

Boiling Point

THE IMPACT OF CLIMATE CHANGE ON SEA TURTLES
AND THE URGENT NEED TO TAKE ACTION



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Climate change has become a reality that we can no longer ignore. Rising levels of greenhouse gases as a result of human activities, such as the burning of fossil fuels, are already changing the climate. Observed changes we are seeing include a retreat of 70% of sandy shorelines, a global mean sea level rise, and the melting of glaciers.¹

Even now, we are beginning to see the signs that increased climate will have a devastating impact on these gentle creatures that have swum the world's oceans since the time of dinosaurs.

Biodiversity is particularly vulnerable to climate change. While life on Earth has always needed to adapt to changes in temperature and rainfall patterns, the pace of the current climate change will be faster than anything experienced in the last 10,000 years.² Additionally, the decline of species due to other human caused factors, especially habitat loss and the impacts

of pollution, suggest that adaptation will be incredibly difficult.

Sea turtles, because of the uniqueness of their life histories, are likely to be especially hard hit by a changing climate. All seven species has been listed as endangered, threatened or vulnerable under US law or international treaties. Even now, we are beginning to see the signs that increased climate will have a devastating impact

on these gentle creatures that have swum the world's oceans since the time of dinosaurs.

Rises in ocean levels mean that the sandy beaches on which sea turtles nest are disappearing. Increased temperatures threaten to play havoc with the gender determination of sea turtles, since sand temperature indicates whether embryos develop as male

or female. Additionally, changes in ocean temperatures, modified currents and increased rainfall events may also negatively affect these slow adapting creatures.

While climate change has not been the primary factor in the decline of the sea turtles, it is a serious impact that still must be addressed to help protect these creatures that are already teetering on the brink of

extinction. With populations of turtles decimated by industrial fishing practices, development on nesting beaches, egg harvesting, their continued direct take, and pollution, the impacts of climate change, especially on nesting beaches, could be the last straw that pushes populations of sea turtles to the point of no recovery.

The time for action is now – to protect the sea turtles and ourselves.

Sea Turtles: Vanishing Species

Sea turtles have swum the world's oceans for over 150 million years, since before the time of dinosaurs. Sea turtles play an important role in a variety of ecosystems. For example, these giant reptiles occupy a novel position in the ocean's food web, feeding on an unusual range of prey including jellyfish, sponges, tunicates, algae, sea grasses, and crustaceans. The nesting phase of their life cycle makes them an important component of beach and coastal ecology, and reverses the usual flow of energy from land to sea. The nesting females and the massive quantity of eggs laid are eaten by a myriad of predators ranging from small crabs to jaguars. Even the bacteria and micro-fauna of beaches are strongly influenced by the nesting turtles.

Most populations of sea turtles are highly migratory, traveling thousands of miles

between nesting and feeding habitats. About two months after sea turtle eggs are laid on beaches, hatchlings break free of their shells to crawl to the ocean where they begin a deep sea pelagic existence, floating with the currents for several years. Eventually, most species will then spend their sub-adult years feeding and growing in coastal zones or bays, river mouths, and estuaries. For a number of sea turtles very little is yet known about their lives during these portions of their lives on the high seas and away from land. This is one of the great mysteries of the sea turtles. At an age of 10 to 50 years, depending on the species, adult sea turtles will begin an annual migration back to their natal beaches to lay their eggs in order to continue this fascinating and successful life history.

There are seven species of sea turtles. Because of the highly migratory nature of sea turtles and the large amount of hatchlings coupled with low survival rates, it is difficult to estimate overall populations. Sea turtles are found in all of the world's warm water



Photo: Thomas Litteral

oceans from the Gulf of Mexico to the Mediterranean to the South China Sea. The leatherback species spends part of its adult life in colder waters as well, with individuals migrating as far north as Alaska in search of jellyfish, its primary food, before returning to the tropics to reproduce.

Current Endangered Status and Threats

Unfortunately, sea turtles are severely endangered, with some species teetering on the brink of extinction. All seven species of sea turtles have been declared endangered, threatened or vulnerable. For example, the nesting population of Pacific leatherback sea turtles has declined by 95% in the last

The development of nesting beaches for housing, tourism, and other human activities interferes with the nesting activities by loss of available habitat.

two decades.³ In 1947, 40,000 Kemp's ridley sea turtles nested at a single beach in Mexico on a single day. Today, the nesting females for this species number only a few thousand.⁴

When species, such as sea turtles, are endangered, it is crucial that the cause of the problem and the solutions be identified through the use of scientific methods. The threats to sea turtles are numerous including:

- **Death by fishing gear** - Sea turtles breathe air and must surface regularly to survive. When they get accidentally caught in fishing gear, they often drown or are injured. The growth, industrialization and commercialization of fishing have resulted in higher numbers of sea turtles dying in shrimp trawl nets, longlines, and gillnets. This indiscriminate gear is also responsible for the incidental capture of numerous non-targeted species, therefore threatening overall marine biodiversity.



Photo: ©Erin Seaney, Texas A&M U at Galveston

Gulf Office Program Director Carole Allen

- **Commercial development on once-isolated nesting beaches** - Sea turtles must return to land to nest. The development of nesting beaches for housing, tourism, and other human activities interferes

with the nesting activities by loss of available habitat. Certain activities also reduce nesting ability and hatching success. For instance, lighting of beaches disorients the hatchlings' ability to locate the water when they emerge from their nests. Noise can also reduce turtles abilities to nest successfully. Commercial development also contributes to the decimation of coastal ecosystems, such as mangroves, and impacts a wide range of species and habitat.



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Photo: Jane Stones

- **Pollution** - Sea turtles have been found dead after having choked on plastic bags that are mistaken for jellyfish, a common food. Additionally, a disease known as fibropapilloma, a tumorous growth that kills sea turtles, is now affecting large numbers of sea turtles around the world. It has been hypothesized that this epidemic, which is believed to be linked to toxic ocean pollution, is affecting sea turtles' immune systems.



- **Commercial exploitation of adult turtles for their shells, skin, and meat -**
In Mexico, until 1990, up to 50,000 sea turtles a year were slaughtered for their skins and shells. These animal parts were made into luxury items such as boots and eye glass frames in markets such as Japan. Consumer demand for luxury items continues to threaten species worldwide. Turtles continue to be harvested for local and international market



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- **Uncontrolled harvesting of eggs -**
Increasing population pressure and disparate economic conditions have contributed to a growth in the uncontrolled harvesting of sea turtle eggs. This harvesting is often done illegally

and unsustainably. For example, at one beach in Costa Rica, poaching was estimated to have been responsible for the loss of 95% of the eggs that were laid.⁵ Fortunately, a few communities where large numbers still nest are beginning to develop and implement sustainable egg harvesting programs, which allow for healthy sea turtle populations and additional income and protein for the local community members. Even more communities are now developing egg protection programs, noting that the vanishing sea turtles are an integral part of their culture and history.

Climate Change and Sea Turtles

According to the Intergovernmental Panel on Climate Change, 20-30% of animal and plants species that have been assessed are likely to be at increased risk of extinction if global temperatures rise by more than 1.5 – 2.5°C.⁶ We are beginning to see the impacts of climate change on endangered sea turtles.

Increased Temperatures will Impact Sea Turtles

Sea turtles are temperature sensitive species. Specifically, the gender of developing embryos is determined by sand and air temperatures, hatchling success depends on temperature, and temperature plays a role in the migratory range of these species.

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Photo: ©Doug Perrine/Seapics



Female leatherback nesting in Las Baulas, Costa Rica

Increased Temperatures will Skew Gender Ratios

Sea turtle gender ratios are determined by the temperatures experienced by the eggs. Higher temperatures result in more females and lower temperatures in more males. The critical period for the determination of gender occurs during the middle third of the incubation.⁷

Increased sand and air temperatures due to climate change will result in gender ratios that are skewed towards females. A recent study⁸ conducted on loggerhead sea turtles at Bald Head Island, North Carolina reviewed 26 years of data to examine past gender ratios and to predict future scenarios. The study showed the estimated mean annual gender ratio over the 26 year period was 58% female, 42% male. Through the use of modeling, the researchers determined that increases in air temperature up to 7.5°C would lead to 100% female hatchlings. If there were no more male sea turtles in this population, breeding from within this

population would eventually stop. Males from neighboring populations would be needed for breeding to continue or the population would vanish. As a result, every male from neighboring populations would become that much more important and need to be better protected from other sources of mortality, such as bycatch in fishing gear.

Further, the study noted that certain populations in southern US, such as Florida, are already female biased.⁹ The researchers found with warming as little as 1°C, these populations would be ultra-biased to females.

Increased Temperatures will Reduce Hatchling Success

There are certain optimal temperatures that promote hatchling success for sea turtles, which explains why they only nest in regions that maintain a certain range of temperatures. If it is either too high or too low, hatching success rates will drop. With increased temperatures, the difference could be lethal.

Photo: David Wimpfheimer



Critically endangered leatherback with jellyfish



The researchers in the study above noted that for the southern US, extreme levels of nesting mortality would occur if warming exceeds 3°C.¹⁰

Additional anecdotal information from the largest remaining leatherback nesting site in the Pacific suggests that increased temperatures are already reducing hatchling success.

At Jamursba Medi in the Papua Province of Indonesia, reduced hatching success is being noted by those involved with protecting this nesting population¹¹, and a key factor in this reduced hatching rate has been the increased temperature (compounded by poaching).

Up to 2003, the hatch out range was 50-85%. However, from 2004 to 2006, it was a mere 10-15%. For example, in one nest of 101 eggs, only seven hatched.¹²

Increased Temperatures may Reduce Food Supply

Coral reefs are an important habitat for certain species of sea turtles. For example, coral reefs are an important habitat for hawksbill sea turtles in the Caribbean¹³ and in the waters of Papua New Guinea¹⁴. Loss of this habitat will impact this species.

One of the major studied impacts of climate change is on corals. Rising sea temperatures increase the frequency of major coral bleaching events. If stressful conditions continue, these corals then die. Further research suggests an increase in coral disease can be attributed to rising sea temperatures.¹⁵

Rising sea temperatures increase the frequency of major coral bleaching events. If stressful conditions continue, these corals then die.



Photo: James Watt

Additionally, changes in water temperatures can force changes to feeding habits and availability of food supply for sea turtles. Recent information has begun to demonstrate that the ranges of jellyfish, a prime food source for the giant leatherback sea turtle, are changing.¹⁶

For example, the Southwest Fisheries Science Center of NOAA has discussed the changes in the presence of jellyfish and leatherback sea turtles in Monterey Bay.¹⁷ In 2005, as many as 15-18 turtles were seen in a single day, which corresponded to increased numbers of jellyfish. In 2006, there were significantly less jellyfish and, as a result, no leatherback sea turtles sighted in the month of September. These changes were a result in differences in the atmospheric condition. This change in the location of prey can either force leatherbacks to shift feeding grounds, force delays in reproduction, and reduce available food supply to these creatures that have migrated across the entire Pacific. Thus in the pursuit of jellyfish, the migratory behavior of leatherbacks may shift, further complicating management measures in place to protect sea turtles from the impacts of fishing gear.

Rising Sea Levels will Impact Sea Turtles

There is strong evidence that global sea level gradually rose in the 20th century and is rising at an increased rate. Projections for sea level rise by 2100 range up to almost 3 feet. During the 20th century, sea level rose about 6 inches.¹⁸ The two major causes are the expansion of water as it warms and the melting of land-based ice. Small Pacific islands have been identified as areas to be most severely impacted by climate change since they will go underwater or decrease in size.

Some of these same islands provide critical nesting habitat to sea turtles which will then be lost

According to a recent scientific report¹⁹, a rising sea level could put up to 75 percent of some low-lying Northwestern Hawaiian Islands underwater 2100. These islands provide nesting grounds for threatened green sea turtles.²⁰ This loss of land will also mean crowding and competition from monk seals and birds that also use these islands.

Photo: ©Doug Perrine/Seapics



Another key nesting area for loggerhead and green sea turtles in the United States is Florida. It has been predicted that in Florida, seawater will advance inland as much as 400 feet in low-lying areas, which will flood and erode beaches.²¹

Extreme Rainfall Events could Impact Sea Turtles

Increased rainfall events could impact sea turtles in several ways. Storms during nesting season could reduce nesting success through increased salinity from storm surges and increased moisture. Additionally, storm surges can simply wipe out nests as well as transfer greater sediment and raise water tables which would also flood nests.

A recent team of scientists compared the reproductive seasonality of three sea turtle species along the Atlantic coast of Florida in the United States from 1995 to 2005²². The study found that frequent or intense storms reduced the numbers of nests hatching and the number of hatchlings emerging from each nest. Storm surges affected 95% of the green turtle nests since these turtles' nesting season occurs during the tropical cyclone season.

In 2004 and 2005 tropical cyclones occurred in this area during the entire green turtle nesting season. As a result, a mere 2% of all green turtle nests hatched²³

In 2007, villagers from the Tokain in Madang Province gave up their traditional harvest of adult female leatherback sea turtles and the harvesting of eggs from nests. They even began to protect the nesting sites. However, storm surges inundated several nests, undermining the transformative work of this community.²⁴

Photo: ©Doug Perrine/Seapics



Photo: ©Doug Perrine/Seapics



Conclusions and Recommendations

Climate change will have an impact on sea turtle populations. This impact is magnified by the continued threats that these ancient creatures face from industrial fishing, coastal development, and their direct harvest. Protecting sea turtles adds to the call for action on climate change.

There are two main ways to reduce the impacts of climate change: to reduce climate change emissions and to strengthen the ability of endangered sea turtles and their ecosystems to survive climate change.

To reduce climate emissions, all nations should:

- cut greenhouse gas emissions
- engage in international deliberations to facilitate emissions cuts globally
- promote increased energy efficiency
- develop and fund sources of clean energy like wind and solar.

To strengthen the ability of endangered sea turtles to survive climate change, nations should:

- increase protections for all critical sea turtle nesting, foraging and migratory habitat, including the implementation of marine protected areas
- reduce impacts of non-climate related threats, such as bycatch in industrial fishing gear, plastic bag pollution, and development on critical nesting beaches
- implement adaptive management strategies to shift marine protected areas based on changes in climate.



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End Notes

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