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For Additional Information Contact:
Heather Crunchie
hcrunchie@splashcommunication.com
503.327.8620
or
Dr. Michael Coyne
mcoyne@seaturtle.org
301.221.9952

Scientists Debate Climate Change Impact on Sea Turtles

New research shows turtles have adapted in the past – can they do it again?

Myrtle Beach, S.C. — New research from Australia shows that flatback sea turtles have made radical changes in their behavior to adapt to changing climates over the last 10,000 years. This suggests they may be able to adapt to future climate changes, but possibly not quick enough to survive the dramatic changes predicted by some climatologists.

Marine turtle scientists and researchers from around the world met last month at the International Sea Turtle Symposium in Myrtle Beach, S.C., to share their latest data and discuss the implications for survival of the species. Not surprisingly, climate change and its impact on turtle populations was a primary topic of scientists' presentations. Australian research gave hope for future turtle populations, while studies conducted in North Carolina showed alarming news for North American loggerhead turtles. A new study on leatherback turtles revealed that climate change is a significant factor in the rapid decline of the species in the Pacific Ocean.

Australian flatbacks have already adapted to rising sea levels

The new research conducted in Queensland, Australia, explores how a present day population of flatback sea turtles might respond to climate change, looking back at how

they've changed behavior in the past to adapt to the environment. Prior to the last ice age, sea levels were significantly lower, so the coastline and turtle nesting beaches were further out, as far as 1,200 kilometers (745 miles) from their present day locations. By the time the last ice age ended 4,000 years ago sea levels had risen significantly. The flatback turtle adapted by finding new nesting sites and foraging areas. Today's nesting beaches along the northern areas of Australia were once dry land.

Dr. Colin Limpus of Queensland Turtle Research believes that today's turtles can respond to new climate change impacts, given the opportunity. "The flatback will likely continue to lay on some existing nesting beaches with elevated dunes, simply by crawling higher up the beach to lay," says Limpus. "We will likely see this at suitable beaches such as Wild Duck Island." This is a major flatback nesting site within the Great Barrier Reef, off the northeastern coast of Australia.

Limpus cautions that not all existing nesting sites will be sustainable under rising sea levels. "Some sites are at high risk of erosion and eventual loss," explains Limpus. "Low sand islands will almost certainly flood over," he adds. In addition, developed coastlines with hotels, houses, sea walls and other man-made structures leave no place for the turtles to go as the sea rises.

Increased temperatures will reduce number of hatchlings, possibly eliminating male loggerheads in Florida

Perhaps a bigger concern among scientists is the direct effect of global warming on nesting beaches – higher sand temperatures. When the nest becomes too hot, the hatching success rate drops, sometimes dramatically. In Australia, Limpus has seen

decreases in incubation rates of 25% since 1998. "Since 1998, beach temperatures have been over 32 degrees Celsius (90 degrees Fahrenheit) for most of the breeding season," he says. "That's too warm for turtles to hatch."

One of the most important effects of temperature on marine turtles is in determining gender. The sex of turtle hatchlings is determined by the temperature of eggs during incubation. Warmer nest temperatures produce females, and cooler nests result in males. Research by U.K. and U.S. scientists analyzed 26 years of North American loggerhead turtle nesting and climate data and compared the findings with models for future temperatures. In North Carolina 42% of hatchlings are presently male, compared to just 10% further south in warmer Florida.

According to Lucy Hawkes of the Marine Turtle Research Group at the University of Exeter (U.K.), these ratios could soon change. "With just two degrees Celsius of warming, there would be no more males produced at Cape Canaveral, Florida," states Hawkes. It's widely accepted that three degrees Celsius will occur in the next 100 years, which could be disastrous for Florida loggerhead populations. According to Hawkes, three degrees of warming would cause nests to incubate above the lethal threshold, reducing hatching rates.

The threat of temperature increases is exacerbated by human activities. Dr. Matthew Godfrey, sea turtle coordinator for the State of North Carolina, believes that beach "nourishment" activities, common in the Carolinas and Florida, can cause more problems for the turtles. "The renourishing material is drawn from the seabed floor, and is often darker," explains Godfrey. "The darker sand produces warmer incubation temperatures."

How can turtles adapt to warmer temperatures? They could change their biology, altering the pivotal temperature at which males and females are produced. However previous studies suggest that this is unlikely. The other alternatives are nesting in cooler areas or during cooler times. Hawkes thinks that turtles may shift nesting sites slightly, but not over great distances. "We may see some movement to cooler areas, however turtles are programmed to nest on the beach where they hatched," says Hawkes. "Since more females are produced in warmer areas, there will likely be more females from those areas returning to breed, further compounding the problem."

And what about nesting earlier in the season, when temperatures are cooler? According to Godfrey, turtles nest multiple times over the season, returning up to six times over several weeks to lay a new clutch. "Even if they begin nesting a week earlier, they still won't avoid the warmer temperatures during the middle of the summer," says Godfrey. "Or they may start nesting later, to take advantage of cooler temperatures in the fall," he adds.

Leatherback decline in Pacific Ocean now attributed to climate change

Scientists have long wondered why leatherback turtles are relatively successful in the Atlantic Ocean, while Pacific populations continue their rapid decline. There are estimated to be only 2,000 Pacific females nesting each year, compared with over 17,000 in the Atlantic Ocean. This is despite the fact that more leatherbacks are incidentally caught through longline fisheries in the Atlantic than in the Pacific. While fisheries, egg harvesting and habitat loss are partially responsible for the continued decline, some researchers now accept that climate change could be the primary stressor on a vulnerable population.

Climate and availability of food may be key parts of the puzzle. "Resource availability is higher and more consistent in the Atlantic Ocean," says Vincent Saba of the Virginia Institute of Marine Science. "Essentially, there's more food in the Atlantic and the turtles don't have to swim such great distances to reach it."

According to Saba, the Eastern Pacific is the most unstable part of the ocean in terms of marine climate. "The frequent El Niños we're experiencing in the Pacific alter the availability of food resources," Saba explains. Saba's recent study shows that reproductive output of Eastern Pacific leatherbacks is significantly reduced during El Niño years. "With global warming possibly altering the El Niño phenomenon, the turtles will continue to experience serious resource droughts," says Saba.

Satellite tracking will help protect future populations

"We're dealing with an already threatened species," says Limpus. "When you add in the climate change factor, it puts the species at even greater risk," he adds. According to Dr. Wallace "J" Nichols, president of the International Sea Turtle Society, survival of the species will depend on how much we can learn about sea turtle behavior. "It's imperative that we monitor sea turtles and work to protect even the minor nesting areas and those beaches that will still be around as sea levels rise," says Nichols. "The added stress of climate change could have severe impact on a species that's already in danger."

One of the techniques used to learn about sea turtles is tracking their movements through the use of satellite transmitters. Researchers around the world use this technology to better understand turtles' migratory paths and foraging behavior.

Scientists and the public can view many of these tracking projects online at www.seaturtle.org. Dr. Michael Coyne, director of Seaturtle.org, believes that satellite tracking can provide important data. "The knowledge we gain through tracking can help us to understand where turtles go and why, which will help us reduce our impact on sea turtle populations," explains Coyne.

However, research may not be enough to protect the species from the worst-case climate change scenarios. "The world has to come to terms with climate change and adapt our behavior to protect threatened species such as sea turtles," says Limpus. "If we're successful with sea turtle populations, that will be a good indicator of success in maintaining biodiversity throughout our oceans."

About The International Sea Turtle Society
A non-profit organization, the International Sea Turtle Society brings people together to promote the exchange of information and advance the global knowledge of sea turtle biology and conservation. The ISTS envisions a global network of diverse peoples, professions and cultures sharing knowledge, ideas and inspiration to ensure healthy sea turtle populations worldwide. The organization's strategies include promoting public awareness, providing for personal interactions and encouraging networking, to demonstrate that sea turtles and human cultures can live in harmony. For more information go to www.seaturtle.org/ists.

Photos available upon request

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