

# **CLIMATE CHANGE & COMMERCIAL FISHING:** **A ONE-TWO PUNCH FOR SEA TURTLES**



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An underwater photograph of a sea turtle swimming in clear blue water. The turtle is seen from below, with its head and front flippers visible as it moves towards the surface. The water has a deep blue hue, and the lighting creates a sense of depth and tranquility.

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# THE ONE-TWO PUNCH FOR SEA TURTLES

Sea turtles are in trouble around the world. Given the severely diminished populations, threats from global warming may be too much for sea turtle populations to withstand. But if we act now to protect sea turtles, they may be able to adapt and survive.



Sea turtles have been swimming the world's oceans since before the dinosaurs roamed the Earth. Just decades ago, sea turtles were abundant but now populations are dwindling. Sea turtles live for a long time, but only reach reproductive maturity late in life. Natural threats, such as predators, take a heavy toll on sea turtles, meaning that relatively few survive to maturity and even fewer live to reproduce. On top of these natural threats, humans have piled on a myriad of other threats: commercial fishing catches and kills thousands upon thousands of sea turtles every year, development destroys nesting beaches, people still collect and sell turtle eggs at nesting beaches, and pollution kills sea turtles that ingest plastic waste. As a result of

these needless abuses, every species of sea turtle that swims in United States water or nests on United States beaches is listed as endangered or threatened under the Endangered Species Act.

Adding to these other severe threats, humans are now threatening the ecosystems that sea turtles depend on by altering the Earth's climate. By burning fossil fuels and polluting the atmosphere with carbon dioxide, methane, nitrous oxide, and other greenhouse gases, our actions are shifting Earth's climate, disrupting land use and agriculture, degrading water and air quality, flooding coastal lands, and destroying marine habitat.<sup>1</sup>



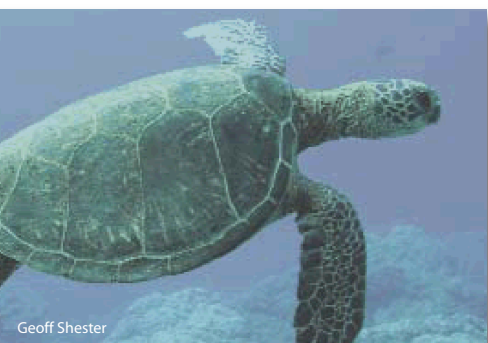
# SEA TURTLES OF THE UNITED STATES



## Olive Ridley Sea Turtle, *Lepidochelys olivacea*

Status: Endangered (Mexico's Pacific coast breeding colonies)  
Threatened (all other areas)

Olive ridley sea turtles do not nest in the United States, although individuals migrate to feed in the waters off of the southwestern coast. They are regarded as the world's most abundant sea turtle, though they have declined significantly from their former population levels. They are named for their olive-colored shell.



## Green Sea Turtle, *Chelonia mydas*

Status: Endangered (Florida & Mexico's Pacific coast breeding colonies)  
Threatened (all other areas)

Green sea turtles are found in the Atlantic Ocean from Florida to Massachusetts, as well as in the Gulf of Mexico and the Caribbean. Primary nesting sites for the Atlantic populations in U.S. waters are the eastern coast of Florida, the U.S. Virgin Islands and Puerto Rico. Additionally, they inhabit the central Pacific, including the Hawaiian Islands. When green sea turtles are not nesting or foraging in coastal waters, they can be found in the open ocean. They are named for their green-colored body fat.



## Kemp's Ridley Sea Turtle, *Lepidochelys kempii*

Status: Endangered

The smallest of all the sea turtles, Kemp's ridley sea turtles are about two feet long and weigh up to 100 pounds. Their primary habitat is the nearshore and inshore waters of the northern Gulf of Mexico and nesting populations are found along the southeastern coast of Texas and northern Mexico.

## Leatherback Sea Turtle, *Dermochelys coriacea*

Status: Endangered

The largest sea turtles in the world, leatherbacks spend most of their time out in the open ocean, though the females from the Atlantic population come to nest in Florida, the U.S. Virgin Islands and Puerto Rico. In the past 25 years, the Pacific population has declined by 95 percent mainly because of being caught by fishing gear, human consumption of eggs, and ingesting plastic waste.



## Loggerhead Sea Turtle, *Caretta caretta*

Status: Threatened

Loggerhead sea turtles are found in the Atlantic, Pacific, and Indian Oceans. They nest on beaches from Texas to Virginia. Florida hosts one of the two most important nesting beaches for the species in the world. Loggerheads are named so because of their large heads, which have a strong jaw for crushing shellfish.



## Hawksbill Sea Turtle, *Eretmochelys imbricata*

Status: Endangered

In the United States, hawksbill sea turtles nest on beaches in the U.S. Virgin Islands, Puerto Rico, Texas, and Hawaii. They are named for their beak-like mouth. Extensive poaching for the highly prized hawksbill shell has caused hawksbill populations to plummet worldwide.



## GLOBAL WARMING

Global warming refers to the increase in the Earth's temperature caused by the dramatic increase in the concentration of greenhouse gases and other warming pollutants in the atmosphere, primarily from burning of fossil fuels. These gases accumulate in the atmosphere like a blanket around the Earth allowing sunlight to pass through and warm the planet. Some of the heat from the sun is absorbed by the Earth and then radiated back to the atmosphere. In turn, some of this heat is captured by the greenhouse gases, warming the atmosphere. This process is known as the Greenhouse Effect. While natural levels of greenhouse gases are, in fact, vital to the maintenance of a habitable temperature on Earth, human produced greenhouse gases are magnifying this process, causing the planet to warm much more than our ecosystems can tolerate.

The 4th Intergovernmental Panel on Climate Change (IPCC) study released in February reports several global changes in the climate including those in amounts of precipitation, ocean salinity, wind patterns, Arctic temperatures, and Arctic ice. In addition to these changes, extreme weather such as droughts, heavy precipitation, heat waves, and intense tropical storms, also results from climate change. The IPCC is now reporting that the increase in global temperatures is "very likely due to the observed increase in anthropogenic greenhouse gas concentrations."<sup>2</sup>

### SOURCES OF GLOBAL WARMING POLLUTION



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## EXTREME WEATHER

The IPCC reports that it is very likely we will see an increase in heavy precipitation events over most areas, as well as an increase in intense tropical cyclone activity. This type of severe weather could increase erosion rates and greatly reduce the beach habitat of sea turtle species along the shores of the United States. An increase in hurricanes along southern U.S. shores could flood the nests of sea turtles found in the sands and decrease nesting success rates.<sup>24</sup> Increased rainfall causes high levels of mortality for sea turtle eggs and hatchlings, and affects the sex of the hatchlings, if they survive, through the cooling of the turtle nests.<sup>25</sup>

Scientists believe that the nesting areas of sea turtles naturally are located in areas where extreme weather events have occurred in the past, but that sea turtles succeed in these areas through maintaining a large population size and spreading nests over a wide geographic area. With sea turtle populations already diminished, nesting habitat shrinking and growing threats from climate change, including increasing threats from extreme weather, the strategy sea turtles have evolved for surviving extreme weather may no longer work.<sup>26</sup>

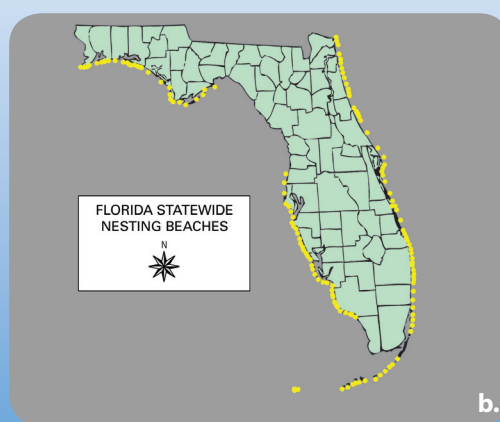
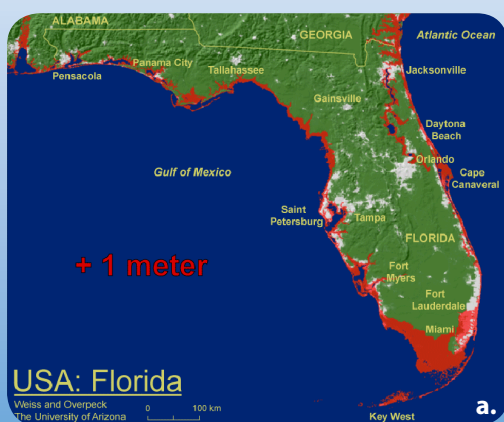


## SEA LEVEL RISE

As global warming continues to melt glaciers and ice sheets and heat the oceans, sea levels rise. In fact, sea level rise projections for the end of the 21st century range from 0.18 m to 0.59 m. Sea level rise is predicted to flood low coastal areas and accelerate erosion.<sup>3</sup> Even a small rise in sea level could result in a large loss of beach nesting habitat. A study conducted in Bonaire estimated that a 0.5 m rise in sea level could consume up to 32% of beach area on the island.<sup>4</sup> The three most vulnerable land areas in the United States to sea level rise are Louisiana, southern Florida and the Chesapeake Bay.<sup>5</sup> Sea level rise in Florida will be especially problematic as the beaches of Florida are some of the most important sea turtle nesting habitat in the world.

### The Florida Example

The peninsula of Florida has 825 miles of beaches, of which nearly 40% are in a critical state of erosion.<sup>6</sup> The peninsula is also home to some of the most important sea turtle nesting rookeries in the world. Ninety percent of all loggerhead nesting that occurs in the United States takes place on Florida beaches.<sup>7</sup> Sea level rise in Florida is predicted to be between 0.11 m and 0.36 m by 2080.<sup>8</sup> The entire Florida coastline is susceptible, especially the Florida Keys and Miami. Beaches that are narrow, at low elevations and are backed by hotel land use were identified as the most vulnerable in a recent study.<sup>9</sup> Florida, with heavy coastal development and artificially enhanced and armored beaches, may suffer accelerated beach loss, further jeopardizing already threatened and endangered sea turtle populations.



**a.** Map of projected sea level rise in Florida. Red area indicates places inundated by a 1-meter rise in sea level. Map courtesy of Jonathan Overpeck at the University of Arizona. **b.** Map of Florida nesting beaches. Map courtesy of Florida Fish and Wildlife Research Institute.



## ISING TEMPERATURES

In addition to rising sea levels, climate change is likely to result in further increases in the temperature of the sand, which could alter the sex ratio in sea turtle populations.<sup>10</sup> As with some other reptile species, the sex of sea turtle hatchlings is determined by temperature.<sup>11</sup> In the case of turtles, hatching when the sand is above the pivotal temperature produces a female; hatching below the temperature produces a male.<sup>12</sup> If rising temperatures cause mostly female turtles to be born, the population will rapidly decline. One recent study concludes that it is likely that southern populations of turtles in the United States will become “ultra-biased” towards female populations if temperatures increase by even 1°C.<sup>13</sup>

Similarly, if the air and water temperatures rise, the time of year when sea turtle nesting occurs could be drastically changed.<sup>14</sup> Evidence is growing that changes in temperature due to climate change shift critical life events in many species including their breeding, feeding and migration cycles.<sup>15,16</sup> For example, important springtime events, such as leaf-unfolding, migration, and the laying of eggs are starting earlier or moving towards higher latitudes and altitudes.<sup>17</sup>

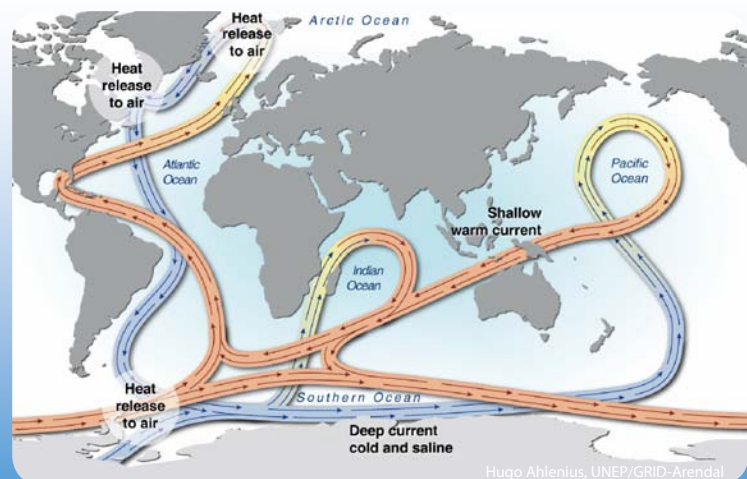


David Palange

## OCEAN CURRENTS

Increasing ocean temperatures, together with the addition of significant amounts of fresh water from melting ice caps and glaciers, may disrupt ocean current patterns and break down the marine food web. Sea turtles depend on ocean currents throughout their life. Juvenile sea turtles journey across ocean basins, sometimes swimming with currents, in search of productive feeding grounds. Young adults move through coastal areas, migrating thousands of miles to feed in open-ocean pelagic waters in search of oceanic fronts, upwelling zones, and eddies where their food is concentrated. Adult females often travel across ocean basins to return to their original nesting beaches to lay eggs and renew the cycle. They are excellent navigators, able to sense minute variations in the Earth’s magnetic field.<sup>18</sup> There is growing evidence that climate change will change ocean currents.<sup>19</sup> With any changes in ocean circulation, either through the oceans heat content or atmospheric cycles, sea turtles may have to alter their movements and possibly even shift their range, along with the timing of their nesting.

Climate change will likely affect seagrass beds by changing tidal circulation or water motion which would decrease the growth rates of the grass by limiting the amount of sunlight that reaches the beds.<sup>20</sup> Seagrass is a primary food source for green sea turtles, so degradation of seagrass beds could have a significant effect on these animals.



The great ocean conveyor belt.



## OCEAN ACIDIFICATION

Warming temperatures are not the only problem for the oceans resulting from the massive amounts of carbon dioxide and other pollutants we are releasing into the atmosphere. These excessive amounts of carbon dioxide are actually changing the chemistry of the oceans—making them more acidic. Acidifying oceans will have major adverse effects on corals and other marine life, especially those that produce shells. As the oceans become more acidic, corals and other organisms will be unable to build new skeletons and shells and those that already exist will begin to dissolve.<sup>21</sup> The oceans absorb carbon dioxide from the atmosphere, which reacts with sea water to produce carbonic acid and also reduces the amount of available carbonate. Corals and other organisms use carbonate to produce their calcium carbonate (limestone) skeletons and shells. As the pH in the oceans become more acidic, shells and skeletons of ocean organisms are dissolving. The lack of carbonate also means that corals and other organisms will find it increasingly difficult to produce new skeletons and shells.

Hawksbill sea turtles primarily eat soft sea sponges that are found on coral reefs. The degradation of coral reefs will likely hurt hawksbills and other sea turtle species that use coral reefs for food and protection. Crustaceans and mollusks, which play a large part in the loggerhead sea turtle diet, rely on what carbonate can be found in the ocean to produce and replenish their calcium carbonate shells. Ocean acidification could leave some vital animals in the sea turtle diet more vulnerable to other species preying on them, lower rates of population survival, and diminish the biodiversity of the ecosystem.<sup>22,23</sup>



### Role of Sea Turtles in the Ecosystem:

Sea turtles play several important roles in the ocean ecosystem. Diminishing sea turtle populations could have major ramifications on entire marine ecosystems. For example, sea turtles feed on jellyfish in the Chesapeake Bay; jellyfish in turn feed on fish larvae. Fewer sea turtles could result in an increase in the jellyfish population, causing "blooms" that would harm the fish populations of the bay.<sup>27</sup> Green sea turtles grazing on seagrass actually increase the productivity and nutrient content of the beds, thus benefiting other species.<sup>28</sup> By eating sponges, hawksbills keep the balance of sponges and corals on reefs and thus play an important role in coral reef ecosystems.<sup>29</sup> Sea turtles also play an important role in nutrient transport, bringing substantial quantities of nutrients from feeding areas to nutrient-poor coastal habitats near nesting beaches.<sup>30</sup> Sea turtles play important roles in the ecosystems they inhabit and reducing their population sizes can cause damaging rippling effects throughout the ocean.



## CONCLUSIONS

The effects of climate change are already being documented. The impacts on sea turtles will put these threatened and endangered species under ever increasing pressure. Though the full extent of the consequences will not be felt until many decades into the future, precautionary action must be taken now to minimize inevitable losses. We need to take action now to ensure that we have robust populations of sea turtles that will be better able to withstand the new and deadly challenges of climate change.

We must reduce global warming and recover sea turtle populations so they will be better able to adapt to the consequences of climate change and ocean acidification. Protecting sea turtle populations must be a multi-faceted effort on the part of us all. Reducing emissions of greenhouse gases into the atmosphere through acts such as buying energy efficient appliances and driving less can help to reduce the effects of climate change. The health of sea turtle populations can be improved by expanding protections for sea turtle habitats and reducing threats from commercial fishing.

### Recommendations:

- Expand the use of renewable energy sources and reduce greenhouse gas emissions from all sectors of the economy
- Protect key habitat areas for sea turtles
- Require techniques to reduce sea turtle interactions and mortality in fisheries
- Conduct research to determine how many turtles are in U.S. waters and what effect human induced mortality is having on their populations



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