# Understanding the impacts of Climate Change on sea turtles and their habitats

## Climate Change

Current warming trends in the earth's climate are very likely due to increased atmospheric concentrations of carbon dioxide and other greenhouse gases from human activities. Climate scientists project that the earth's average temperature will increase by between 1.8 and 4°C by the year 2100. Much of this heat will be absorbed by the oceans, resulting in thermal expansion and a concurrent rise in sea level. Other projected changes from increasing greenhouse gases include altered precipitation patterns, an increase in the frequency and intensity of extreme weather events, altered strength and location of oceanic currents and ocean acidification. Human-induced climatic changes will have impacts on both human and natural systems and changes in many systems, from the poles to the tropics, have already been observed.

## Marine turtles

The seven species of marine turtle are distributed around the globe and use a variety of habitats throughout their lives, including sandy beaches, oceanic frontal systems and gyres, coral reefs, seagrass beds and other shallow nearshore foraging areas. The dependence of marine turtles on multiple, interlinked habitats makes them ideal flagship species for examining the impacts of climate change on coastal ecosystems. Together coastal habitats form one of the most productive systems in the world, providing essential resources for human communities. Maintaining healthy habitats for marine turtles in a changing climate can therefore have additional ecological, social and economic benefits. Healthy ecosystems provide protection for additional species and continue to supply resources to coastal communities.

In many areas, populations of marine turtles face threats from fisheries bycatch, modification and loss of habitat due to coastal development and associated pollution, overexploitation for meat, eggs and shell and, now, climate change. Aspects of climate change could affect sea turtles in numerous ways (see reverse). Temperature profoundly influences many aspects of marine turtle life behaviour and distribution, from adult distribution to sex ratios of hatchlings. Extreme weather events, sea-level rise and ocean acidification all have the potential to change foraging and nesting grounds.

There is much we do not know about how sea turtle populations will be affected by climate change. In the past, abundant marine turtle populations probably adapted well to climatic change both behaviourally and genetically through natural selection. Today populations of these species are severely depleted, human pressures constrain their recovery and the pace of environmental change is unprecedented. Given the uncertainty about sea turtles capacity to respond in time, we need to commit to a precautionary approach and implement measures that increase the resilience of sea turtles and their habitats. At the same time, research should focus on answering key questions for a better understanding of the impacts of climate change on turtles, including:

(1) How will climate change affect key marine turtle habitats and how will these changes affect populations?

(2) What is the potential for marine turtles to mitigate the effects of increasing temperatures and loss of current nesting beaches by nesting at alternative sites? What other behaviours could be adapted?

(3) What is the current hatchling sex ratio, what are adult sex ratios and how many males are necessary to maintain a fertile and productive population?

(4) How will climate change affect marine turtles at sea in terms of their distribution, behaviour and dietary breadth? How will this differ between species and what levels of potential resilience might this confer?

If you are addressing any of these research questions, or carrying out related research, please consider joining the Adaptation to Climate change for marine Turtles (ACT) initiative, a global network of experts interested in marine turtles, climate change and adaptation.

### *For more information see:*

Hawkes, L. A., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2009. Climate change and marine turtles. Endangered Species Research 7:137-154

To learn more about the ACT initiative see:
**www.panda.org/lac/marineturtles/act**
or contact
**cctortugas@wwfca.org**

# Climate Change

## PROJECTED PHYSICAL CHANGES







## HABITAT CHANGES

Land

Higher beach temperatures

Ocean

Higher ocean temperatures

Coral bleaching

Increased precipitation

Decreased precipitation
-higher sand temperatures-

Increased precipitation
-cooler sand temperatures-

Storm surge

Altered strength and location of sea-surface currents

Beach erosion

Coastal squeeze

Reduced coral calcification

Higher seagrass productivity

## POTENTIAL IMPACTS ON SEA TURTLES

- Female-biased sex-ratios
- Egg mortality
- Shorter incubation time:
  - smaller hatchling size, increased locomotor performance
- Faster growth rates
- Changes in distribution due to increase in thermally suitable habitat
- Intra and inter-annual nesting periodicity reduced
- Earlier onset of nesting / extended nesting season
- Higher incidence of disease
- Changes in predator distribution / abundance
- Altered prey availability
- Altered prey availability for hawksbills
- Nest flooding from higher groundwater
- Smothering of reefs and seagrasses from sediment run-off:
  - loss of foraging areas
- (see above)
- Male-biased sex-ratios
- Longer incubation time:
  - reduced swimming ability, larger hatchling size
- Nest flooding
- Nest flooding
- Nests eroded / washed away
- Nests smothered by redistribution of sand
- Removal of beach vegetation
- Debris limiting access to beach
- Seagrass removal/reef damage: loss of foraging areas
- Shifts in migration patterns
- Altered distribution of juveniles
- Reduced nesting site options
  Density-dependent effects:
  - Intra / inter-specific nest destruction
  - Higher density of predators
  - Increased nest infection
- Decrease in foraging habitat (hawksbill)
- Increase in foraging habitat (green)