Conflict islands

PARADISE IN THE CORAL SEA

CICI & TCI Ltd
2022 – 2023 Nesting Season Final Report

Conflict Islands Conservation Initiative & The Coral Islands Ltd

2022 – 2023 Turtle Nesting Season

End of Season Report

Report Contents

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About the Conflict Islands

The Conflict Islands Atoll, in the heart of the Coral triangle and part of the Coral Sea in Milne Bay, Papua New Guinea is a bridge between the Solomon Islands, Australia and other interconnected waters of the greater Pacific Ocean.

Within Papua New Guinea, The Conflict Islands are held under a free hold land title, with 100% ownership to Mr. Ian Gowrie-Smith and his business The Coral Islands Ltd, and therefore decisions about how the Conflict Islands can be sustainably used and managed falls under the Papua New Guinea *Land Act 1996* and can be made by the owner. Adjacent communities are consulted and are involved in decision making and awareness and education programs are held with active communities.

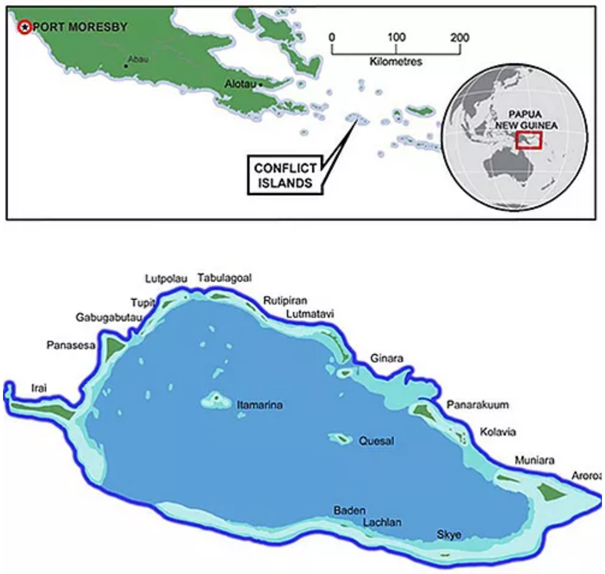

Figure 1: The Conflict Island Atoll is located in the Milne Bay Province of PNG, and within the coral triangle.

The Conflict Islands Atoll has very diverse coral fauna. A total of 418 Scleractinia corals clearly places it within the area of the highest coral diversity in the world ("Coral Triangle") along with the Philippines and Indonesia. The highest average number of species of reef fish (220) was recorded for the Conflict Group. The number of species in the below families is totaled to obtain the Coral Fish Diversity Index (CFDI). The total CFDI for Milne Bay Province is 337 with the following components: Labridae (108), Pomacentridae (100), Chaetodontidae (42), Acanthuridae (34), Scaridae (28) and Pomacanthidae (25). This is the highest total for a restricted location thus far recorded in the Indo-Pacific, surpassing the previous figure of 333 for the Maumere Bay region of Flores, Indonesia. Significant numbers of maori wrasse (*Cheilinus undulatus*), giant clams, white teat and black teat sea cucumber, all IUCN Red Listed as endangered species, also inhabit the reefs of the Conflict Group. Along with amazing richness of the coral reef and fish biodiversity rivalling that of Indonesia, the Conflict Group has recorded such important mega fauna as whale sharks, reef manta ray (*Mobula alfredi*) giant manta ray (*Mobula birostris*), bowmouth guitar shark (*Rhina ancylostoma*), endemic epaulette shark (*Hemiscyllium michaeli*), bigeye thresher *(Alopias* *superciliosus*) and marine mammals, such as risso dolphin (*Grampus griseus*), dugongs (*Dugong dugon*), false killer whales (*Pseudorca crassidens*), bottlenose dolphins (*Tursiops sp.*) and reported sightings of orca (*Orcinus orca*) and sperm whales (*Physeter macrocephalus).*

The Conflict Island Group has globally and regionally significant nesting populations of sea turtle, many of which have migrated to the islands from other countries (e.g., Australia) to court and nest. There is also foraging populations that reside in the lagoons of the Conflict Island Atoll.

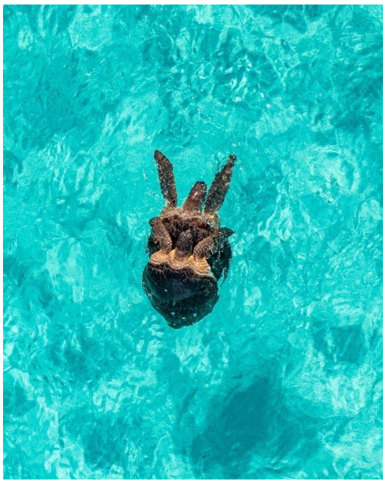

Figure 2: Aerial image of mating green turtles inside the Conflict Islands Atoll lagoon area. (© Migration Media Underwater Imaging, 2022)

The critically endangered hawksbill turtle (*Eretmochelys imbricata*) and the endangered green turtle (*Chelonia mydas*) (IUCN Red List) are the two species known to use the islands to nest, breed and feed, however, there have been multiple sightings of the olive ridley turtle (*Lepidochelys olivacea*) foraging in these waters. There are also images of reported nesting and harvest of olive ridley turtles on surrounding islands which indicates a gap of understanding about this vulnerable species to also be utilizing the area of, around and beyond the atoll.

The Coral Islands Ltd (TCIL) in partnership with Conflict Islands Conservation Initiative (CICI) has been running a Turtle Conservation Program on 21 of the Conflict Islands since the 2016-17 nesting season.

The program was built around a voluntourism model that relied on income from overseas volunteers, but also assisted the attendance of local Papua New Guinea university students and graduates to attend the program to gain experience and knowledge in the field of turtle conservation and husbandry. Financially supplemented by the island's owner Mr. Ian Gowrie-Smith where required and small grants and fundraising efforts received, limited conservation work was able to be conducted during the 2020-21 nesting season due to the impacts of COVID-19 and 100% loss of funding from volunteers' attendance and travel restrictions. These issues continue to impact the conservation work into 2023 as tourism confidence, PNG restrictions on COVID-19 policies and numbers of competitors in the same space for voluntourism continues to rise.

Our turtle conservation program has only been able to continue running through the support of our varied and generous sponsors and donors, of which we are forever grateful to for their support in these challenging times.

Turtle Life Cycle

Turtles take roughly 20 to 30 years to reach sexual maturity in the wild. After hatching out of the sand as 2-3 cm long hatchlings, they head out into oceanic currents for their lost years those years where they are difficult to track. After a period of around 5-15 years, those which survive the lost years at sea, they settle to reside in a coastal reef area where they spend years feeding to reach breeding maturity. Once they are sexually mature, they migrate from their foraging grounds to a courtship area and then the females continue to a nearby location close to where they hatched to lay their own eggs.

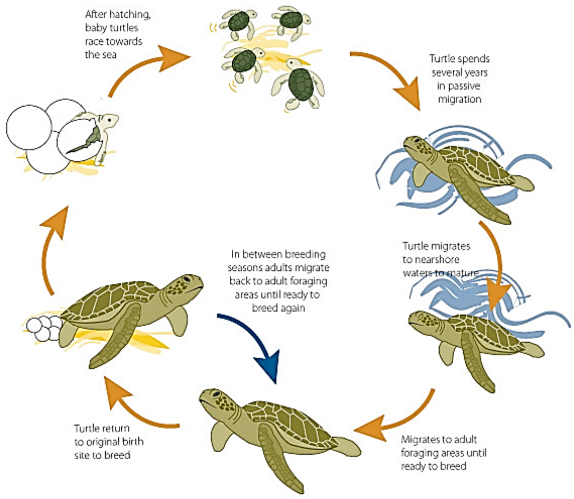

Figure 3: Turtle Life Cycle (courtesy of kingfisherbayresort.blogspot.com)

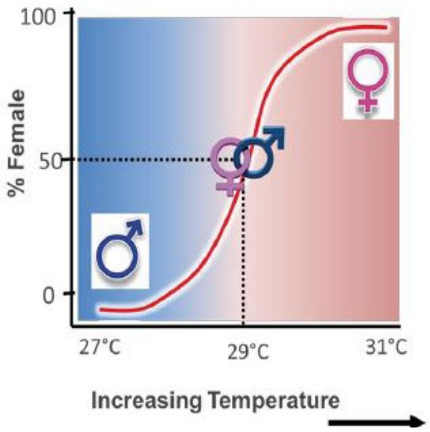

Figure 4: Marine turtle sex-ratio temperature dependence chart (adapted from Morreale et al. 1982).

CICI monitors both green and hawksbill turtle nesting in The Conflict Island Atoll. Researchers from WWF-Coral Triangle Programme and one of our directors Ms Christine Madden Hof, has been satellite tracking some hawksbill turtles that nested on the islands in 2017 and 2018. This data showed that most nesting hawksbills are migrating across the Coral Sea, to and from the Great Barrier reef in Australia to feed. Data collected from foraging turtles tagged in the Howick Island Group in the northern Great Barrier Reef also showed that green turtles have long migrations to the Conflicts to return to their nesting grounds. Female turtles do not make this migration annually, but every 5 – 8 years, returning to the nesting grounds to lay between 3 – 5 clutches of eggs. Whilst male turtles are likely to return to breed 2 – 3 times more frequently than their female counterparts.

The nesting season here starts in October, and the last of the hatchlings usually emerging by the end of April. There is no parental care for turtles. After the female deposits her eggs in her nest, she returns to the sea, with no further interaction with the nest or her hatchlings. Nest depth can vary between 30 – 60 cm deep for the different species, as does the number of eggs laid in each clutch. Some females may lay only 50 eggs toward the end of the season, but the total clutch count (number of eggs) can be as high as 220 or more.

The sex of the hatchlings is not determined at fertilization (i.e., by sex chromosomes). Instead, sex is determined by the nest temperature during the middle third of embryonic development. Nest temperatures over ~29°C produce more females, and temperatures below this range produce more male hatchlings. With the warming global temperatures, some sea turtle populations are producing close to 100% female hatchling, such as the northern Great Barrier Reef green turtle population on Raine Island, the largest green turtle nesting site in the world. The consequences of this could be dire for the future of turtle species. Similarly, nest temperatures above 32°C are lethal for developing sea turtle embryos and have huge consequences to the overall health of the hatchling. Along with the low survival rate to maturity, which is less than one in every 1000 hatchlings, the future for the species without expert management and intervention is looking dire.

Threats to Turtles Globally and Locally

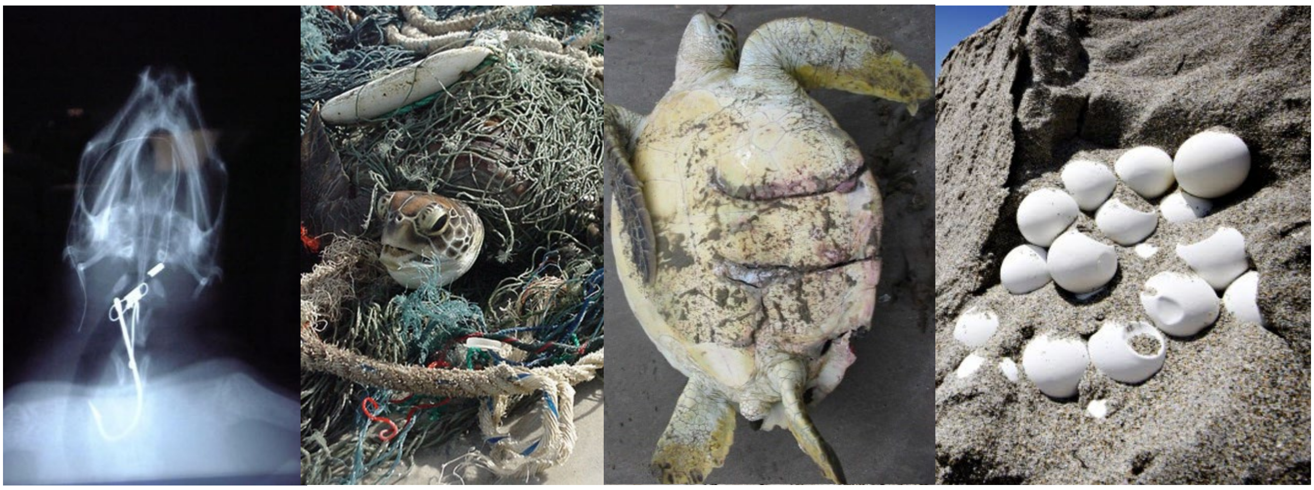

Figure 5: Turtle threats of by-catch from long liner (www.seaturtlestatus.org); passive fishing by discarded fishing nest at sea part of the plastic pollution problem (www.dhimurru.com.au); and boat strike victim (Ian Bell, Sea Turtle Foundation); coastal erosion exposing vulnerable turtle eggs due to sea level rise (champagnewhisky.com).

The global trend for many turtle populations is **declining** due to the many factors that affect them in every stage of their life cycles, from global to local scales. Global threats include increasing sand temperatures ('feminization' and lethal incubation temperatures), sea level rise and erosion (nesting habitat loss), pollution (heavy metals, chemicals, toxins and plastics), fishing (either intentional or as by-catch), marine debris (including discarded (ghost net) fishing gear), over-harvest of meat and eggs, and the illegal wildlife trade.

For turtles in the Conflict Islands, key threats are poaching of turtles for meat and eggs, the illegal wildlife trade for "tortoise shell" (hawksbill turtles), erosion caused by sea level rise leading to a loss of available nesting beach, plastic debris, and marine debris including trees blocking access to the nesting habitats. The carapace of hawksbill turtles (*Eretmochelys imbricata)* is highly sought-after used in the fashion, medicinal and ornamental industry contributing to the illegal wildlife trade.

PNG's human population growth has increased around ~2% each year since 1950 (http://www.worldometers.info). In combination with the global increase in the cost of living, further pressure has been put on turtle populations as there is an increased demand for their meat and eggs to substitute income for villages. When sold for cash, these products can be sold for ~350 kina ($130 AUD) at local markets. Traditional trade of turtles and the products is legal and widely used across the rural and maritime regions of the country. The turtle nesting season coincides with Christmas and New Year, and every year where the demand for cash increases and puts extra pressure on communities to provide for these western celebrations introduced with Christianity to Papua New Guinea.

Our team of Rangers are without exception, reformed turtle poachers, who openly admit to poaching and harvesting of turtles and was the most common use for the turtles that they harvested. As stated by our rangers, they money they got from selling turtles was often used to buy alcohol, betel nut, and Christmas supplies. Enforcement and effective management have always been an issue in PNG, even though high-level political members condone the sale of turtles.

Figure 6: Illegal sale of turtle products in Papua New Guinea, jewelry and picture frames in Jacksons International Airport in Port Moresby and the turtle meat for sale in Alotau fish market. (Images from Migration Media Underwater Imaging, 2018)

Figure 7. Collection of images taken at Jacksons international departure airport lounge shop with turtle products for sale in May 2022 (© Migration Media Underwater Imaging, 2022).

Turtle Monitoring and Protection Program Overview

Figure 7: New dingy and outboard generously sponsored by Sea Shepherd and named by rangers as "Baby Blue."

CICI's ongoing Turtle Conservation Program is designed to monitor and protect nesting turtles and their eggs of the Conflict Island Atoll. Over the years we have also been creating a baseline data set that CICI and others will be able to use to determine if the management strategies put in place are successfully contributing to the conservation of green and hawksbill turtles. Supported my nesting population survey monitoring, some of the species management strategies used are poaching deterrence, egg protection, translocation, nest cooling, "head-start" hatchlings, environment clean ups and community education and awareness. The program is continually evolving and adapting the methods and techniques to keep up with worlds best practice and to ensure laws, ethics and regulations are adhered to. This also involves partnering with government, students, PhD candidates, universities, scientific advisors, and other conservation organizations, ensuring data sharing and collaborations where possible.

The project area consists of the atoll's 21 islands with the furthest being Auroroa Island, ~ 22 kms away from the base and hatchery at Panasesa Island. This makes the logistics and costs to effectively monitor all the islands difficult and expensive to run.

CICI's Turtle Conservation Project aims to monitor the marine turtle populations at the Conflict Islands Atoll via a long-term tagging program to allow population trends and trajectories to be calculated (i.e., is the population increasing, stable or declining). Beach patrols occur at night when the female turtles come up to lay. At this time, the rangers are able to tag green and hawksbill turtles, take genetic samples where necessary, collect facial ID photos, and other morphological data collection such as carapace length (CCL) and nest depth. These patrols also protect the turtles and their eggs from poaching and enables education and awareness to be conducted when poachers are encountered. This project conducts emergence and hatchling success studies by collecting eggs and translocating them to the Conflict Islands Turtle Hatchery. The nests are incubated, and temperature regulated using shade and irrigation to produce healthy hatchlings and not all females. Some hatchlings are raised in the on-site nursery until they are healthy and strong enough (3 – 12 months) to be released into the wild as part of our 'head-start' program.

Figure 8: Titanium flipper tag on juvenile green turtle (©Migration Media Underwater Imaging, 2018)

Our primary rangers of the team this season consisted of Steven Amos as Project Manager Patrick Lemeki as Head Rangers, and Toby Losane as our Community Liaison Officer. Henry John piloted a new project in his home community at Tewatewa island to our east sponsored by [Steamships] community grant program and [SEE_Turtles] Sea Turtle Inclusivity Fund.

Promoted in their roles from last season were trainee rangers Banian Leonard and Clinton Luke, to take on more responsibilities in their roles respectively being responsible for data entry and equipment inventories. Badi Seko, Jonathan Weinam, Michael Moten, Rodney Taliya, and Norman Poate remained as trainee rangers as they have room to improve their skills and knowledge from their performances from last year.

Youth engagement is a priority as we aim to meaningfully employ, educate, teach new skills and conservation principles to the trainees regardless of past opportunities, education or experience levels. All the trainees in the past had either eaten, harvested, or killed turtles and their eggs. After spending the last six months at home in their villages all of the rangers reported changes in their communities' attitudes towards turtles and even their own positions in the community. They also reported they had carried out awareness about the work they were doing and the effects it has had on the community.

Figure 9: Security team supplied by ESS Security from Port Moresby

In addition to the Community Conservation Rangers, we also employed a security team from a Port Moresby based firm, to patrol the atoll at night to help to alleviate the pressure on the rangers when faced with poachers. These poachers are often family relations or community members of the rangers from their villages. This system of the outside security firm worked very well with very few incidences of active poaching from the islands over the last seasons.

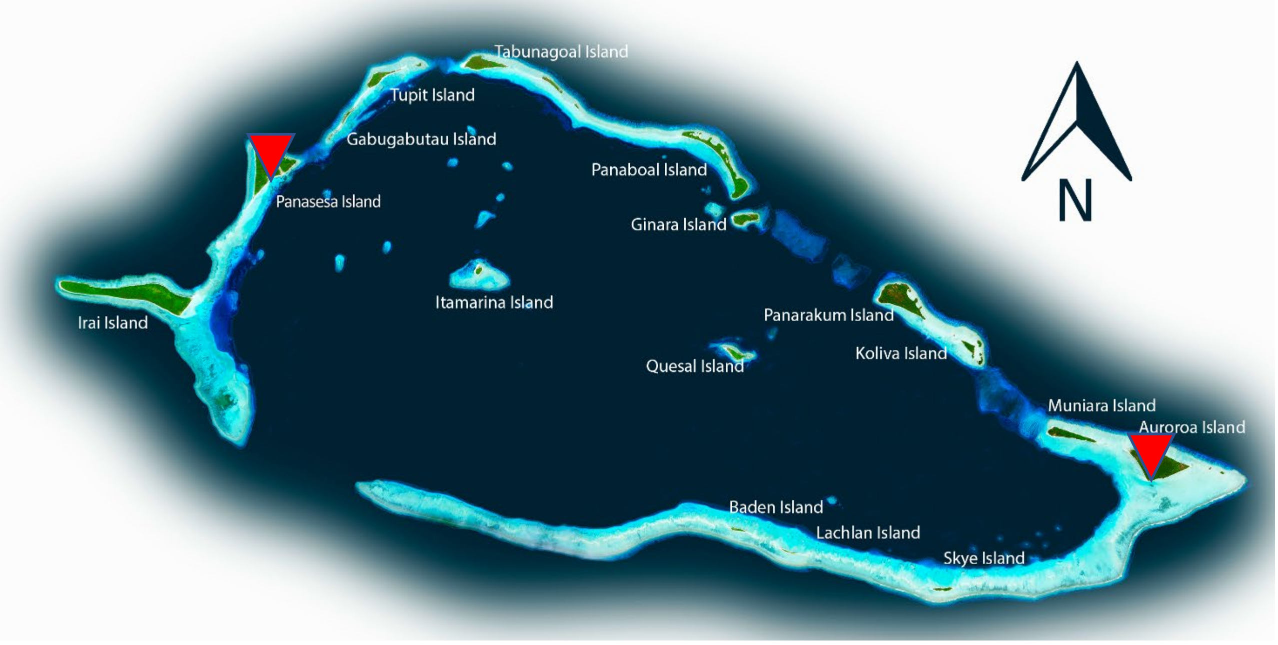

Figure 9: Conflict Island Map with Island names and locations of ranger deployments.

With fewer Rangers this season we were limited for the number of patrol base stations. This season we had one established at Auroroa Island and one at Panasesa where the main resort is based. This gave good coverage of the atoll most nights unless weather became an impediment. This was a much quitter season of nesting which allows for the rangers to spread the monitoring and patrol across the highest frequency nesting beaches for a greater result of relocations.

METHODS

Tagging and Patrols

The tagging method was adapted from standard SPREP tagging instructions (Geermans, 1993) sections 2 (2.2) and 3 (3.1, 3.2 and 3.3). Female turtles were tagged on nightly patrols during the months of November 2022 – February 2023 across the entire atoll. The patrols started at nightfall through to the lowest point of the tide every night. The turtles were tagged with standard self-locking titanium tags. The tags belong to the Conflict Islands Conservation Initiative; tag series IGS0001-IGS3000.

Recorded data included when a turtle is encountered includes:

- Species
- Tag ID number
- Carapace length and width (CCL and CCW)
- Injuries, diseases or scars on the nesting female
- 2x facial identification photos (left and right)
- Date and time of laying event
- Nesting island
- GPS location of nest
- Nest Habitat (e.g., bare sand, grass)
- Number of eggs laid (total clutch count, TCC)
- Number of nests building attempts
- Reasons for nest failures (e.g., tree roots, erosion)
- Nest Relocation information

Figure 10: Facial Identification photo being taken by a CICI Conservation Ranger (©Migration Media Under Water Imaging, 2022)

So as not to disrupt her during the egg laying phase, the female turtle is not handled/touched until she is near completion of laying. She is then flipper tagged on the trailing edge of her front left or right flipper on pad L3 (closest to the body), otherwise subsequent pads, L2 or L1 will be tagged. The turtle is only tagged after laying is finished and only once on the left flipper (a primary tag), and then on the right flipper on the second time the turtle is encountered (recapture). The tag number will be recorded as well as any injuries or previous tags. Where possible we also record a facial identification photograph, that is later uploaded to an online database (www.wildme.org) where facial mapping occurs through artificial intelligence (AI) software. Turtles have a unique scale print on their faces that in the future we hope will be able to be used effectively to identify individual, and to replace the flipper tags.

Figure 12: Turtle Eggs and mucous being captured during oviposition. (©Migration Media Underwater Imaging 2022)

Egg Collection & Relocation

Eggs are only relocated if they are at high-risk of mortality. This may include poachers, predators or if the female has dug her egg-chamber below the high-tide line as they are at risk to drowning and erosion. Unfortunately, most clutches of eggs laid have to be relocated to a hatchery due to the high levels of threats.

Figure 13: Ranger catching eggs from a laying green turtle. (© Migration Media Underwater Imaging, 2022)

As the female starts laying her eggs into her egg-chamber, she is no longer susceptible to disturbance. This allows our Conservation Rangers to easily place a ziplock bag under her cloaca to catch the eggs and the mucous she excretes whilst laying (Figure 10). Once laying has finished, the air is removed from the ziplock bag minimize exposure to oxygen during relocation, which pauses the development of the pin head-sized embryos until they are placed into their new nest site (Williamson et al 2017, Kam 1993, Kennett et al 1993).

The eggs are then carefully transported back to the hatchery on Panasesa Island via boat. This process is done as quickly as possible from the time of collection, to minimize the risk of mortality caused by rotations of the egg.

A replicate nest is dug in the hatchery, to the same depth and width as the natural nest and is covered with the same sand the was removed to excavate the nest. The species, number of eggs and estimated hatching date, female's tag number and hatchery position are all recorded on the data sheet. We also collect data on the maximum and minimum diameter and weight of each egg from a random sample (n=10) pre clutch laid. The nest is then covered by a nest protector to exclude any crabs or other predators. The eggs are then left for approximately 60 days to develop and allow the hatchlings to emerge naturally.

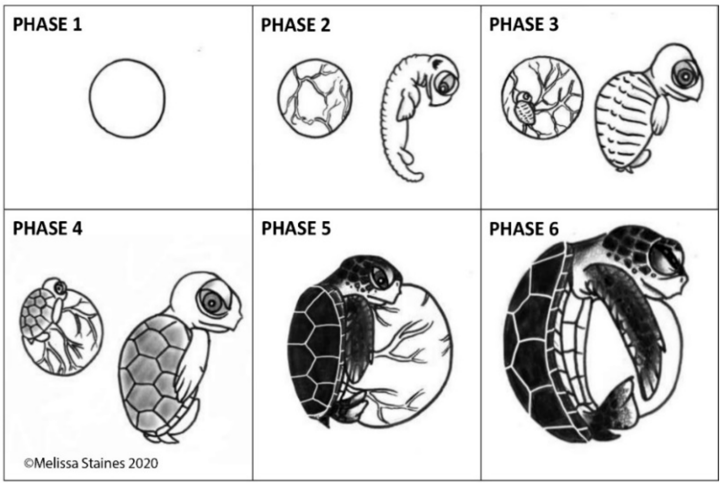

Figure 14: Embryonic development stages used in the field for assessing development stage at death (©Melissa Staines).

Hatchlings

The nests are observed approximately a week prior to the estimated hatch date for the first signs of emergence of the hatchlings. The clutch is allowed to emerge naturally with some or very little assistance from the rangers. Hatchlings with no morphological mutations are released the same evening they hatch. The release location depends a lot on weather and conditions, and we try to release the hatchlings from high up on the originating beach where the eggs were originally collected from which may be important for their natal returning imprinting. If we cannot take them back to their natal beach, they are released at the closest beach to the nursery under the cover of darkness to reduce the number of predators. Other hatchlings that show distinct genetic deformities or weakness are brought to the nursery onsite for further husbandry and observation. The nest is then excavated to determine the hatchling and emergence success, and to identify if any eggs that did not develop, at what stage their development ceased. This entails opening any unhatched eggs to look for different stages of development. This helps us to improve our relocation and incubation techniques. If there are any unhatched eggs that look healthy, we use a candling technique to check if the embryo is still viable inside the shell. If it is, these are what we have termed 'live eggs' and we take these back to the nursery to our sand incubation tanks where they are left to emerge naturally. Once emerged they will be released with another clutch of hatchlings the same night if they are healthy.

Hatchery Construction

To create our hatchery, we excavated an area 15m x 8m to a depth of 80 cm and lined the perimeter with builder's plastic (20 cm down in the sand) to stop root invasion and aid in predator exclusion, leaving the base open for natural water drainage. Roots alone can cause severe dehydration and death of the developing embryos.
Encompassed by a 60cm tall fence, this area is then refilled with beach sand from the ideal location for natural nesting. A roof to provide shade is then constructed over the top of the whole area, made from bush materials such as natural wood and woven coconut leaves for the roofing. A bird exclusion net is then placed to cover the gap between the roof and the top of the fence to ensure no predation (by animals alone, not humans), of emerged hatchlings by any of the birds.

Figure 15: Shaded Turtle Hatchery. (©Migration Media Underwater Imaging, 2018)

Nursery

We have limited use for the nursery and do not keep many hatchlings in there for extended periods. We utilize the facilities for any clearly deformed or week hatchlings and the incubation of any live eggs that require extended incubation after the rest of their clutch has emerged. We feed the hatchlings on a gelatin mix with calcium fresh fish pellets and ibika a local spinach whilst we keep them if for extended periods. W do not feed them if we release them with in 72 hours of hatching.

RESULTS

1. Nesting Population Surveys

Table 1: Number of individual turtles tagged an observed within the Conflict Islands Atoll, during the survey period of nesting females from late September 2022 to the end of February 2023.

Species	New Individuals	Re-migrant Individuals	Total Individuals	In-season Recaptures	One-off Captures
Green Turtle	98	7	105	89	63
Hawksbill Turtle	25	2	27	11	23
Total	**123**	**9**	**132**	**100**	**86**

Table 2: Number of Green turtles observed within the Conflict Islands Atoll, during the survey period from 2017 when the program commenced until the end of 2023 nesting season.

GREENS					
	New Turtles	Re-migrant Turtles	SPREP Tags	QLD Tags	Total
2017-18	234	0	5	1	240
2018-19	52	0	2	0	54
2019-20	342	0	1	0	343
2020-21	78	5	0	0	83
2021-22	655	10	3	0	669
2022-23	98	7	0	1	106
Total	**1,361**	**15**	**11**	**1**	**1,388**

Table 3: Number of hawksbill turtles observed within the Conflict Islands Atoll, during the survey period from 2017 when the program commenced until the end of 2023 nesting season.

HAWKSBILL					
	New Turtles	Re-migrant Turtles	SPREP Tags	QLD Tags	Total
2017-18	30	0	2	0	32
2018-19	40	0	2	1	43
2019-20	25	0	0	0	25
2020-21	35	0	0	1	36
2021-22	35	1	1	0	37
2022-23	25	2	0	0	27
Total	**165**	**3**	**5**	**2**	**173**

Table 4: Number of green and hawksbill turtles tagged and observed within the Conflict Islands Atoll during the survey period from 2017 when the program commenced until the end of 2023 nesting season.

COMBINED GREEN & HAWKSBILL DATA					
	New Turtles	Re-migrant Turtles	SPREP Tags	QLD Tags	Total
2017-18	264	0	7	1	272
2018-19	92	0	4	1	97
2019-20	367	0	1	0	368
2020-21	114	5	0	1	119
2021-22	690	11	4	0	706
2022-23	123	9	0	1	133
Total	**1,650**	**25**	**16**	**4**	**1,694**

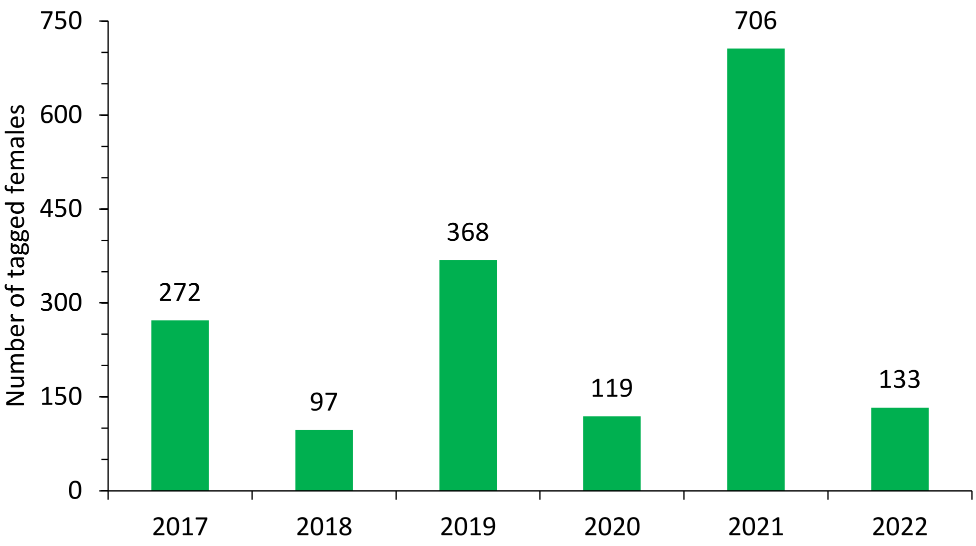

Figure 16. Combined tagged turtle interaction from 2017 through to 2022 nesting seasons.

2. Nesting Success

Table 5. Number of nesting events throughout 2022 – 2023 nesting season.

Species	Successful Nests	Failed Nest Attempts
Green Turtle	162	142
Hawksbill Turtle	38	15
Totals	**200**	**157**

Table 6. Number of clutches Translocated and Protected in 2022 – 2023 season.

Species	Total Number of clutches Translocated	Total Number of eggs Translocated
Green Turtle	116	11,246
Hawksbill Turtle	27	3,934
Totals	**143**	**15,180**

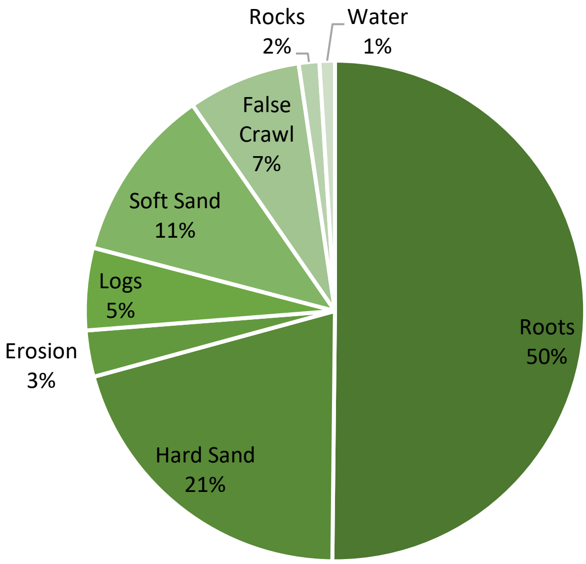

Figure 17. Reasons for failed nesting attempts of green and hawksbill turtles during the 2022-2023 nesting season.

Table 7. Number of nesting attempts categorized by survey island in the Conflict Island Atoll for the 2022 – 2023 Turtle Nesting Season, including missed turtles and tagged turtle nesting events for both Green and Hawksbill turtles.

Island	Green	Hawksbill	Total events (n)
Auroroa	67	8	75
Panasesa	55	4	59
Tabunagoal	36	1	37
Lachlan	32	0	32
Skye	32	1	33
Irai	24	0	24
Baden	15	4	19
Panarakum	15	6	21
Muniara	14	8	22
Tupit	10	13	23
Kolavia	3	3	6
Ginara	1	1	2
Itamarina	1	0	1
Panaboal	1	1	2
Quesal	0	2	2
Total	306	52	358

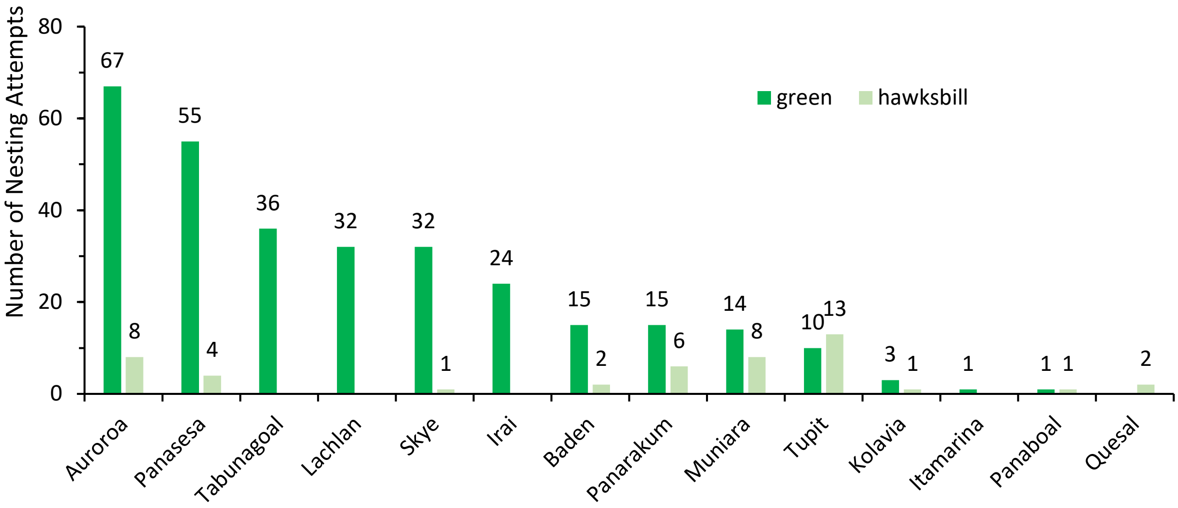

Figure 18. Number of nests events for green (dark) and hawksbill (light) turtles across the islands of the Atoll in 2022-2023 season.

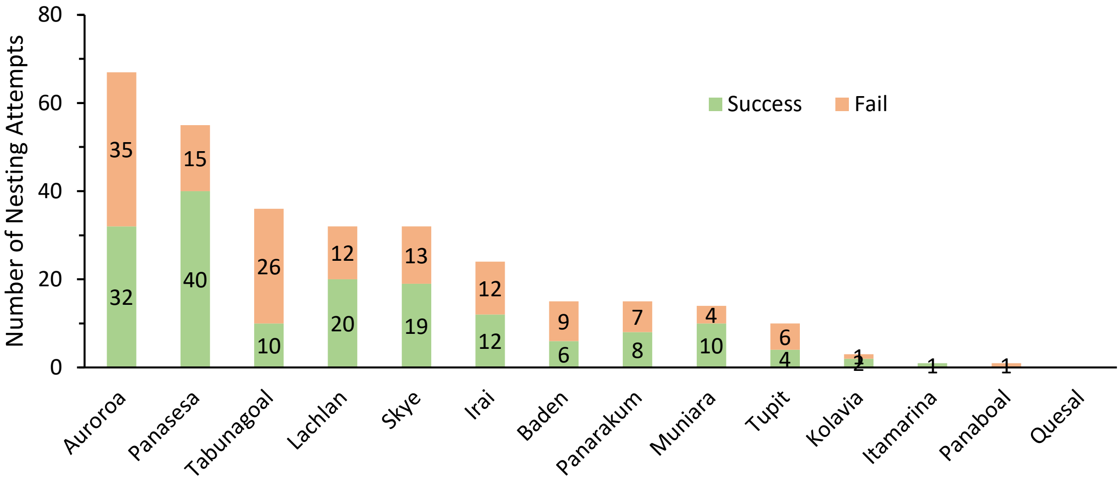

Figure 19. Total number of failed (orange) and successful (light) nesting attempts for each island by green turtles throughout 2022 – 2023 season.

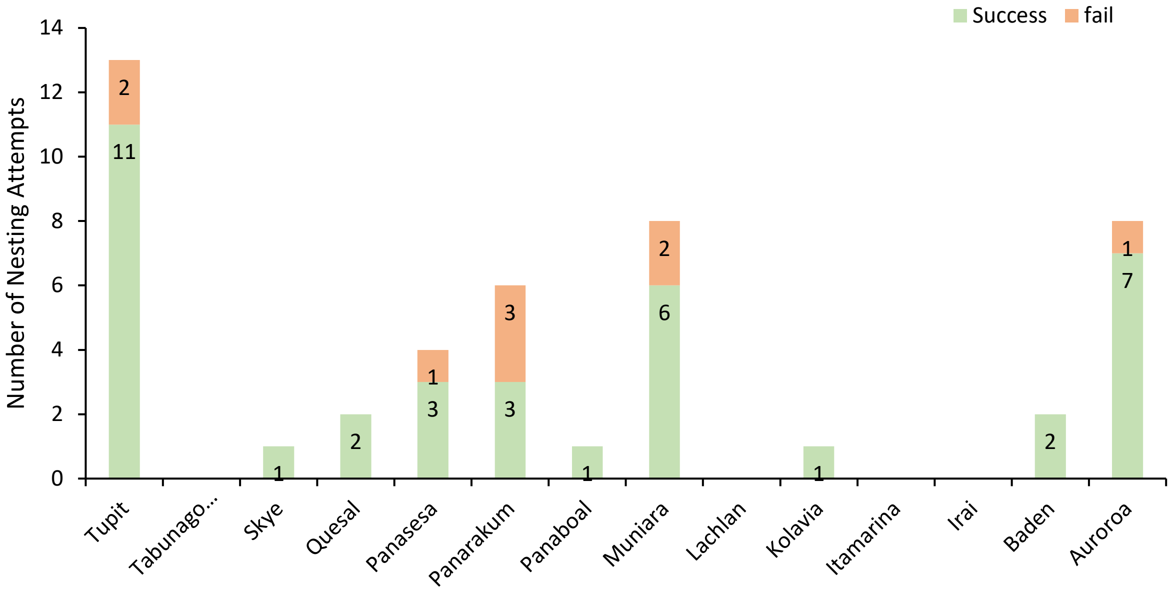

Figure 20. Total number of failed (dark) and successful (light) nesting attempts for each island by hawksbill turtles throughout 2022 – 2023 season.

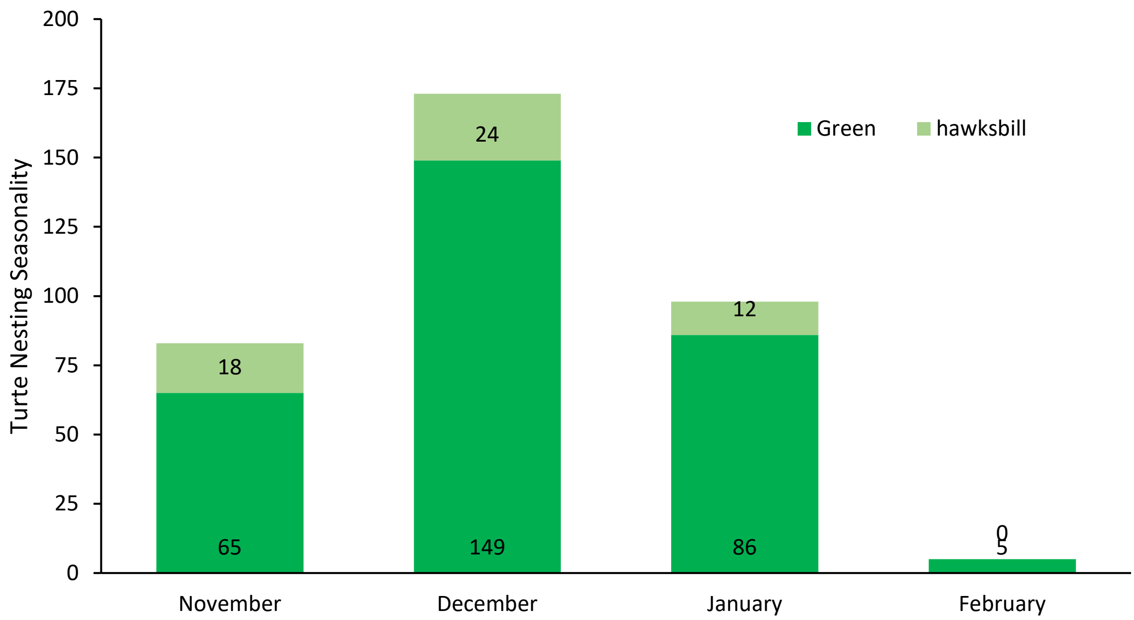

Figure 21. Total number of nesting attempts for each month for green and hawksbill turtles throughout 2022 – 2023 season.

Figure 22. Box and whisker plot showing the variation in the number of eggs (clutch size) laid per nest in the 2022 -2023 nesting season by both green (green) and hawksbill turtles (orange).

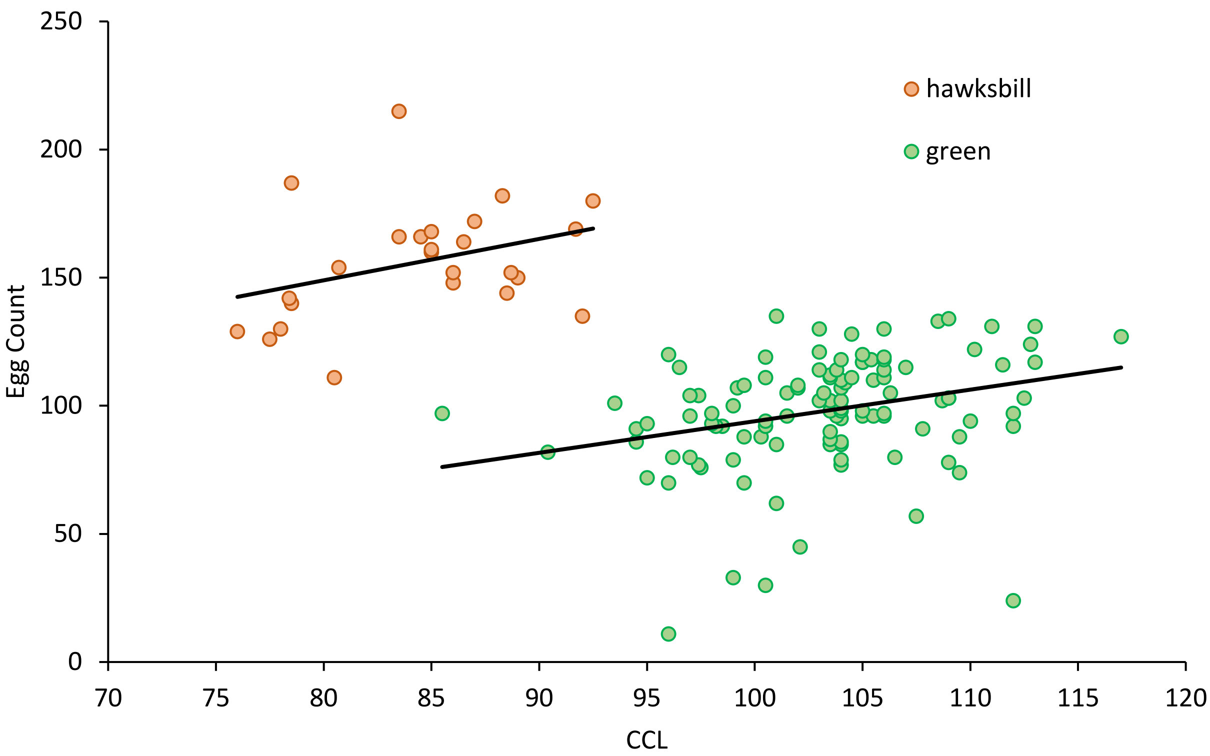

Figure 23. Relationship between female curved carapace length (CCL) and the number of eggs per clutch (total clutch count).

3. Hatchery Success

Table 8. Number of hatchlings released from translocated nests in hatchery during the 2022 – 2023 season to date.

Species	Nests Relocated	Number of Eggs	Number of Hatchings
Green	116	10,955	9,288
Hawksbill	27	4,088	3,600
Total	**143**	**15**	**12,888**

Table 9. Number of clutches relocated to the hatchery for the 2022 – 2023 Turtle Nesting Season, and corresponding hatchling production. (Excluding incomplete clutches of <30 eggs laid, 5 green turtles' samples)

Species	Hatchling Success (%)	Emergence Success (%)	Sample Size (clutches)
Green Turtle	85	85	111
Hawksbill Turtle	88	89	27
Both Species	**86.5**	**86.5**	**138**

4. Hatchling and Egg Morphometrics

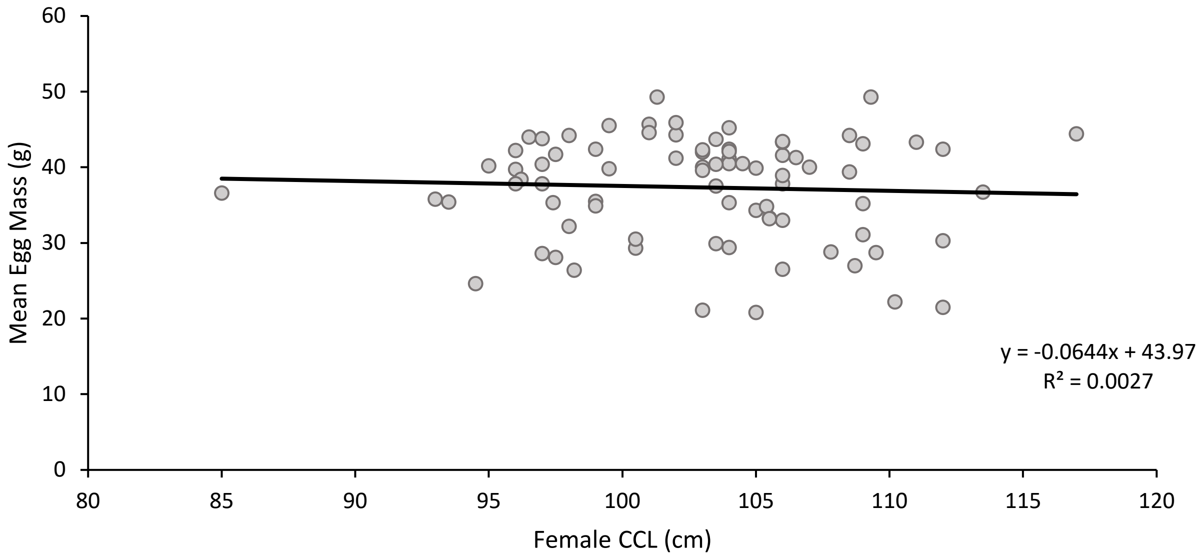

Figure 24. Scatter plot showing the relationship between the Green turtlefemale size (CCL) and the average egg mass for green turtle clutches.

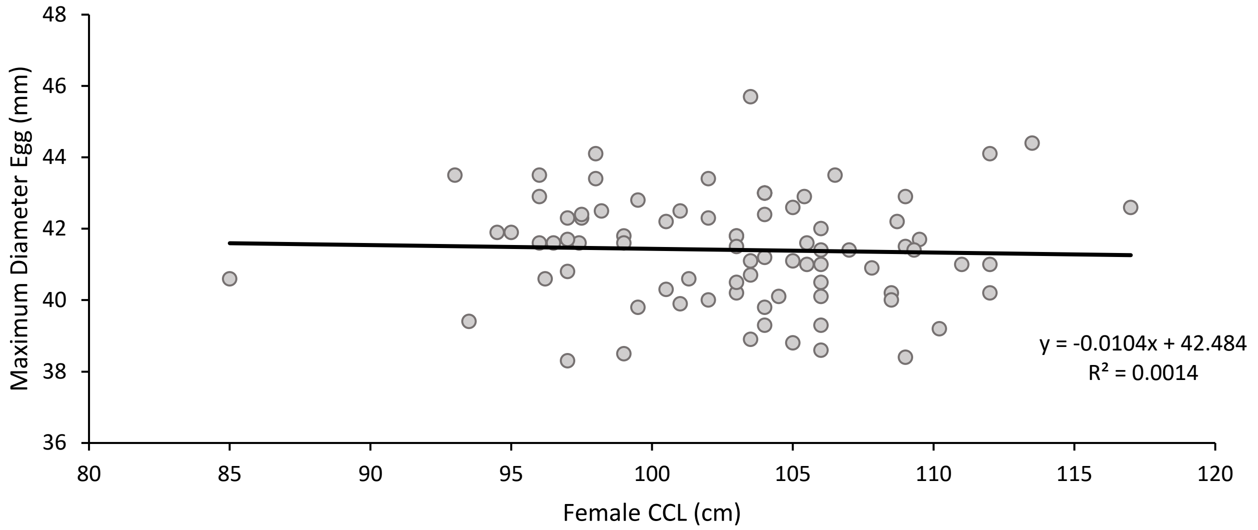

Figure 25. Scatter plot showing the relationship between the female size (CCL) and the average maximum egg diameter for green turtle clutches.

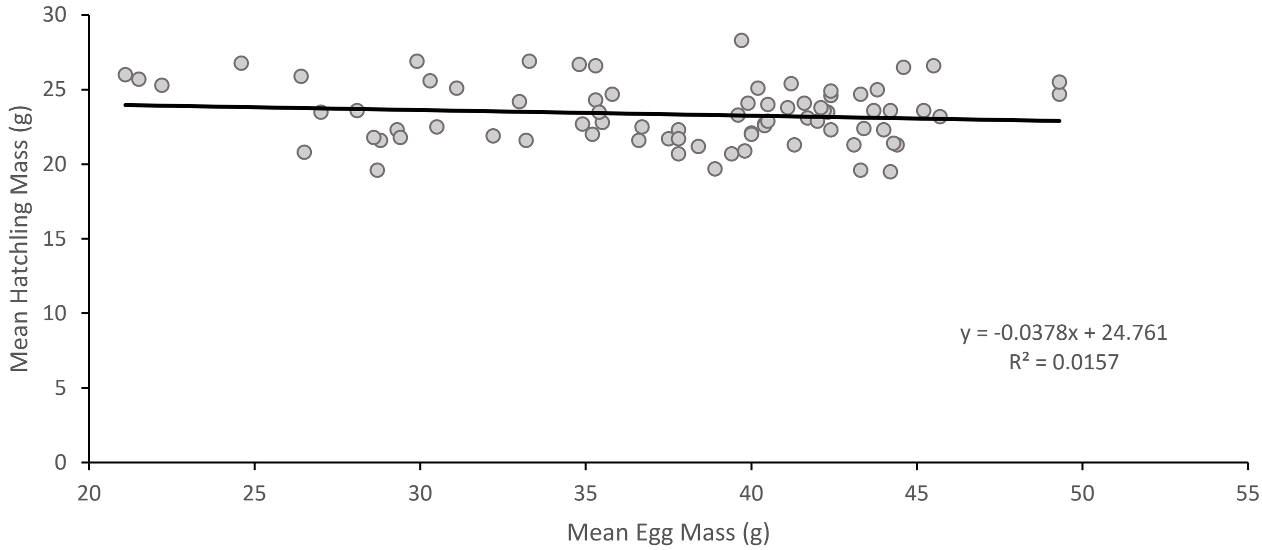

Figure 26. Scatter plot showing the relationship between the mean egg mass and the mean hatchling mass for green turtles.

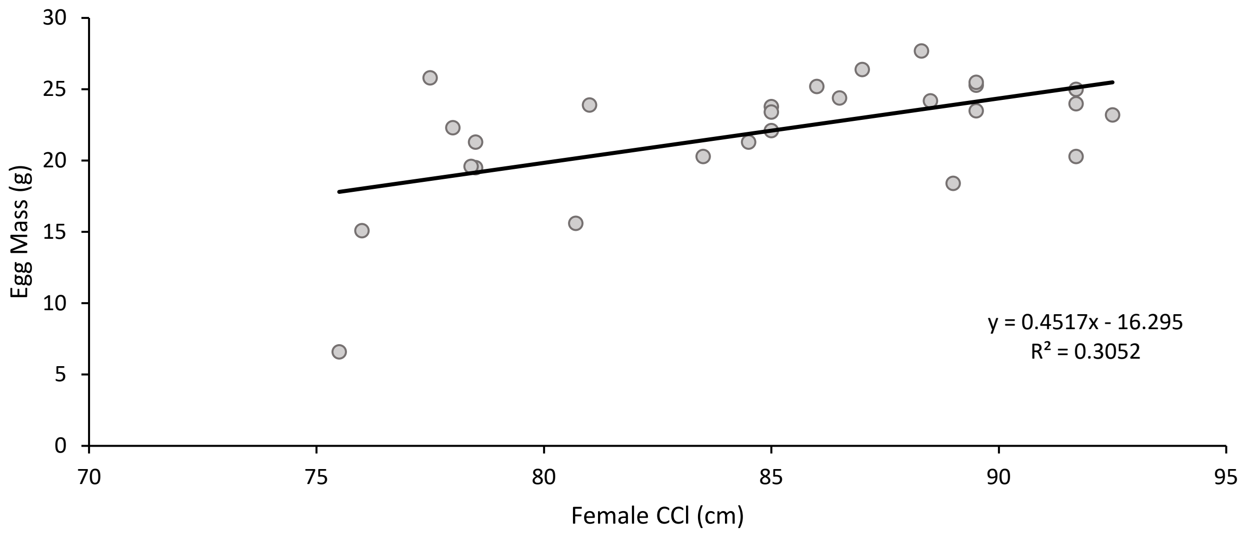

Figure 27. Scatter plot showing the relationship between the female size (CCL) and the average egg mass for hawksbill turtle clutches.

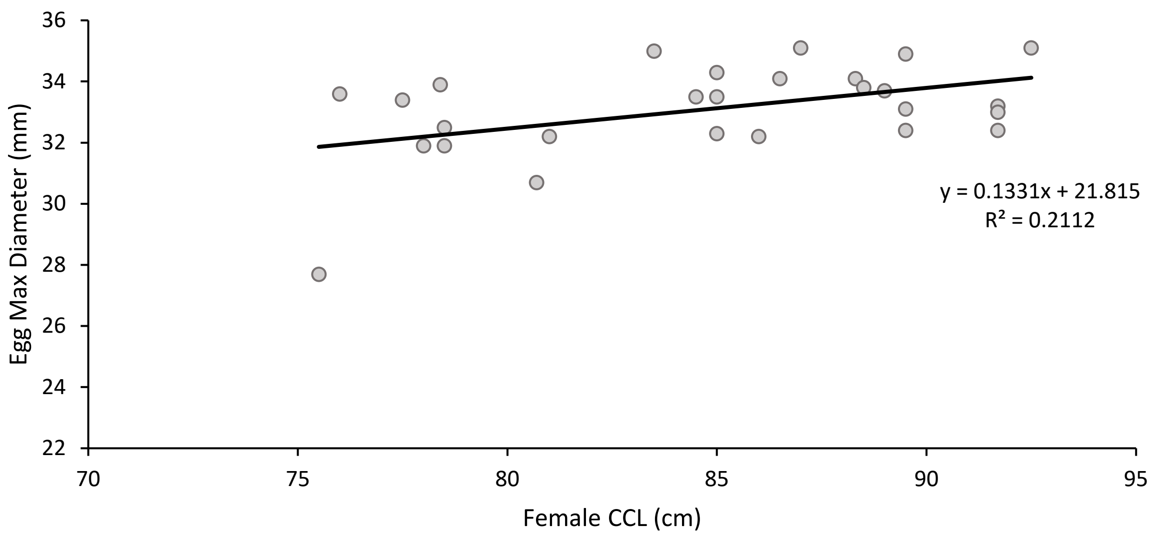

Figure 28. Scatter plot showing the relationship between the female size (CCL) and the average maximum egg diameter for hawksbill turtle clutches.

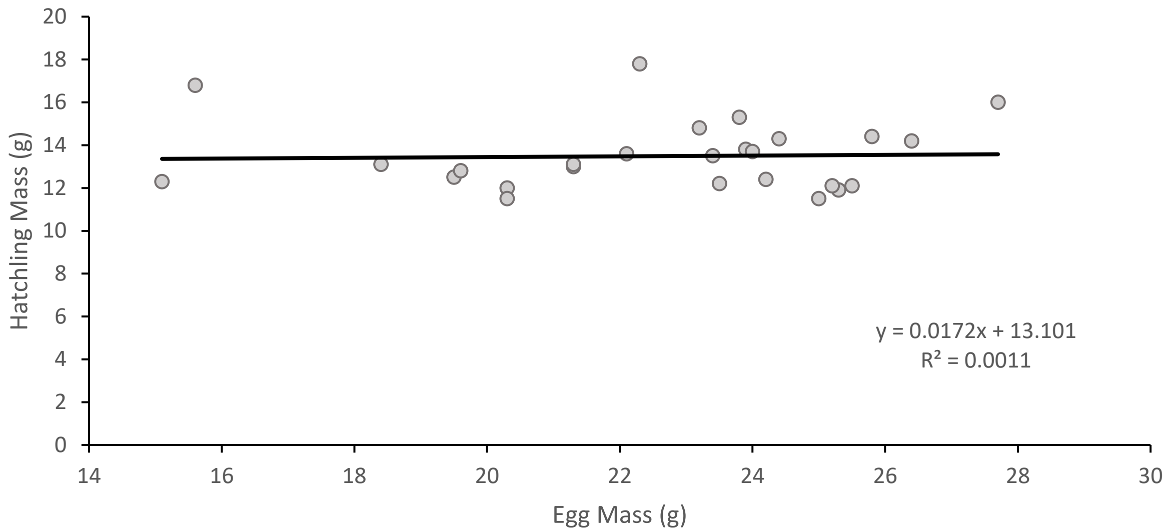

Figure 29: Scatter plot showing the relationship between the mean egg mass and the mean hatchling mass for hawksbill turtles.

5. Natural Nests

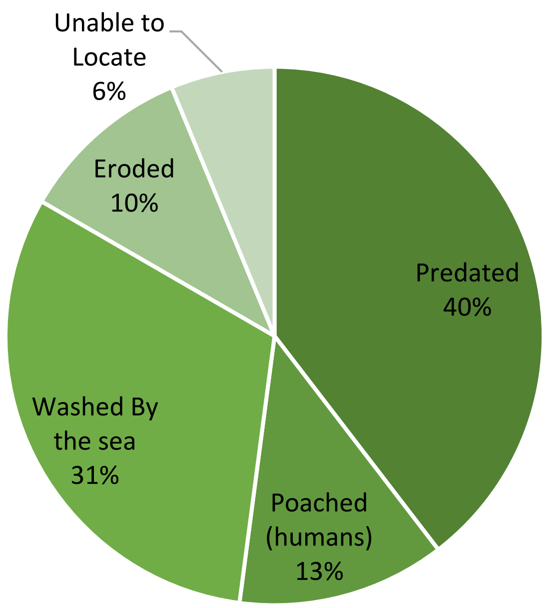

Figure 30. Reasons for unsuccessful 'natural nests' (in-situ nests) observed on the islands.

Table 12. Number of natural nests laid successful hatching and lost nests in the 2022 – 2023 season.

Species	Number of Natural Nests	Protection Placed	Successful	Impacted/ Lost	% Lost
Green Turtle	48	40	20	28	58%
Hawksbill Turtle	12	5	1	11	92%
Total	**60**	**45**	**21**	**39**	**75%**

Table 13. Number of natural nests where successful hatchings occurred, and nest excavations were possible as most of these nests had been protected from predators with a mesh nest protector by the Rangers.

Species	Natural Nests found with successful hatching	No. of Eggs	Hatchlings emerged successfully from Natural Nests
Green Turtle	20	1,766	1,290
Hawksbill Turtle	1	125	106
Total	**21**	**1,891**	**1,396**

Table 14. Average Success of natural nests, most of these nests had been protected from predators with a mesh nest protector.

Species	Hatchling Success (%)	Emergence Success (%)	Sample Size (clutches)
Green Turtle	72	69	20
Hawksbill Turtle	86	85	1
Average	**79**	**77**	**21**

6. Turtle Poaching

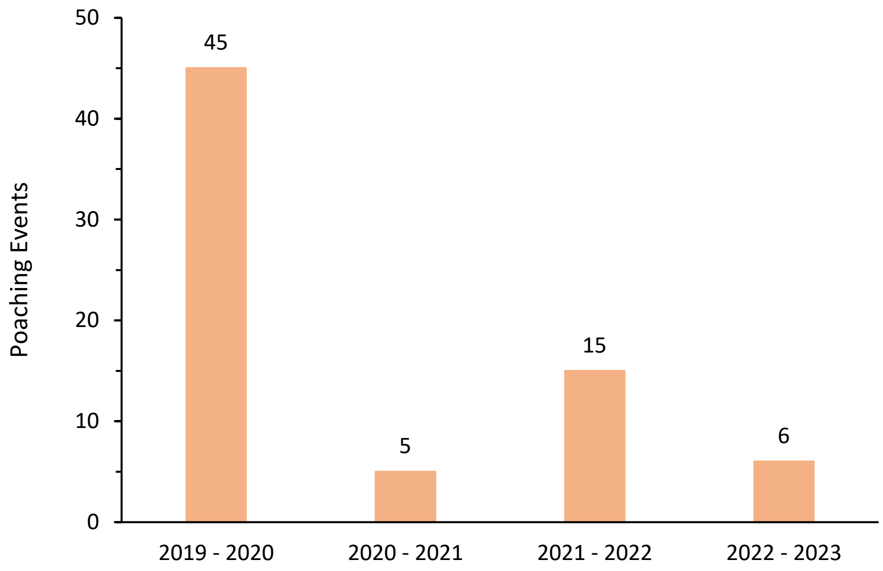

Figure 31. Number of poaching events that occurred within the Conflict Island Atoll over the past four nesting seasons.

7. Monitoring Logistics

Table 15. Number of turtles tagged and recorded by each ranger for the 2022 – 2023 Nesting Season.

Ranger	Recorded	Tagged
Badi	9	9
Banian	45	17
Clinton	55	6
Jonathan	20	13
Michael	59	5
Norman	62	14
Patrick	21	15
Rodney	31	8
Steven	13	8
Toby	24	16

Table 16. Number of tags used in the 2022 – 2023 nesting season and cost.

Species	Tags Applied	Cost
Green Turtle	98	$588.00
Hawksbill Turtle	50	$300.00
Damaged or lost tags	15	$90.00
Total	**163**	**$978.00**

Table 17. Number of hours spent training new recruits (n = 8) for 2022 – 2023 Nesting Season.

Position	Training Hours
Marine biologist	196
Project Manager	1176
Head Ranger	1176

8. Marine Debris Surveys

Table 18. Results of Marine Debris and Plastic Removal for 2022 – 2023 Nesting Season

Kilograms of waste removed	1,232.5
Number of pieces of waste removed	39,076
Number of people who participated	191
Number of islands cleaned	23
Hours spent collecting	78.5
Hours spent sorting	71.5

PROJECT OUTCOMES 2022 – 2023

Another year of great work and success by the Conflict Islands Conservation Initiatives Rangers and The Coral Islands Ltd company to run this program here in Milne Bay, Papua New Guinea. Thanks to the support of Sandrina Postorino & Chris Ellis, The British High Commission in Port Moresby, Steamships, SEE_Turtles, CICI and Animal Assist for your financial support to enable this season's work to go ahead.

Our 2022 – 2023 season has been a moderately busy season for new turtles occurring on the islands, but it was a relatively seasons for our BINGO or re-migrant turtles. Those turtles who have been tagged in previous nesting seasons and this is their second or more times returning to the islands to nest again and are what we call our re-migrant turtles. This data collected can be used in estimating the population of turtles for the Conflict Islands. The Mark-Recapture technique that we use to estimate the size of a population, as it is impractical and near impossible with marine migratory species such as the turtles to count every individual. The basic idea is that you capture a small number of individuals, flipper tag them with a unique tag ID number, and release them back into the population. Later, when we patrol in another season and encounter them, we record how many tags these are our re-migrants. Our tagging work has not been carried out for long enough yet to be able to use our data for a population study and with marine turtles it is a very difficult and convoluted process which needs to take into consider all types of environmental factors such as La Nina and El Nino years, quality of feeding grounds, temperature and oceanic currents and events.

A surprising trend has started to emerge from our data showing every second year as an either relatively busy or relatively slow season. These peaks and lows vary but the trend has remained the same in the 6 years of data we have been collecting. What drives this trend is unknow and most likely not from a single drive but many factors influencing the nesting seasonality. Annually our hawksbill nesting turtle numbers remain steady with roughly the same number of turtles nesting each season, with our highest number in our 2018-2019 season and lowest number this season and in our 2019-2020 season. Again, the drivers in these fluctuations are unknown.

This nesting season and leading up to the season saw moderate weather patterns through our islands, however there is a noticeable and significant loss of sand from most of the nesting beaches around the atoll. This is disturbing as it has led to a decrease in natural nesting success for our turtles, with limited habitat remaining they are also facing harder and more difficult conditions to try and lay their clutches and dig their nests. Following the flooding of one of our ranger stations last seasons, this has increased awareness of the large seasonal fluctuations in the weather patterns, sand, and water distribution locally around the islands of the atoll. All these patterns and movements of the terrain, the disturbance and loss of habitat throughout the atoll.

As a fall out from this loss of habitat, a greater percentage of nests required greater interventions and relocations of these nests by our rangers. Of the 304 attempted nesting events of the green turtles recorded by the rangers 47% of them resulted in a nest failure. This does not include the attempts from turtles that make multiple attempts in the one emergence from the sea and on average the nesting attempts for this season was 1.3 attempts across the total 304 nesting events for green turtles. For hawksbill turtles this number of the 53 nesting events recorded by our rangers the turtles failed 28% of the time with the average number of nesting attempts being 1.4 attempts per turtle. This may be due to the naturally shallower nests that hawksbills dig, resulting in greater nesting successes than the green turtles as when they dig, the hawksbills do not dig so to such a depth where there are thick and impenetrable roots. Roots this season were responsible for 50% of the total nest failures for both green and hawksbill turtles, followed by hard sand where the turtles could no longer dig into. **More and more climate change and loss of nesting habitat is exposing itself to be the greatest threat to the long-term threat to the survival of nesting marine turtles in the Conflict Islands Atoll.**

Of the 200 successfully laid nests throughout the atoll 143 were relocated to the safety and protection of the hatcheries back at Panasesa Island. There were 15,180 eggs relocated in those nests, of which 3,934 were hawksbill eggs, and the remaining were green eggs. As well as seeing a shift in the terrain of the islands we also saw a shift in the preferential nesting and site selections by the nesting females from lasts seasons data. This season Auroroa was the preferred island, which also remained relatively stable in its sand and water shifts seeing not much change from last year. Irai was by far the busiest island last year, but this year only ranked the 6th most popular with only green nesting events recorded and a low number of them. However, this also coincided with a huge difference and loss of sand on the island leaving very little areas suitable for nesting available to the turtles as observed by the rangers. Our peak months remain December and January, however this season our monitoring only commenced in November and ceased in February. By the end of February, it was already clear the nesting was over as we only had 5 turtles' nest across the atoll the whole month.

When we look at the size of each clutch being laid, we can see green turtles they average close to 99 eggs per clutch laid with the highest number of eggs being recorded at 157 eggs and the lowest at just 11. For the hawksbill turtles their average is at 153 eggs and 215 for the highest number of eggs and a very high low of 94 eggs the lowest number of eggs laid by a hawksbill turtle this season. We also found that for both green and hawksbill turtles there is a strong positive correlation between their curved carapace length (CCL) and the number of eggs laid per clutch. This indicated the large females have a higher reproductive fecundity potential as compared to these "younger" and smaller turtles.

From our translocated clutches in our hatchery, there were 116 green turtles clutched collected and translocated with a total of 10,749 eggs that produced 9,098 hatchlings. That puts the hatchery success to 85% for live emerging turtles that have been released into the wild populations. There were 5 clutches that had less then 30 eggs laid in them and are counted as incomplete, and there were an additional 3 clutches that had emergence success rates 24% or less. All 3 of theses nests showed signs of fungal infection with black spores coating most of the eggs which did not develop to full term or at all. In addition to the presence of fungus was evidence of crab predation taking place inside 2 of the 3 nests, although the presence of the black fungus is not exclusive to nests that have signs of predation if it often the case that where there is evidence of predation the fungus is also present. This is the same for the hawksbill eggs. The hawksbill clutches had a slightly higher success rate at 89%. We had a total of 4,088 eggs translocated which resulted in 3,600 hatchlings that have been released into the wild from 27 clutches. This numbers remains about average each season with the number of nesting females and nests laid steady without seasonal fluctuations in the nesting numbers. This is different from the green turtles we see nesting whose numbers are highly seasonal.

Looking at the egg morphologies this year for green turtle we do not see any significant correlations between the egg mass and females CCL, the eggs diameter and the females CCL nor do we see a correlation for the egg mass and the resulting mass of the hatchlings. However, when we look at the data from the hawksbill egg morphology, we do see a strong positive correlation between all 3 of these variables. The larger and heavier eggs are all from the nesting females that have a larger CCL, these larger eggs also result in heavier hatchlings at the time of emergence. This difference in the green and hawksbill egg and hatchling morphologies are an interesting point of difference this season.

As the islands are more and more effected by erosion, sea level rise and sever weather event the impacts on the nesting beaches is very evident. There are significantly less sand and suitable nesting sites available. This season we left at total of 60 in-situ nests around the atoll. These were comprised of 48 green turtle nests and 12 hawksbill nests. Of these "natural" or in-situ nests 75% of these were lost, and the most heavily effected were the hawksbill nests where we lost 92% of them. 41% of all the nests were lost to either erosion or the inundation of the nests by the sea, 40% of them had been predated despite our best efforts to protect the nests using a wire mesh protector over the top to the nests. The remaining were either unable to locate again due to sand movements or inaccurate GPS locations and the remaining 13%, which represents 6 of the natural nests were dug up and poached from the islands by humans. These were our only poaching events recorded this season.

Of the natural nests 20 of the green clutches hatched and only one of the hawksbills clutched survived naturally this season. The emergence success rates of these surviving clutches were not as low as they have been in previous seasons at an average of 77% emergence success and 79% Hatchling success, showing that if the nests do survive the incubation period to the hatching stage their natural success rates were good. However, if we account for all 48 and 12 nests laid by both species the success rates drop dramatically to only 25% hatchling success and 24% emergence success, which is an incredibly low rate. Theses natural nests only produces a total of 1,369 hatchlings, 106 of them being hawksbills from the one clutch.

Every season our rangers collect tonnes of marine debris from the nesting beaches and islands of the atoll and this season was no different collecting over 1.2 tonnes of waste from the beaches. By far the most common item found was bottle tops, then thongs and plastic bottles. Working with Tangaroa Blue foundation this data gets entered into a database to help make informed decisions and recommendations to the Australian Government for legislative and law making.

RECOMMENDATIONS FOR THE 2023 – 2024 SEASON

It is still along term goal to move to a paperless data recording system to reduce our carbon footprint of the program and are looking into different options to be able to do so. We also need to find a sustainable financing model for the program, as it currently stands, we are each year grappling for funding to run the turtle work we do. Having this uncertainty each year adds additional stress, pressure and uncertainty for the important program's future.

Having reduced the treat of poaching we now need to focus on reliance building and beach stabilization and protecting the islands from the effects of sea level rise. This is now these nesting turtles and this rookery's largest threat and without significant help in this area the islands may only be a sustainable nesting ground for the next 20 years at this rate of erosion and loss.

In our hatcheries we need to take more care around the removal from crab predation on the relocated nests. This season it lead to some losses in success for the clutches that were effected by the crab predation.

ACKNOWLEDGEMENTS

On behalf of the management Hayley Versace and Edward Cardwell, we would like to express our sincere gratitude, to you the communities of the Deboyne and Engineer Groups for your co-operation and fulfilment of the restrictions of island stays during the 2022 – 2023 Turtle Nesting Season at the Conflict Islands and no-take of turtles as we work together now and into the future to protect your turtle populations for generations to come. We would also like to express our sincere gratitude to the Tewatewa community, rangers and leaders for your support through the implementation of your pilot project. Our combined efforts will hopefully mean numbers will start to increase on these islands in the future. Again, we thank you, our neighbors very much for your co-operation and for sharing your community with us to help monitor the Conflict islands this season.

We would also like to express a sincere gratitude to the hard work of our Conversation Rangers who work tirelessly, almost seven days a week for five months of the year to protect the turtles, collect this valuable data and promote a positive conservation message to their communities. Thank you, Steven Amos, Patrick Lemeki, Toby Losane, Henry John, and out trainee rangers, Banian Leonard, Clinton Luke, Badi Seko, Jonathan Weinam, Michael Moten, Rodney Taliya and Norman Poate. To the Tewatewa trainees Mary Jeremiah, Benson Leonard, Rose Gaion and Ranson Romulas, you have all done an amazing job and your community proud for the hard work and efforts you have tirelessly have put in over this learning and nesting season. Well done and welcome to the CICI family!

We would like to acknowledge the rest of the staff from the Coral Islands Limited, who work to support the Conservation Rangers and help the islands running so we can achieve the conservation work. Thank you for stepping in driving dinghies, doing the maintenance and caretaking of the island's infrastructure. Thank you to Maureen Lako, who keeps the Rangers fed and the accommodation clean. Thank you to our PhD candidate Melissa Staines for your contribution to the project report and data analysis.

We would also like to acknowledge and thank all those who privately contributed to the program with financial and in-kind donations. This season would not have been possible without your help. Rob Holden – Rob Rich – Chris and Trina Barter – Milan Will -

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PROJECT IMAGES----

a clutch of hawksbills being released.jpg

Awareness for a passing sailu about rules.jpg

Beach washed away.jpg

collected hatchlings for counting and measuings.jpg

Collecting data on a nesting turtle.jpg

Collecting eggs for relocation.jpg

Collecting morphological data on nesting female.jpg

Collecting morphological data.jpg

Deformed hatchling born with 2 heads.jpg

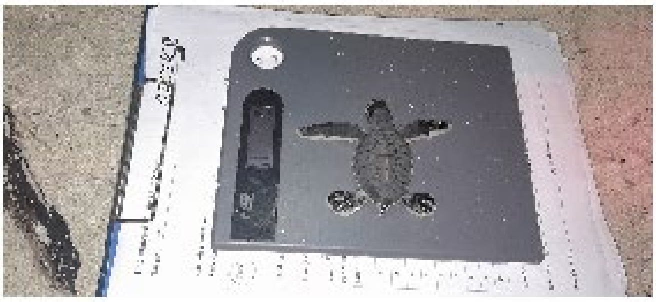
Developmental stages of unhatched eggs.jpg

Eggs being checked for development stages.jpg

Emerging hawksbill hatchlings from a nest.jpg

Erosion.jpg

Escavating nests in hatchery and doing data collection.jpg



Green hatchling being weighed.jpg

Green hatchling in hatchery ready to be measured.jpg

Green nesting framle returning to the sea after laying her clutch.jpg

Green Turtle Facila ID photo.jpg

Green turtle hatchling.jpg

Happy Team of Rangers.heic

Hatchery with only a few nests remaining.jpg

Hatchey alomst filled up.jpg

Hatchlings getting transported for release.jpg

Hawksbill hatchlings bring released.jpg

Hawksbill hatchlings from the hatchery being released.heic

Loss of habitat and sea level rise.jpg

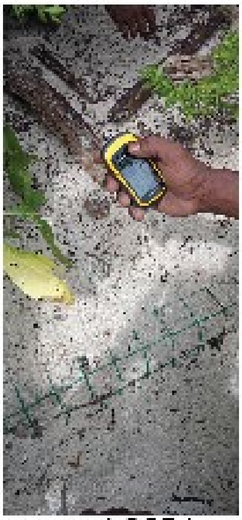
Loss of sand bank and erosion.jpg

Loss of trees and sand.jpg

marine debris and bottles being collected.jpg

Measuring hatchling.jpg

Measuring the weight of a hatchling.jpg



Natural nest protector and GSP location recording.jpg

Nesting female in the bushes instead on a beach.jpg

Nesting green turtle in her campflauge phase.jpg

Nesting Green turtle with ranger.jpg

Nesting green tutle.jpg

nesting obstical caused by erosion.jpg

Obstical caused by erosion.jpg

Ocean washing into the intereior of an island.jpg

Plastic auditing by the Rangers.jpg

Plastic audting by the rangers.jpg

Ranger Bani collecting morpholcgical data on hatchlings.jpg

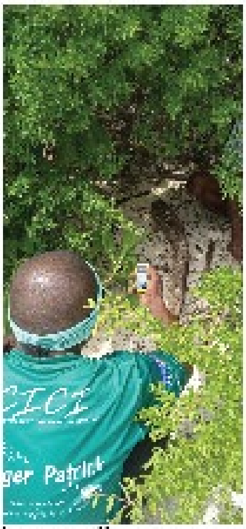
Ranger Clinton collecting data in hatchery.jpg

Ranger Clinton on the radio.jpg

Ranger Jonathan covering a relocated nest.heic

Ranger Michael on the look out for poachers.jpg

Ranger Michael removing marine debris.jpg



Ranger Patrick recording a natural nest site.jpg

Ranger Toby and his plastic rubish.jpg

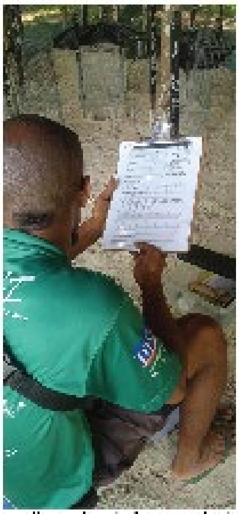
Ranger Toby Collecting data in hatchery.jpg

Rangers Bani and Michael Collecting data in hatchery.jpg

Rangers collecting data.jpg

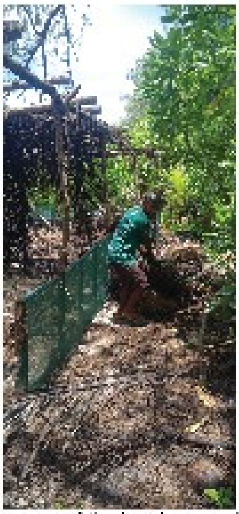
Rangers loading marine debris.jpg

Rangers Toby and Badi with fishing gear marine debris.jpg



Recording hatchery data.jpg

Releasing Green tutlr hatchlings.jpg



Removal of the shade on top of the hatchery at the end of the season.

.magers collecting morphological data on hatchlings.heic

Sand clif created by sea level rise with plastic rope burried in it.jpg

Sea bird nesting on the islands.jpg

Tree root ball washed out from island.jpg

Trees enuglfed by the ocean.jpg

Tubs of hatchlings getting transported to the islands for release.jpg

Wall of roots that turtles struggle to climb up.jpg

Sponsors and Donors

Rob Holden – Rob Rich – Chris and Trina Barter – Milan Will – Sandrina Postorino & Chris Ellis