



# Hatching a Plan for Marine Turtles:

## The Artificial Incubation of Marine Turtle Nests in Cold Climates

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**Australian waters are known to host six of the world's seven marine turtle species. It is thought that three of these turtle species, the loggerhead sea turtle (*Caretta caretta*), the green sea turtle (*Chelonia mydas*), and the flatback sea turtle (*Natator depressus*), have altered their nesting locations up and down the east coast of Australia in response to changing climatic conditions, over tens of thousands of years, leading to the choice of ideal thermal nesting conditions.**

As we enter an accelerated climate change period in Earth's history (relative to historical data), it is unknown whether, as a species, marine turtles will be able to naturally adapt and shift from nesting beaches that have become too hot for optimal nesting, to cooler beaches further south along the east coast of Australia.

All sea turtles have temperature-dependent sex determination, where the sex of the turtle hatchlings is determined by the temperature of the nest during the middle third of embryonic development. Cooler temperatures favour male turtle hatchling production, and warmer temperatures favour female turtle hatchling production. Because of climate warming, a rapid feminisation of marine turtle hatchlings is observed at many sea turtle nesting beaches, including some beaches along the northern latitudes of

the east coast of Queensland. In some cases, nest temperatures can reach and even exceed 36°C – proving fatal to many developing embryos. In these northern latitudes, management efforts at some sites focus on cooling nests to produce a healthy clutch of hatchlings, especially the increasingly rare male turtle hatchling. It is understood that cooling turtle nests cannot offer an effective long-term solution for preserving the large numbers of marine turtle species that choose to nest on Australian shores each year.

At more southern latitudes, in northern New South Wales, current statistics and observations show an increase in the number of sea turtles breeding and seeking out nesting sites. Here, additional conservation efforts are underway to support nests laid in the current cooler climates, with some nests being laid at the very end of summer

or early autumn when sand dunes, and hence nest temperatures, are falling below optimal incubation temperatures. These cooler, late-season nests create a compromised scenario for the eruption of a healthy, live clutch of hatchlings. However, it is anticipated that some southern nesting sites could become climatically optimal sites for marine turtle nesting and breeding in the not-too-distant future.

In the 2020-2021 summer season, expert Green Heroes volunteers were able to design and build a high-quality prototype system for the artificial incubation of marine turtle eggs. With the generous support from the Australian Wildlife Society, the incubation system has been created to support marine turtle clutches that are 'more than likely to fail' if left *in situ* at their current locations at these southern latitudes.

In cooperation with the New South Wales National Parks and Wildlife Service and local Aboriginal Land Council, Green Heroes conducted a pilot

**Top:** The successful release of the loggerhead sea turtle hatchlings into the ocean. Image: Ashi Hilmer.



trial and artificial incubation of three locally rescued loggerhead sea turtle nests – one from Pottsville Beach and two from Fingal Head Beach, New South Wales.

In the northern latitudes, it is typical for loggerhead sea turtles to hatch naturally between fifty-five to seventy-five days after the nest is laid. However, permission was given for the Green Heroes incubation trial to excavate three loggerhead sea turtle nests ninety days after they were laid and only after temperatures within the nest had dropped below 22°C for several consecutive days. It was unknown whether any eggs would still be viable, however after two weeks of artificial incubation at 30°C, the first clutch produced 107 male hatchlings from 113 eggs, yielding an unprecedented hatchling rate of over ninety-six percent. Two additional clutches hatched shortly after with similar success and were released into the ocean.

Many successes were attributed to the design of the incubation chambers, capable of maintaining an optimal temperature within half a degree Celsius and combined efforts to minimise handling and transport of eggs. Many other considerations such as the inclusion of sand and nutrients from the nest site, exclusion of ferrous metals, exclusion of electrical currents and heating devices, and the ability to monitor temperature and humidity remotely via an application are also noteworthy, but the impact of these considerations are yet to be quantified.

More research is required to understand the long-term effects or changes that artificial incubation may have on hatchling development and the life of a marine turtle. Green Heroes is committed to working alongside like-minded organisations to take a multi-pronged approach to the conservation of marine turtles whilst monitoring outcomes of any manipulations applied. Some conservation efforts will prove more successful than others over time, however artificial incubation will ensure that all efforts are made without delay to provide the best possible chance for species recovery as outlined in the Marine Turtle Recovery Plan.

In brief, the pilot trial showed very promising results for the benefit of threatened and endangered marine turtle species, and with careful planning and support, the artificial incubation and hatching of males in northern New South Wales could help to:

1. Provide an appropriate male-female balance along the east coast of Australia,



Loggerhead sea turtle (*Caretta caretta*) eggs. Image: Sarah Jantos.



The Endangered loggerhead sea turtle (*Caretta caretta*) hatchlings. Image: Ashi Hilmer.



A health assessment of a loggerhead sea turtle before its release. Image: Ashi Hilmer.





Measuring the loggerhead sea turtle hatchlings before being released. Image: Ashi Hillmer.



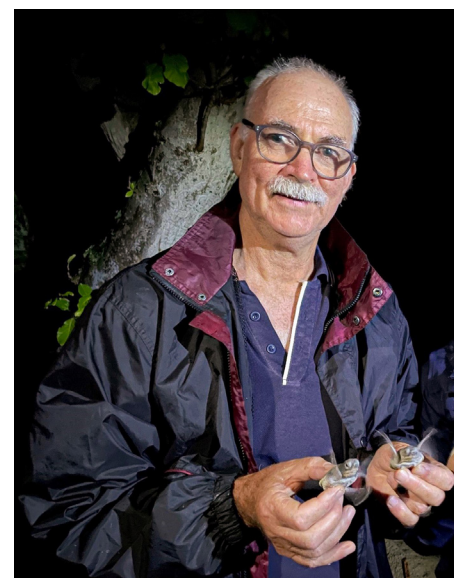
Steven Kudzius, a Green Heroes volunteer, operating the marine sea turtle (*Caretta caretta*) incubation system. Image: Sarah Jantos.

2. Support several viable locations for loggerhead and green sea turtle nesting aggregations to form along the north coast of New South Wales, and
3. These efforts will also aim to counter the feminisation effect of warming incubation temperatures at the current nesting aggregations in Queensland.

Green Heroes is pleased to continue working with authorities, the local Aboriginal Land Council, the Australian Wildlife Society, and like-minded conservation organisations to prepare for the upcoming turtle nesting seasons. Stay tuned! If you would like to find out more about the work of Green Heroes, please visit [www.greenheroes.org.au](http://www.greenheroes.org.au)



Sarah Jantos is the Founder of Green Heroes, a wildlife conservation and education organisation established in 2016. Sarah has been actively involved in wildlife rescue and rehabilitation for over twelve years.



Doctor David Booth is an Honorary Associate Professor in the School of Biological Sciences at the University of Queensland. He has been involved in the research of sea turtle incubation biology for over twenty years. David is pictured here with two turtle hatchlings at Heron Island, Queensland, in February 2021.