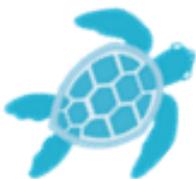




# TURTLE COOLING PHASE 1 FIELD RESEARCH

## MILMAN ISLAND 2018-2019

### KEEPING TURTLES COOL



Warmer sand temperatures caused by climate change have caused an imbalance in the sex-ratios of marine turtles. Sand temperatures determine the sex of incubating turtle eggs, where cooler temperatures produce more male hatchlings and warmer temperatures produce more females. As a result, some populations are experiencing ~99% female hatchling production. This is called feminisation. Ultimately, feminisation means a loss of reproductive output and genetic diversity, threatening turtle populations already facing extinction.

As a complimentary project to annual turtle nesting census on Milman Island led by the Queensland Government Department of Environment and Science (DES), this year WWF-Australia partnered with the University of Queensland and DES to run the *Turtle Cooling Project*. Supported by corporate partner *Koala*, the aim of the project was to explore methods that could mitigate the impacts of climate change on marine turtles in the northern Great Barrier Reef (nGBR).

The *Turtle Cooling Project* was designed to investigate novel and innovative sand cooling techniques on remote nesting islands in the nGBR with the plan in the future, to scale-up the most 'successful method' to other turtle nesting islands across Indo-Pacific experiencing similar rates of feminisation.





When investigated in the 1980-1990s, Milman Island was identified as hosting one of the most concentrated and significant hawksbill nesting populations in the northeast Australian region, for one of the largest hawksbill stocks in the world (Limpus and Miller 2008; Loop et al., 1995; Limpus 2009). Milman Island is also a nesting site for a small population of green turtles (*Chelonia mydas*) from the northern Great Barrier Reef (nGBR) genetic stock. Although the primary nesting area for the nGBR genetic stock of green turtles is on Raine Island (120 km southeast of Milman Is.), over the past two decades, turtles originating from this (and nearby) nesting beaches are extremely female-biased, meaning these beaches would have been experiencing an increase in sand temperatures (Jensen et al., 2018). The experiment therefore focussed on both species of turtle – hawksbill and green.

Field work for the *Turtle Cooling Project* encompassed both the nesting and hatching season on Milman Island from 5 January-23 March 2019. When we arrived on 5 January, clutches of both green and hawksbill eggs were relocated into experimental sites for the *Turtle Cooling Project* to begin.

While supporting the DES nesting census study, the purpose of the *Turtle Cooling Project* was to ascertain which method of shade was most successful in cooling both hawksbill and green turtle nests on Milman Island, and which method resulted in high hatchling success, by:

1. Collecting nest temperature, incubation success and sex-ratio data from clutches in sun-exposed and shaded sites.
2. Providing data on the effects of shading/cooling treatment on hatchling quality (size and locomotion performance).

Where other islands or times of year are not producing sufficient males, if proved successful, these results could be used to inform future management decisions to further conserve and protect nGBR islands (like Milman Island) as ‘male-producing’ rookeries for both greens and hawksbills, and, the best method scaled-up and rolled out to other turtle nesting beaches warming from the impacts of climate change.

## The 2018/2019 Nesting Season Field Trip: Milman Island



A large collaboration of partners from government, not-for-profits and universities made up the research team – working together to deliver the objectives of the trip.

Camp was set up on 7 January 2019 by the first team of researchers. This site would be home for over 14 researchers for the next three months of the nesting season.

For the first week and a half the weather was clear and sunny, most days there wasn't a breath of wind drifting through the camp, which made the sting of the heat even stronger. The lack of rain also meant that humidity and insects at night were inescapable.



During the first two weeks of the study, the new moon made it difficult to spot turtles in the dark, and the tides were extremely low making it less likely for turtles to come up to nest. By 14 January, the tides were beginning to heighten, and the turtles made their appearance to nest in much larger numbers - meaning we could really start to fill our experiment nest plots with turtle eggs.

Once the rain started to fall, from the 20 January we had 10's of hawksbills and green turtles attempting to lay on Milman Island each night. The nesting success for greens was close to 50%, whereas hawksbills were laying 99% of the time. Monitoring typically takes place two hours either side of high tide, unless the high tide was past 2 am, then there would be more activity towards dawn.



Clutches were relocated from the 8-19 January, into the five different experiment plots. Each marked as to when the nests were likely to erupt (approximately 53-60 days later), all that was left to do, was to irrigate the seawater plots, and wait.



On 18 January, WWF and the researchers conducted a marine debris survey. In just four hours, close to 100 kg of debris was removed from the beach. The debris included everything from toothbrushes, plastic bags, Styrofoam, water bottles, marine buoys, fluorescent light tubes, glass, ghost nests, thongs and so much more. All the data will be uploaded to Tangaroa Blue – a database which collates marine debris surveys all over Australia. The rubbish will be ferried off the island once a suitable vessel and disposal location is sourced.

During the entire trip, it was interesting to watch the beach profile as the tides, wind and rain fluctuated - it was essentially shape-shifting. Areas of the island that were shear beach rock and predominately

inaccessible for most turtles, slowly night after night became covered with sand and sprouted new nesting hot spots all over the island.

As the tides, wind and rain changed the beach profile, so did the two severe weather events. On the 21<sup>st</sup> of February, the experiment was threatened by wave wash-over and all 51 nests were rescued and moved to a new site within 28 hours. On 18 March, evacuation was necessary due to Cyclone Trevor. The weather was extremely testing, but the experiment continued, all nests excavated, hatchling performance tests undertaken, and everyone home safely (albeit wet) by March end.

## 18 January - 25 March 2019, Panasesa Island:

A second pilot study was undertaken on Panasesa Island in the Conflict Island group of Papua New Guinea (PNG), conducted by researchers of the Conflict Island Conservation Initiative (CICI) under the guidance of WWF-Australia. The period of incubation, methods for relocation, watering, hatchling measurements and excavations were consistent with the study conducted on Milman Island. Six green turtle clutches were relocated into a sun-exposed experiment plots and six green turtle clutches were relocated into the seawater experiment plots. This small study was undertaken in order to compare differences in the two cooling methods and hatchling success between two nesting beaches at similar latitudes – Panasesa and Milman Islands. And if different results were found between the two beaches, what might have played a role (e.g. different sand granule size, individual turtles)?

### The Science:

In a paper by Jensen et al. (2018), the researchers found that 99% of juvenile green turtles from the nGBR stock were female in the feeding grounds. A second paper by Gaos et al. (2018) estimated that 95% of hawksbill hatchlings that emerged from natural nests in El Salvador (Central America) were female – this is a global feminisation issue which requires multiple mitigation strategies.

**51 NESTS  
RELOCATED**

**15 GREEN  
36 HAWKSBILL**



**12 SUN**

**12 SEAWATER**



**9 PALM-FRONDS**

**6 SHADE CLOTH**

**12 TREE SHADE**

For high-density nesting islands such as Raine Island, shading structures would be destroyed by the thousands of green turtles that come up to lay each night. Hence, the idea of irrigation arose as a way to cool sand and prevent nest temperature from rising above 29.1 °C (when females are predominately produced). Specifically, for Raine Island and for remote countries where freshwater is scarce or too precious of a commodity, watering with seawater was proposed as an alternative to freshwater irrigation. From observational studies, many clutches survive wave wash-over and have a regular hatching success. If this is determined as a safe option for incubating clutches, we may see sand temperature reductions of up to 2 °C. Secondly, no study has ever been conducted on seawater irrigated nests – hence the need to investigate seawater irrigation as a possible option particularly for unvegetated nesting beaches. Hatchling performance (including locomotive) studies are also limited surrounding irrigated nests,

so it will be interesting to see if hatchling performance is affected by seawater irrigation during the first half of incubation. The second part of the cooling project involves the use of palm fronds as an alternative to artificial shade. Two main problems with artificial shade cloth is that for remote parts

of the Pacific Islands, there is little to no access to such materials and if they do, they are too expensive for conservation programs to purchase. Some researchers also believe that the plastic in the cloth has a chemical that imitates estrogen and can leach into the sand when it rains. If this chemical accumulates enough inside the embryo, the sex may be determined as female, regardless of nest temperature. Hence, testing natural alternatives such as palm fronds to conventional artificial shade cloth.

## Turtle Cooling Project Stats, Milman Island:



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- 51 clutches relocated (15 green and 36 hawksbill)
- 1,232 green turtle eggs and 4,085 hawksbill turtle eggs
- 12 nests in sun treatment (6 green and 6 hawksbill)
- 12 nests in seawater treatment (6 green and 6 hawksbill)
- 9 nests in palm-frond treatment (3 green and 6 hawksbill)
- 6 nests in shade cloth treatment (6 hawksbill)
- 12 nests in tree-shade treatment (12 hawksbill)
- Only hawksbill nests were assessed for hatchling quality
- 420 hatchlings measured for performance and morphometrics

## Turtle Cooling Project Stats, Panasesa Island:



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- 12 green turtle clutches relocated
- 1,165 green turtle eggs relocated
- 180 green turtle hatchlings measured for performance and morphometrics

## Highlights from the trip:

- A friendly visit from a Great Barrier Reef Marine Park Authority compliance officer who arrived in helicopter on the island.
- Perfect sunny conditions for the first two weeks on the island, wet for three weeks, and calm conditions until Cyclone Trevor.
- Watching the weather station twist and turn in what was once thought to be ‘unpredictable’ weather events.
- A dedicated team of turtle monitors (rangers) in Papua New Guinea enjoying a different type of turtle research project – racing swimming hatchlings – to measure performance.



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This collaborative project included researchers and volunteers from the University of Queensland, DES, CICI, Sea Turtle Foundation, Cape York NRM's Western Cape Turtle Threat Abatement Alliance, James Cook University, and WWF-Australia.

The Turtle Cooling Project was project managed by Dr Ian Bell, DES, Dr David Booth, UQ and Ms Christine Madden Hof, WWF, and primarily led by Melissa Staines as part of her Honours Thesis at the University of Queensland.

The field trip was primarily supported by WWF (through *Koala* sponsorship) and DES, with smaller donations from the Sea Turtle Foundation.

The field trip would not have been possible without remote transportation from SeaSwift's vessel *Biquele Bay*, as well as John Charlton's *Strait Runner*. A shout out to all the researchers and volunteers (in no particular order and if not already mentioned above): Hayley Versace and all the turtle monitors at CICI, Alastair Freeman, Sophie Thomas, Brittany Zandler, Lauren O'Brien, Bella Reboul, Jeremy Raven, Daniel Panizo Coronado, Sara Kophamel, Edith Shum, Stephen Menzies, Jo Karam and Kerri Woodcock.

## Next steps

In Phase II of the turtle cooling project we aim to identify the most effective intervention to produce males, while also determining how many males are required to help halt a feminising population from a catastrophic population decline.

Until then, I'm signing off – Chris Hof.



koala



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## FOOD

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## SPECIES

WWF focuses on bringing some of our most-loved Aussie wildlife species, including the black-flanked rock-wallaby, green turtle, quokka, and koala, back from the brink of extinction.

## LOW-CARBON FUTURE

We promote innovative, low-carbon and zero carbon solutions to achieve a more climate-resilient future before 2050.

## PROTECT OUR MARINE LIFE

We work with partners, governments, Indigenous communities and corporate partners to protect the marine migratory pathways of our turtles, whales, penguins and other marine species.

	<p><b>Why we are here</b> To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.</p> <p><a href="http://wwf.org.au">wwf.org.au</a></p>
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