Chapter 3 Natural and Human Impacts on Turtles

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Key Points

- Sea turtles worldwide are threatened by a variety of natural and human (anthropogenic) forces. Because they use of a variety of habitats (beaches to open oceans to nearshore environments), sea turtles are vulnerable to human impacts at all life stages, although natural mortality is believed to decline with age (increasing size).
- Natural mortality factors include the destruction of eggs on the beach by inundation or erosion, predation at all life stages, extreme temperatures, and disease.
- The primary cause of mortality among juvenile and adult sea turtles is drowning after becoming entangled in fishing gear, primarily shrimp trawls. Mortality has decreased in U.S. waters with the use of turtle excluder devices (TEDs).
- Other significant sources of mortality include direct take (poaching) of eggs and turtles and the destruction or degradation of their habitat.

TED - turtle excluder device, an adaptation to commercial shrimp nets to permit sea turtles to escape.

Natural Mortality Factors

Egg Loss

Turtle eggs are subject to a variety of both natural and anthropogenic impacts. High tides or storms can drown the eggs, cause beach erosion, and wash away nests, and beach accretion can prevent access between nesting areas and the water. Predation on eggs by raccoons, feral hogs, ants, coyotes, and other animals can be quite high. In the 1970s, before protective efforts began at Canaveral National Seashore, Florida, raccoons destroyed 75 to 100 percent of loggerhead nests, although the numbers destroyed on most beaches were considerably lower.

Predation

By emerging from the nest at night, turtle hatchlings reduce their risk of predation, but they still must run a gauntlet of predators between the nest and sea—from raccoons, birds, and ghost crabs on shore to tarpon, jacks, sharks, and other fish in the waters near shore. Although use of turtle hatcheries has fallen out of favor in the United States, past hatchery management problems exacerbated predation by fish. When hatchlings were regularly released into the water at the same location and same time, predatory fish would gather in high numbers for their scheduled meal.

Larger juveniles and adults may be eaten by sharks and other large predatory fish, though predation decreases as turtles' size increases. One study indicated that 7 to 75 percent of tiger sharks sampled in Hawaiian waters inhabited by sea turtles had preyed on green turtles.

Hypothermia

Another natural source of mortality in sea turtles is hypothermia. Water temperatures that dip below 8° to 10°C affect primarily juvenile and subadult turtles residing in nearshore waters, causing them to become lethargic and buoyant until they float at the surface in a condition known as cold-stunning. At temperatures below 5° to 6°C, death rates can be significant. The animals can no longer swim or dive, they become vulnerable to predators, and they may wash up on shore, where they are exposed to even colder temperatures. Large cold-stun events have occurred frequently in recent years off the coasts of Long Island, New York; Cape Cod, Massachusetts; and even in Florida. Intervention and treatment, such as holding the turtle in warm water and administering fluids and antibiotics, greatly reduces mortality.

Disease

Sea turtles are affected by a number of health problems and diseases. Bacterial infections are rare in free-roaming sea turtle populations but higher under captive conditions. Parasitic infections are common, however. Up to 30 percent of the Atlantic loggerhead population, for example, may be impacted by trematodes that infect the cardiovascular system. These heart flukes are associated with severe debilitation, muscle wasting, and thickening and hardening of major blood vessels. This parasite damage may then permit a variety of bacterial infections, including such species as *Salmonella* and *E. coli*.

Brevetoxicosis - **a deadly condition caused by ingestion of dinoflagellate organisms often responsible for red tides; recently linked to deaths of manatees in Florida and common murres in California.**

Another risk comes from dinoflagellate blooms (red tides), which are occurring in increasing numbers around the world as excess nutrient loads pollute coastal waters, conditions that can lead to health problems and mortality in many marine species. Because immediate effects result from aerosol transport, the sea turtles' mode of respiration—inhaling rapidly to fill the lungs before a dive—puts them at particular risk. Chronic brevetoxicosis, a deadly lung condition caused by red tide dinoflagellates, has been suggested as another recent cause of sea turtle mortalities. In Florida, sea turtles had neurological symptoms, and the ones that died had measurable brevetoxin levels in their tissues. More subtle, long-term effects such as impaired feeding, reduced growth, and immune suppression may occur from consuming prey in which the toxin has bioaccumulated.

By far the most prevalent health problem, however, is a sea turtle disease called fibropapilloma (FP), which has been linked to a herpes virus. FP is typified by large fibrous (noncancerous) tumors (Figure 3.1). If external, these tumors can interfere with vision, swimming, and diving, and thus hinder the turtle's ability to feed and escape from predators. Internal tumors can affect organ function, digestion, buoyancy, cardiac function, and respiration. Turtles with advanced FP tend to be anemic and have salt imbalances. FP has reached epidemic proportions among green turtles worldwide and has been documented in the six other species. Some green turtle populations have infection rates of 65 to 75 percent. The disease rate tends to be higher in environmentally degraded areas.

Fibropapilloma - a tumor-forming, debilitating, and often fatal, disease of sea turtles, manifested by formation of multiple fibrous masses of tissue 1 mm to 30 cm in diameter growing from the eyes, flippers, neck, tail, and scutes and in the mouth.

Figure 3.1 A green turtle with fibropapilloma tumors at the base of its flippers. Photo courtesy of Patricia Sposato, Florida Atlantic University.

Anthropogenic Impacts

Fisheries By-catch

In a comprehensive review of sources of sea turtle mortality conducted by the National Research Council (1990), incidental capture of turtles in shrimp trawls was determined to account for more deaths than all other human activities combined (Figure 3.2). Because of sea turtles' exceptional breath-holding capabilities, the large numbers of deaths blamed on incidental catch (i.e., drowning) was at first greeted with skepticism. However, a variety of field and laboratory studies on the effects of forced (versus voluntary) submergence soon demonstrated the vulnerability of sea turtles to trawl nets. One study, for example, showed that mortality was strongly dependent on trawl times: mortality increased from 0 percent with trawl times less than 50 minutes to 70 percent after 90 minutes. Since the enactment of turtle excluder device (TED) regulations, mortalities due to shrimp trawling have decreased significantly in U.S. coastal waters—in South Carolina alone, mortalities decreased 44 percent. Regrettably, regulation, compliance, and enforcement are lower in other nations.

In addition to trawl entanglement, sea turtles have been killed after becoming entangled in other types of fishing gear, such as purse seines, gill nets, longlines (hook and line), and lobster or crab pot lines. The longline fisheries of the Pacific are currently a significant source of sea turtle mortality, especially among leatherbacks. In other waters of the world, such as the Mediterranean, such fisheries impact other turtle species as well. Vessels themselves are another threat. Between 1986 and 1988, 7.3 percent of all sea turtle strandings documented in U.S. Atlantic and Gulf of Mexico waters sustained some type of propeller or collision injuries, though how much damage was post-mortem

Figure 3.2 Trawl-caught sea turtles off Cape Canaveral, Florida. Photo courtesy of Dr. Peter Lutz, Florida Atlantic University.

versus cause of death could not be determined. The highest numbers of deaths occur where boat traffic is highest, the Florida Keys and the U.S. Virgin Islands.

Poaching

While the taking of adult sea turtles is rare in the continental United States and Hawaii, egg poaching may be significant on some beaches, and in many other parts of the world the harvest of both eggs and turtles is high. In some developing countries, the need for protein and income generated by the sale of turtle products—even where sea turtles are protected—undermines conservation efforts. Breeding aggregations, nesting females, and eggs provide ready access to large numbers of turtles.

Calipee - cartilage

Egg collection and hunting are primary causes of green and hawksbill turtle mortality worldwide (though all species are affected to some extent). Green turtles are exploited primarily for their meat and cartilage (called calipee), while hawksbills are taken mainly for their beautiful shells, which are used to create a variety of tortoiseshell objects such as jewelry and combs. During the twentieth century, the major importers of sea turtle shell and other products were Japan, Hong Kong, Taiwan, and some European nations. Thirty years ago, more than 45 nations exported turtle products: the primary exporter was Indonesia, with Panama, Cuba, Mexico, Thailand, the Philippines, Kenya, Tanzania, and other countries contributing significantly. Today, the market in turtle products continues, especially in Southeast Asia.

Figure 3.3 On a nesting beach in North Carolina, homeowners placed sandbags to halt erosion, rendering previous turtle nesting sites inaccessible to sea turtles. Photo courtesy of Matthew Godfrey, North Carolina Wildlife Resources Commission.

Besides direct take, poaching activities have many indirect impacts on sea turtles that affect every life stage, primarily habitat degradation or destruction.

Alteration of Nesting Beaches

Anthropogenic impacts on nesting beaches may affect nesting females, eggs, and hatchlings. Beach armoring, such as seawalls, rock revetments, and sandbagging installed to protect oceanfront property, may prevent females from accessing nesting beaches. In some areas, sand may erode completely on the ocean side of structures, leaving no nesting beach at all (Figure 3.3). Where erosion is extensive, property owners or government agencies may try to restore the beach by replenishing the sand supply from offshore or inland sources. While preferable to beach armoring, such beach renourishment projects may cause sea turtle mortality as the result of offshore dredging, and nests already on the beach can be buried by the new sand. Mortalities can be reduced by monitoring dredge operations and relocating nests to other beach areas.

beach renourishment - replenishment of beach sand by mechanically dumping or pumping sand onto an eroded beach; also referred to as beach nourishment.

Other effects of beach nourishment are that renourished beaches may become too compacted for nesting and steep, impassable escarpments may form. In addition, the replacement sand can have different physical properties than the original, altering critical aspects such gas diffusion, moisture content, and temperature, which can affect hatchling sex ratios. In sea turtles, like many reptiles, the sex of the hatchling is determined by incubation temperature; cooler nest temperatures produce mostly males and warmer temperatures produce mostly females.

Near beaches, light from condominiums, streetlights, and swimming pools also affects sea turtles (Witherington and Martin, 2000). Excess lighting deters females from nesting, while hatchlings emerging from the nest tend to move toward the bright artificial lights rather than toward the surf. Disoriented, the hatchlings can succumb to exhaustion, dehydration, and predation; become entrapped in swimming pools; or be crushed by cars or beach vehicles.

High levels of egg poaching, predation, erosion, artificial lighting, and heavy beach usage have been used to justify relocating nests to other beach sites, or in rare cases to hatcheries. While the practice may save threatened nests, it is important to note that, compared to nests left in place, relocation decreases nest success due to changes in incubation conditions, mortality during the move, and problems such as increased predation at release sites.

Pollution and Garbage

While direct effects on sea turtles of pollutants such as fertilizers and pesticides are almost completely unknown, some indirect effects are more obvious, such as habitat degradation. Excess nutrients in coastal waters increase the outbreaks of harmful algal blooms (HABs), which may affect sea turtle health directly, such as during red tide events, or indirectly. Indirect effects include a general degradation of turtle habitat, such as the loss of seagrass beds due to decreased light penetration, and the (mostly unknown) potential for long-term effects on sea turtle health and physiology. The toxic dinoflagellate *Prorocentrum*, for example, lives on on seagrasses so it is consumed by foraging green turtles. This dinoflagellate is of particular interest because it produces a tumor-promoting toxin (okadaic acid) that has been found in the tissues of Hawaiian green turtles with fibropapilloma disease.

Figure 3.4 A hawksbill turtle entangled in plastic line and fishing net. Photo courtesy of Chris Johnson, Marinelife Center of Juno Beach, Florida.

The effects of garbage in the water and on beaches are more direct. Turtles ingest plastics and other debris and become entangled in debris such as discarded fishing line (Figure 3.4). Ingesting plastic can cause gut strangulation, reduce nutrient uptake and increase the absorbance of various chemicals in plastics and other debris. The range of trash found in sea turtle digestive tracts is impressive: plastic bags, sheeting, beads, and pellets; rope; latex balloons; aluminum; paper and cardboard; styrofoam; fish hooks (Figure 3.5); charcoal; and glass. Leatherback turtles are particularly attracted to plastic bags, which they may mistake for their usual prey, jellyfish. Loggerheads—indeed, any hungry turtle—will eat nearly anything that appears to be the right size.

Figure 3.5 This X-ray image of a juvenile green turtle shows fishing hooks and other tackle in throat. The turtle underwent surgery and was released after recovering. Photo courtesy of Chris Johnson, Marinelife Center of Juno Beach, Florida.

Table 3.1 A summary of natural and anthropogenic impacts on sea turtles.

Source of Mortality	Primarily Anthropogenic	Main Life Stage Affected	Impact
Shrimp trawling	Yes	Juveniles/adults	High
Predation (natural)	No	Eggs, hatchlings	High
Artificial lighting	Yes	Nesting females, hatchlings	High
Disease	No	Subadults	High for greens
Beach use	Yes	Nesting females, eggs	High on some beaches
Other fisheries	Yes	Juveniles/adults	Medium
Vessel-related injuries, including propellers	Yes	Juveniles/adults	Medium
Poaching	Yes	Eggs, juveniles, adults	Low to medium
Beach development	Yes	Nesting females, eggs	Low to medium
Cold-stunning	No	Juveniles, subadults	Low
Entanglement	Yes	Juveniles/adults	Low
Power plant entrainment	Yes	Juveniles/adults	Low
Oil platform removal	Yes	Adults	Low
Beach renourishment	Yes	Eggs	Low with monitoring
Debris ingestion	Yes	Juveniles/adults	Unknown
Toxins	Yes	Unknown	Unknown
Habitat degradation	Yes	Hatchlings through adults	Unknown

Source: Adapted from National Research Council 1990.

For Further Reading

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