taken. Every egg counts. Poaching currently impacts two-thirds of leatherback nests and all black turtle nests at Playa Junquillal, a recently discovered beach with a high number of nests. Increasing awareness of the benefits of marine turtle conservation among nest poachers and egg consumers, this project promotes alternative income sources dependent on live marine turtles. The *SWBGCF* grant helps fund a comprehensive community education program encouraging poachers to generate income by participating in research and conservation programs.