

# How Will Sea Turtles Cope with Climate Change?

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It is now widely accepted that climate change is a significant threat to biodiversity, especially to species like sea turtles whose life histories are sensitive to fluctuating environmental conditions. A growing number of studies have begun to investigate and predict how different climatic processes will affect sea turtles. Most of the studies have focused on the possible effects on turtle nesting beaches, which reflects the general terrestrial bias present in sea turtle research. Nevertheless, climate change is expected to affect turtles in multiple ways and at all life stages, from the loss of nesting beaches resulting from sea level rise and increased erosion, to feminization of turtle populations because of elevated nest temperatures, changes in reproductive periodicity, shifts in latitudinal ranges, and decreased reproductive success. Although some of these factors have received a fair amount of attention from researchers, much still remains unanswered about how climate change will affect things like hatchling dispersal and migration, foraging ecology, and the ways in which turtles will find new beaches if current beaches become unsuitable for nesting.



THIS PAGE: Small, low-lying islands, such as the one pictured above in Belize, are often used by sea turtles for nesting. Unfortunately, sea-level rise caused by climate change is already causing some low-lying islands to become inundated and, thus, unreliable and unfit nesting habitats for sea turtles. This trend is likely to continue. © KJELL SANDVED AT LEFT: Climate change is expected to cause increased erosion and nesting beach loss in some areas, which can directly affect sea turtle nesting habitats, as shown by this washed-out nest in Florida, U.S.A. Although the exact effects of climate change on sea turtles are uncertain, precautionary human actions can give sea turtles a better chance of adapting to such changes. © CHRIS JOHNSON / WWW.TURTLEIMAGES.ORG

The risk to sea turtle populations from climate change will depend on the turtles' ability to adapt to changing conditions. Sea turtles have survived climate fluctuations during their evolutionary history, but their ability to do so again is uncertain because current rates of climate change are much faster than historic rates. Today, there are many additional anthropogenic pressures to cope with as well. Nevertheless, sea turtles have evolved flexible life history traits and may adapt to climate change through shifts in the distribution of their nesting areas or through changes in nest site selection, nesting season, and nest depths. Other possible adaptation responses include changes in their pivotal temperatures (that is, the temperature at which a nest produces a 50:50 hatchling sex ratio) and alteration of migration routes.

Because of uncertainty about whether sea turtles will adapt on their own, precautionary human actions may be necessary to increase the turtles' chances of adjusting. A mix of different short-term and long-term approaches has been suggested to enhance sea turtle nesting success and reproduction, including reduction of egg harvesting, nest shading, revegetation, and sand renourishing, as well as preemptive protection of areas that are predicted to be optimal nesting sites under future climate scenarios.

Uncertainties about the feasibility and effectiveness of adaptation strategies make the selection of preemptive interventions challenging, as do unanswered questions such as "How many males are necessary to maintain a fertile population of females?" and "What beach characteristics are favored by nesting females?" These factors, as well as how current nesting areas may respond to predicted climate changes, need to be better understood if one is to accurately identify and protect areas that will provide suitable nesting conditions for turtles in the future.

We must continue gathering crucial scientific information to guide our efforts to enhance sea turtles' adaptive capacity. Until such comprehensive data exist, the most appropriate actions might include lobbying for reduction in greenhouse gas emissions and addressing the acute threats to sea turtles. As the negative effects of climate change become more extreme and apparent in the years ahead, more directed interventions may become necessary; the best options will likely be site-specific and will depend on environmental, social, economic, and cultural conditions at a particular location, yet also will be integrated at the appropriate regional scale. Concerted efforts like these will be required across the globe to reduce the direct negative impacts and to increase the resilience of turtle populations to a rapidly changing climate. ■