

# Temperature Monitoring Manual

## Sea turtles and temperature

Current estimates predict a 1.8 to 4°C increase in global temperatures within the next century. A temperature increase has the potential to affect sea turtles in numerous ways by altering conditions at nesting and foraging habitats. One of the main ways in which higher temperatures may affect sea turtles is during embryonic development. Successful incubation of turtle nests is possible within specific thermal limits and is inhibited below 25 °C and above 35 °C. Like many reptiles, and some invertebrates, sea turtles have temperature-dependent sex determination; the sex ratio of hatchlings from a nest is determined by the temperature at which the nest is incubated. Temperatures higher than the “pivotal temperature” produce females and lower temperatures produce males. At the pivotal temperature (around 28-31 °C), a 1:1 sex ratio is produced.

There is some concern that the projected increase in temperature could bias hatchling sex ratios significantly towards females. Low numbers of males is a concern as a shortage of males in the population could be a meaningful restriction for females, through reduced fertilization capacity and a loss of genetic variation which can lower a population’s capacity to adapt to deal with climate change. If temperatures are extremely high, the implications may be much more serious, leading to high nest mortality in some places. High egg loss could lead to a decrease in population size, increasing the vulnerability of these species to extinction.

## Temperature monitoring

There are many gaps in our knowledge of how temperature changes resulting from climate change will affect sea turtle populations. Nest temperatures are subject to several factors, including, but not limited

## Guidelines for Monitoring Sand and Incubation Temperatures on Sea Turtle Nesting Beaches

to, nest location within a beach, shading, vegetation and depth, and may vary not only among beaches but also within beaches. Implementation of temperature-monitoring projects region-wide is a necessary step to assess what the impact of climate change will be on beaches and sea turtles. By monitoring beach and nest temperatures over time and in different locations and relating these to nesting success and sex ratios, it should be possible to fill some of the gaps in our knowledge of current nesting conditions. An improved understanding of current conditions will also allow us to make better predictions about the possible impacts of climate change. Monitoring temperatures regionally over time will enable us to determine where and to

what extent beach temperatures are changing. Some of the key research questions that can be addressed through temperature monitoring projects include identifying locations where males are being produced, and what localities may be acting as temperature refugia for turtles. As nesting beach temperatures increase, turtle conservation projects may wish to take action to alter nest temperatures. Monitoring enables projects to identify the range of temperatures within a nesting beach and identify vulnerable areas. For projects using hatcheries, measurement of temperatures within the hatchery are useful for examining the sex ratio of hatchlings produced, for anticipating overheating risk and taking cooling measures as pertinent.



## Temperature monitoring manual

The Adaptation to Climate change for marine Turtles (ACT) project has produced a manual that provides guidelines for setting up a beach and nest temperature monitoring project at sea turtle nesting beaches. The manual is aimed at any sea turtle program interested in incorporating temperature monitoring into their research agendas and is one of an array of tools that will eventually contribute to a better understanding of the effects climate change may have on sea turtle populations and of ways to mitigate any negative impacts. This manual will evolve over time, as feed-back by users is incorporated into future versions. ACT invites users of the manual to participate in a collaborative, regional effort to try and fill some of the gaps in our knowledge of temperature effects on sea turtle populations.

### Main Objective:

To provide a standardized data collection method to the wider sea turtle community to facilitate data collection, local management design, data sharing and analysis.

### Specific Objectives:

- Provide guidelines on how to establish a temperature monitoring project on a nesting beach with the aim of describing the thermal conditions of the beach

- Standardize the methodology for the collection of temperature data
- Provide guidelines on how to establish a temperature monitoring project in hatcheries
- Help projects incorporate temperature data into adaptive management decisions
- Promote collaborative regional data collection efforts to fill crucial knowledge gaps
- Present a case study of implementation of a temperature monitoring project
- Provide supplemental sources of temperature data

### Contents

The monitoring manual includes the following sections:

- 1) Understanding the study area - a guide to measuring beach characteristics that could influence temperature measurements, including beach width and slope, shading, sand albedo, moisture and grain size
- 2) Setting up a temperature monitoring project - information on choosing locations, setting up the equipment, deploying the temperature monitoring equipment (data loggers) and monitoring the project over time

- 3) Creating a thermal profile for the beach - using data collected to create a thermal profile of the beach
- 4) Case study - this section describes work carried out at Junquillal Beach, Costa Rica, to establish a temperature-monitoring project. The results of two experiments to examine the impact of shading on beach temperature and the relationship between ambient temperature and sand temperature at nest depth are also described
- 5) Lessons learned - this section details the main points to take away from the case study
- 6) Sources of local and regional temperature

See the full  
*'Temperature Monitoring Manual:  
Guidelines for Monitoring Sand  
and Incubation Temperatures on  
Sea Turtle Nesting Beaches'*  
at

[www.panda.org/lac/marineturtles/act](http://www.panda.org/lac/marineturtles/act)

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or contact  
[cctortugas@wwfca.org](mailto:cctortugas@wwfca.org)

