


# Team Turtle CQ: FBA's Community Marine Turtle Monitoring Program

## 2022/2023 Summary Report
## August 2023



The following report was produced by Karl French in conjunction with FBA.

FBA works for our central Queensland community to grow a sustainable, productive and profitable Fitzroy region.

FBA acknowledges the First Nations of the lands and waters within the Fitzroy region where we learn and live, and pay our respects to them, their culture and Elders past, present and emerging.

The success of Team Turtle CQ (TTCQ) is due to the many hours of volunteer effort contributed by community members of the Capricorn and Curtis Coast areas – this report is dedicated to you.

Marine turtle specialist Karl French supplied the summarised data and analysis to inform this report.

TTCQ is coordinated by FBA. Staff have a key role in training and supporting volunteers and have contributed to this report by reviewing data and providing recommendations.

**Version Control**

| Version | Date | Author | Changes |
|---|---|---|---|
| 1 | August 2023 | FBA | Document creation |

**Disclosure Statement**

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# Introduction

All marine turtle species found in Australian waters are threatened with extinction, being listed as either Vulnerable or Endangered under both Queensland and Australian legislation.

Central Queensland is home to six of the world's seven marine turtle species – the Flatback turtle (*Natator depressus)*, Green turtle (*Chelonia mydas*), Loggerhead turtle (*Caretta caretta*), Olive Ridley turtle (*Lepidochelys olivacea*), Hawksbill turtle (*Eretmochelys imbricata*) and the Leatherback turtle (*Dermochelys coriacea*). Three of these species – Flatback turtle, Green turtle and Loggerhead turtle – nest on our region's beaches.

Monitoring of marine turtle activity has occurred along the Queensland coast for decades. In 2014, a gap analysis carried out by FBA identified that the Fitzroy region provided a significant opportunity to add valuable information to this dataset in the form of a community marine turtle monitoring program.

In 2015, an initial three-year program was established to train a network of community volunteers in turtle monitoring, under the Australian Government's Nest to Ocean Turtle Protection Program. Data collected by volunteers was submitted to the Department of Environment and Science (DES), who manage the Queensland Turtle Conservation Program (QTCP) database, which informs and influences coastal management and threat mitigation for marine turtle species. Volunteers were trained in turtle monitoring techniques by qualified experts, with some attending training with QTCP at Mon Repos during the summer nesting season.

In 2018/19, the program trialled the use of an Atlas of Living Australia (ALA) mobile phone app, BioCollect, to record data electronically. Used every season since, this data is collected by volunteers, then quality-checked before being sent to the QTCP.

By 2019/20 this citizen science program, now known as Team Turtle CQ (TTCQ), had grown into a vibrant project group with strong membership and community interest consisting of two cohesive and cooperative groups separated by location - Capricorn Coast and Curtis Coast.

TTCQ currently undertakes three main types of activities:

1. Volunteer training and community engagement
2. Turtle monitoring (citizen science beach monitoring and QTCP census)
3. QTCP authorised activities (nest protection, nest relocation, emergence success and tagging turtles).

This report summarises the results of the 2022-23 TTCQ program. Funding for this season's activities was provided by the Australian Government's Reef Trust through FBA's *Protecting and enhancing high value coastal ecosystems across central Queensland* project. In addition, Gladstone Ports Corporation (GPC) funded Facing Island census activities.

# Volunteer Training and Community Engagement

## Team Turtle CQ

Pre-season TTCQ nesting training workshops were delivered in October 2022 on the Capricorn Coast, Wop-pa (Great Keppel Island) and Curtis Coast to train new volunteers and upskill existing volunteers. Training combined marine turtle biology and ecology education with on-beach practical monitoring skills.

Volunteers learned to identify tracks of locally nesting species and differentiate false crawls and no lays from successful nesting. Training in the effective use of the BioCollect survey was also covered to ensure that the volunteers' data helped build a picture of marine turtle activity on our coastline.


***Figure 1**: Capricorn Coast nesting training October 2022*


***Figure 2**: Curtis Coast nesting training October 2022*

Emergence training was held in December 2022 on the Capricorn and Curtis Coasts, and focussed on emergence monitoring tips and how to align hatching data with original nest surveys. Potential nest impacts, including predation, tidal inundation and light disorientation were explored, with recording guidelines given. Volunteers discussed concerns and issues as a group, strengthening team cohesion and cooperation.

Post-season wrap up events in March 2023 were an opportunity to thank TTCQ volunteers for their five-month monitoring efforts and to share initial collated season data. Volunteers provided important local knowledge, observations and monitoring experience insights, in addition to valuable feedback on the program to inform future project adaptions. Sharing experiences and supporting each other unified and strengthened team dynamics.

## Queensland Turtle Conservation Project (QTCP)

Mon Repos Placement - DES undertakes a program of research and monitoring at Mon Repos Conservation Park each nesting season. This program, led by Associate Professor Col Limpus AO PSM, upskills volunteers in research, monitoring, conservation and interpretation activities related to marine turtle biology and sand dune ecology. FBA encourages and supports TTCQ volunteer applications for these placements, with seven participating in 2022-23 at Mon Repos.

QTCP Port Curtis Threatened Species - Green turtle studies. In October 2022, TTCQ volunteers with QTCP experience were invited to participate in assisting to catch green turtles, to practice tagging and measuring, and to observe toxicology sampling and laparoscopies. These volunteers gained valuable local green turtle foraging knowledge and turtle handling experience. Involving volunteers in this research builds regional capability.

## Field Trips

Field trips provide TTCQ volunteers with invaluable hands-on experience in monitoring and data collection. Trips were led by FBA's contracted marine turtle specialist Karl French, supported by QTCP-experienced volunteers.

### Facing Island (Settlement Bay) Nesting Census

This two-week census was timed to coincide with the peak nesting period for Flatback turtles of the east coast population and aligned with the standard nesting census protocols employed by the QTCP. The project involved two weeks of nest success monitoring; recording of all nesting attempts, tagging, and measuring of observed adult turtles, clutch counts, egg measurements, and nest relocations if required. Clutches were mapped to facilitate re-location and identification upon emergence.

Emergence monitoring was timed to align with the projected emergence of the nests, which were marked during the initial two-week nesting census based on a 50-day incubation period (Mean incubation period of 53 days, Limpus, 2007). Nests were excavated and emergence success calculated by counting hatched and unhatched eggs. Unhatched eggs were further assessed to investigate cause of egg mortality.

Adjunct activities during census included training and upskilling of TTCQ volunteers, monitoring of adjoining beaches for turtle activity, recording of predators and predation on nests/hatchlings, investigating light impacts, carrying out marine debris clean ups and entering clean up data to the Australian Marine Debris Initiative.

Facing Island Nesting Census – Settlement Bay (6 November, 19 November - 4 December 2022)

- Engaged five TTCQ Volunteers led by marine turtle specialist Karl French and supported by FBA project coordinator Lisa Del Riccio.
- Performed nightly nesting success monitoring of all observed nest attempts, tagged and measured observed adult turtles, clutch counts, egg relocations and egg measurements according to standard QTCP protocols. A sample of clutches were mapped to allow for re-location after incubation.
- Surveyed beach for two to three hours each side of nightly high tide and again at dawn to ensure no turtles/tracks were missed.
- Recorded predator signs and predation attempts.
- Checked island beaches for nesting activity and predator presence.
- Collected and removed marine debris from beaches.

### Facing Island Emergence Monitoring

Follow up emergence monitoring was conducted as part of this census for two weeks in January (timed to occur when nest census clutches were due to emerge).

Facing Island Emergence monitoring (9 - 22 January and 3 - 5 March 2023)

- Engaged eight TTCQ volunteers and one marine turtle specialist.
- Relocated egg chambers, exhumed emerged clutches, performed emergence success counts and stage of development assessments of unhatched embryos. This was carried out for emerged nests mapped during the census period at Settlement Bay, plus opportunistic counts for other emerged nests at East Point and East Point Beach.
- Hatchling fans were measured to investigate potential disorientation due to light impacts.

Refer to the Facing Island Nesting Census section of this report for further details.

## Community Interaction

FBA's TTCQ program aims to increase general community education and involvement in turtle conservation. Each season the program focusses on a different location to increase local community participation and stewardship, with Stockyard Point/Byfield the focus for the 2022 season. An October engagement session with the small community at Stockyard Point/Byfield was unable to go ahead due to heavy rain. Rescheduling of the event was not possible within the 2022-23 season.

### Volunteer Attendance

***Table 1 Volunteers attending TTCQ 2022-23 events***

| Location | Total |
|---|---|
| Curtis Coast Nesting Training | 17 |
| Capricorn Coast Nesting Training | 33 |
| Wop-pa Nesting Training | 11 |
| Facing Island Settlement Bay Census | 7 |
| Facing Island Emergence Monitoring | 10 |
| QTCP Mon Repo Placement | 7 |
| Curtis Coast Emergence Training | 12 |
| Capricorn Coast Emergence Training | 13 |
| Curtis Coast Feedback/Wrap Up | 19 |
| Capricorn Coast Feedback/Wrap Up | 22 |
| QTCP Port Curtis Threatened Species Operations | 6 |
| **TOTAL** | **157** |

## Team Hatchlings

**Team Hatchlings** is the volunteer youth arm of TTCQ that works to share marine turtle conservation with the community, especially young people. Team Hatchlings engage Capricorn Coast youth through interactive activities at events and by producing educational resources to promote positive behaviour change. This project has given volunteers an opportunity to contribute to other activities that do not involve beach monitoring.

With FBA's support, Team Hatchlings worked with Traditional Custodians, Darumbal Enterprises Pty Ltd and Woppaburra Traditional Use of Marine Resources Agreement (TUMRA) to create an educational video that encouraged CQ residents and visitors to help turtles by reducing their light pollution - Turtles about, so lights out! video.

For the 2022 season, Team Hatchlings was supported by FBA and TTCQ volunteers, with activities and resources funded through the Australian Government's Reef Trust and the Great Barrier Reef Foundation.


***Figure 3**: 2022 Team Hatchlings*

## Project Partners

FBA maintains and builds valuable **positive relationships with project partners**. We continue to work closely with Gladstone Regional Council (GRC) and Livingstone Shire Council (LSC), collaborating on beach signage, responsible beach 4WD behaviour, reducing light impacts on nesting and hatchling turtles, fox control work and Turtle Hour.

TTCQ's Traditional Custodian engagement continued in the 2022-23 season, with Darumbal TUMRA and Woppaburra TUMRA involved in partnership meetings. Discussions are ongoing in relation to future monitoring and training opportunities.

TTCQ liaises with Queensland Parks and Wildlife Service & Partnerships (QPWS&P) on nest predation and pest animal controls, sharing monitoring data and local observations. A partnership with Gladstone Ports Corporation supports Facing Island monitoring.

FBA continues to raise awareness of marine turtle conservation in the local community through communications, media opportunities and social media campaigns.

# Turtle Monitoring

TTCQ 2022-23 monitoring activity can be divided into two categories: citizen science beach monitoring and QTCP census on Facing Island. QTCP authorised activities (nest protection, nest relocation, emergence success and tagging turtles) are undertaken across both categories. All validated data is submitted to the QTCP database held by DES. Citizen science beach monitoring is discussed within this section, with the Facing Island census covered in its own section within this report.

TTCQ citizen science surveys are conducted by trained and registered volunteers on rosters to ensure maximum beach coverage. Beaches are walked (or accessed by vehicle or marine vessel where necessary) to survey for turtle tracks and nest attempts. Data is provided in one of three ways:

1. For low density nesting areas, data is submitted via the BioCollect App. Photos of tracks and nests are uploaded, facilitating confirmation of species, nest success and habitat on the beach. In many instances, nest attempts are then verified by a QTCP experienced team member.
2. For higher density nesting, data is submitted via the QTCP bulk nesting data sheet (or a variation thereof). This means that it is not possible to verify nesting success until either the nest emerges, it is predated or is located and counted by an authorised team member.
3. Lack of turtle activity is recorded through the 'no evidence' survey on BioCollect. This process has made it easier to identify which beaches had no nesting and to determine if this was a result of a lack of survey effort or a genuine lack of nesting activity. Feedback on this has been positive and it shows significant survey effort is being made across most accessible beaches on both Capricorn and Curtis Coasts.

A small number of nest activity reports are submitted through FBA's website by members of the public, validated through photographic evidence or via QTCP trained volunteers and uploaded to BioCollect.

## Beach Coverage and Volunteers

The number of beaches surveyed by volunteers decreased slightly this season, possibly because of a reduction of no evidence surveys entered. Coverage of most Capricorn Coast Beaches between Bangalee and Zilzie was thorough and Curtis Coast beach coverage had improved from previous seasons. Facing Island (North) coverage was excellent, with a local TTCQ volunteer providing daily monitoring for the entire season, resulting in a solid dataset.

Coverage remained poor or declined at some beaches due to access issues and low local participation, including:

1. Alligator Bay at Stanage: Stanage was not a target of the program this season as census work on Facing Island took priority. Two TTCQ volunteer families independently recorded nesting activity during a visit in the peak nesting period at the end of November.
2. Langham's Beach: Accessed via private land. The owner carries out their own survey, recently providing their data to the TTCQ program. Rain and high tides appear to have impacted nesting outcomes and the completeness of surveys.
3. Beaches of Byfield: A planned engagement with the Stockyard Point community and QPWS&P was cancelled due to weather impacts and could not be rescheduled.
4. Farnborough Beach north of Bangalee: While improved upon from past seasons, it was still incompletely surveyed. This beach is tidally restricted and requires 4WD access.
5. Beaches south of Keppel Sands: These are poorly surveyed due to difficult access, compounded by wet weather and storms/erosion.
6. Keppel Bay Islands: Apart from Wop-pa, reporting was limited. Wop-a is monitored by TTCQ volunteers based on the Island. Access to other islands is generally limited to private vessels.
7. Lilley's Beach and Wild Cattle Island: Access remains restricted by tides and 4WD access is required.
8. Facing Island (South): Fair coverage from a local TTCQ volunteer. The presence of a TTCQ census team collected robust data for the peak nesting and emergence periods.

There was a total of 1,203 'no evidence surveys' entered into BioCollect between 16 October 2022 and 17 April 2023, covering 26 beaches. These surveys predominantly came from the Capricorn and the Curtis Coast - areas with the highest density of engaged TTCQ volunteers and were a mixture of daily and weekly reports. TTCQ aims for quality data over high volunteer numbers.

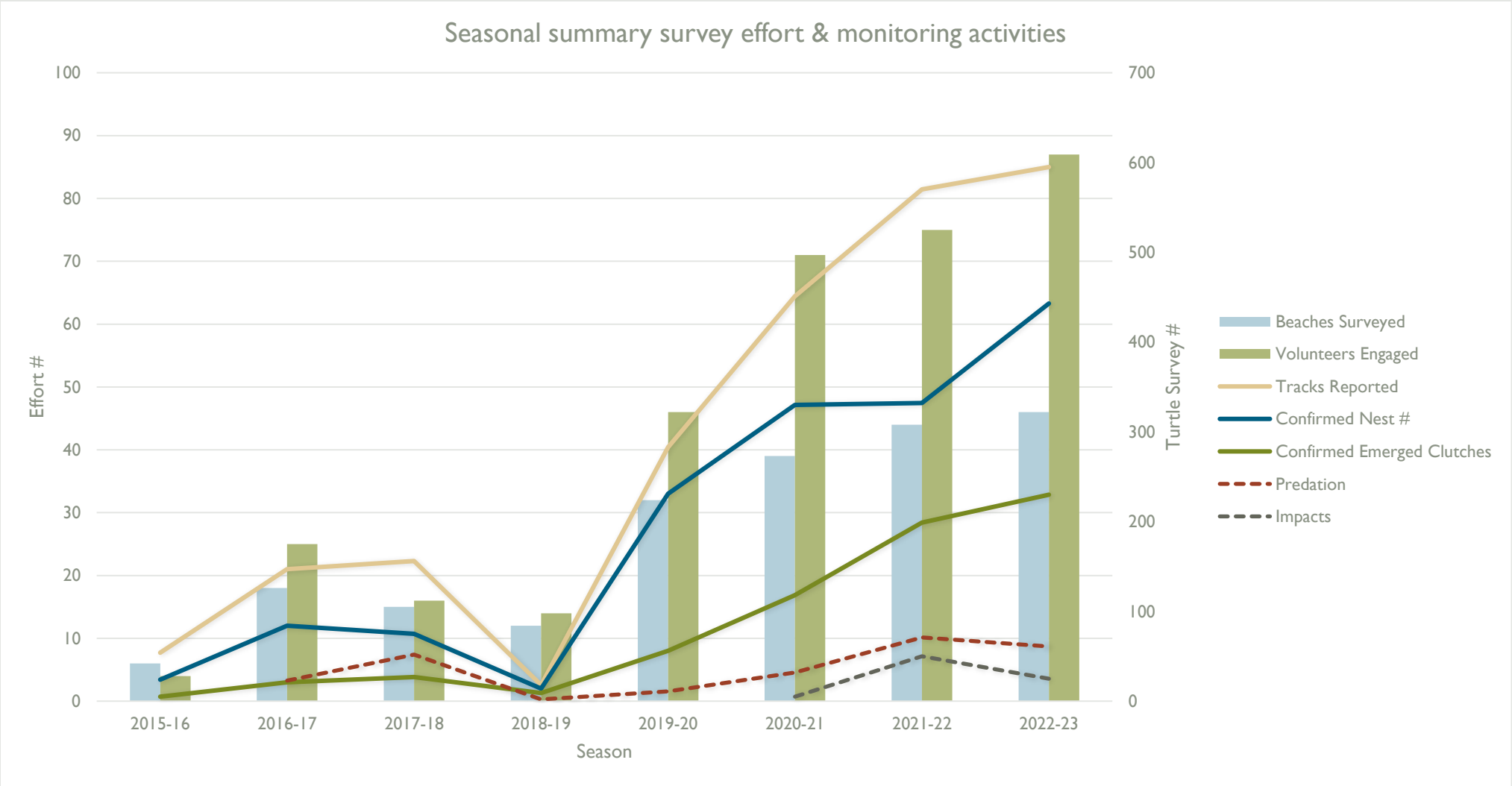


***Figure 4:*** *Seasonal summary survey Effort & Monitoring activities since inception in 2015.* (Note: 2018-19 season was unfunded)

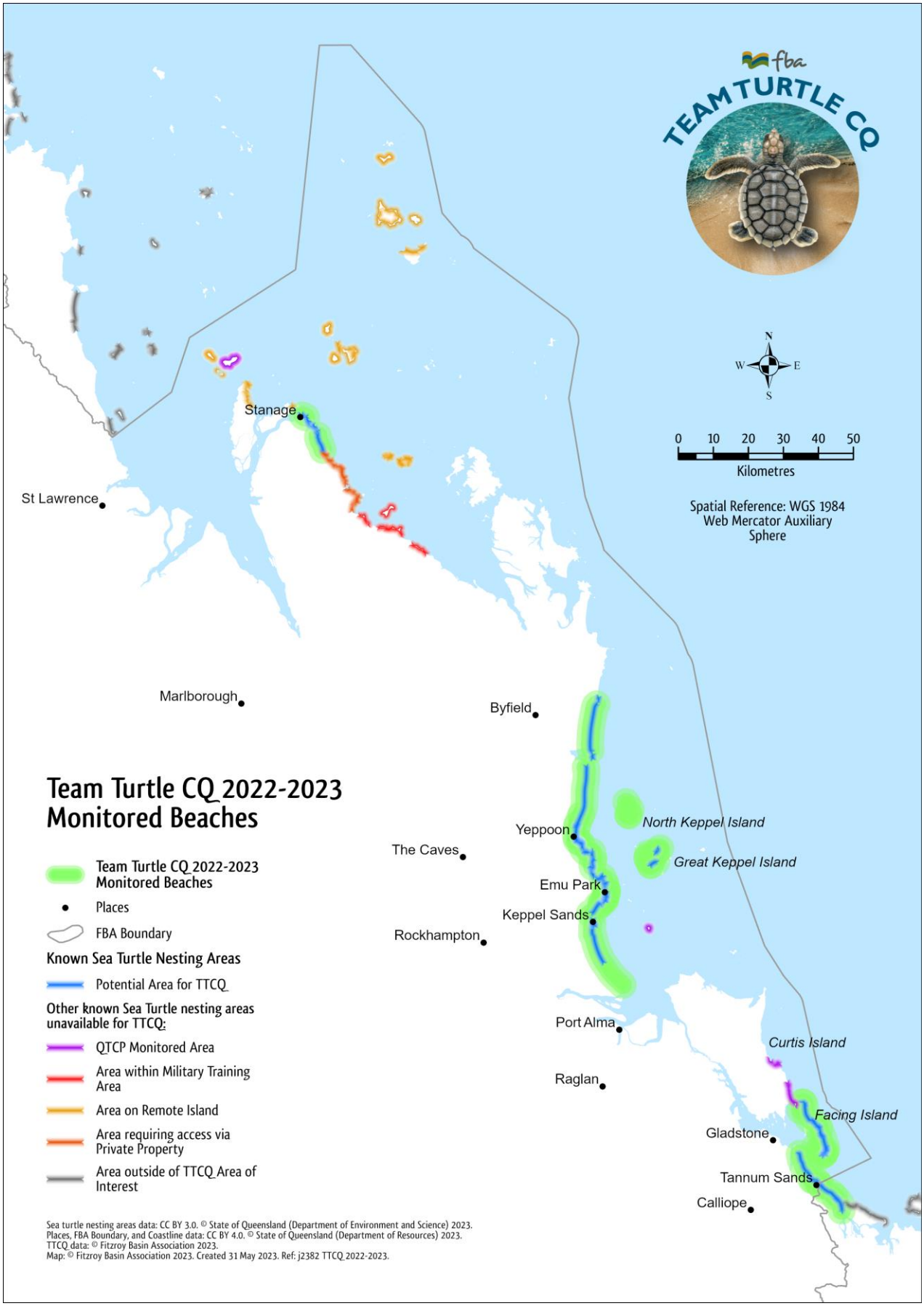


***Figure 5:*** *Distribution of turtle monitoring activities in 2022-23*

## General Observations

- There were significant heavy rainfall events across the season. Rainfall stabilises the sand and allows excavation and formation of egg chambers. It also cools the sand and minimises heat-induced mortality during incubation. Temperature loggers on Facing Island recorded significant temperature drops associated with rainfall events. Langham's Beach reported 355mm of rain for the week of 12 - 19 January 2023.
- Heavy rainfall was observed to impact two nests this season. A nest laid in a dune swale on Lilley's beach and a Settlement Bay nest in a gully were both flooded and did not emerge.
- Rainfall hampered access to some locations. We were unable to access Stockyard Point to deliver a planned community engagement activity.
- Strong winds and storm surges associated with tropical lows resulted in drifting sand, higher than average tides and significant erosion on exposed beaches such as Farnborough, Wild Cattle South and Ocean Beach on Facing Island.
- Erosion banks on Wild Cattle South prevented turtles accessing dunes to lay.
- Strong winds, heavy rain and storm activity likely impacted the ability to identify turtle tracks and nests, making it harder to locate nests for later emergence success monitoring. This was an issue on Wop-pa, Farnborough (North) and northern Ocean Beach, Facing Island.

## Emergence Success

In addition to TTCQ activities, some QTCP trained volunteers have authority to excavate emerged nests and investigate emergence success. This helped quantify successful incubation and identify heat-induced mortality (from increased sand temperature during incubation and emergence), as well as impacts of storm surge and wave run up on incubating nests. Emergence success counts are usually performed 48 hours after the nest has emerged. Where a nest had not emerged after an extended period following the due date, they were also excavated on the assumption that the nest had not incubated successfully. If the egg chamber had been compromised by a predator, the counts were not valid, and the data is discounted due to the possibility of eggs having been removed or eaten.

## Nesting Observations

Marine turtle nesting fluctuates seasonally, with variations in nesting numbers to be expected each season. All three locally nesting species were reported again this season, Flatback turtles were the predominant species, with Green turtles and Loggerhead turtles also recorded. Observed Flatback turtle nesting commenced in late October/early November and ended by mid-January. This was approximately two weeks later than last season.

A total of 595 tracks were reported across the region - 570 Flatback turtles, 21 Green turtles and 3 Loggerhead turtles for a total of 443 confirmed nests. This data is displayed in greater detail in Tables 2 and 2a-e. Where data was unable to be verified through lack of photographic evidence those records have been omitted from this report.

Of these 443 nests, 230 were recorded as emerged. Emergence success counts were performed on a total of 319 nests. On more isolated/exposed beaches emergences were not always recorded, and evidence was quickly lost. (See also Tables 2, 2a, 2b, 2c, 2d and 2e).

Hatchling survivorship after emergence is extremely difficult to quantify with the protocols TTCQ employs and is not recorded.

TTCQ volunteers were unable to cover all beaches daily so there were areas where nest numbers recorded may be an underestimate. This was true for Stanage Bay, Keppel Bay Islands, Facing Island and localities such as Farnborough Beach North, Lilley's Beach, and Wild Cattle Island.

## Summary of Nest Impacts and Predation

Data recording was adapted in the 2021-22 season to identify individual impacts such as predation or environmental impact (flooding/erosion, light and heat impacts) more accurately. This focus on gathering more in-depth data was more valuable for guiding local management decisions.

The Recovery Plan for Marine Turtles in Australia 2017 states that at least 70% of nests need to successfully emerge for a marine turtle population to remain stable (Commonwealth of Australia, 2017). Observed losses for 2022-23 ran to approximately 16% of the confirmed nests, implying that for this season at least, the population remains stable.

Attempted fox predation was noted around The Haven/Tanby Beach and Emu Park's Fishermans and Main Beaches. Three nests were predated by foxes, with a further 10 unsuccessful attempts. This is an increase on previous seasons. It was only the use of Predator Exclusion Devices (PEX) that prevented more clutches from being lost.

Other impacts included:

- Light - localised light impacts were reported for four nests on the Capricorn Coast and were documented for Facing Island (Settlement Bay).
- Tidal inundation - several nests were observed to be inundated by wave run up during incubation but still emerged successfully. More serious flooding and erosion was reported for Langham's Beach, and a nest was lost to flooding on Wild Cattle North.

- Human interference - there was evidence of human interference on one nest on Farnborough North and a 4WD drove over a nest on East Point Beach, Facing Island, with no discernible impact on emergence.

*Table 2 - TTCQ 2022-23 summary of turtle activity by locality*

| Location | Track | Flatback track | Green track | Logger head track | Total laid (X) | Total laid (?) | Total no lay | Nests (max) | Nests (min) | Emerged nests | Nest success counts | PEX installed | Nest reloc'ns | Total predation | Total impacts | No evidence surveys |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Curtis Is. | 18 | 17 | 1 | 0 | 9 | 0 | 9 | 9 | 9 | 4 | 8 | 8 | 0 | 0 | 2 | 354 |
| Facing Is. | 430 | 422 | 7 | 1 | 324 | 18 | 88 | 342 | 324 | 144 | 225 | 11 | 8 | 47 | 10 | 0 |
| Capricorn Coast | 51 | 48 | 3 | 0 | 49 | 1 | 1 | 50 | 49 | 35 | 42 | 31 | 9 | 14 | 7 | 823 |
| Keppel Islands | 36 | 25 | 9 | 2 | 23 | 8 | 5 | 31 | 23 | 19 | 17 | 0 | 0 | 0 | 1 | 24 |
| Stanage Bay | 60 | 59 | 1 | 0 | 38 | 17 | 5 | 55 | 38 | 28 | 27 | 0 | 0 | 0 | 5 | 2 |
| **TOTALS** | **595** | **570** | **21** | **3** | **443** | **44** | **108** | **487** | **443** | **230** | **319** | **50** | **17** | **61** | **25** | **1,203** |

*Table 2a - Turtle activity 2022-23 per beach surveyed – Stanage Bay*

| Beach | # of nests/species | | | | | | | | Predation | | | | | | Other impacts | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of tracks | Flatback turtle | Green turtle | Loggerhead turtle | Total successful nests | Number of nests emerged | Predator exclusion device (PEX) installed | Number of nest Relocations performed | Unsuccessful | Goanna | Fox | Dog | Unidentified | Human interference | Erosion/flooding | Heat impacts | Light impacts | Number of emergence success counts | Number of no evidence surveys (Oct-Mar) |
| Alligator Bay Bch- Stanage | 21 | 11 | | | 11 | 1 | 0 | 0 | | | | | | | | | | 0 | 2 |
| Langhams Bch - Stanage | 38 | 27 | | | 27 | 27 | 0 | 0 | | | | | | | 5 | | | 27 | 0 |
| Nine Mile Bch - Byfield | 1 | | | | 0 | | 0 | 0 | | | | | | | | | | 0 | |
| **TOTALS** | **60** | **38** | **0** | **0** | **38** | **28** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **5** | **0** | **0** | **27** | **2** |

*Table 2b - Turtle activity 2022-23 per beach surveyed – Keppel Bay Islands*

| Beach | # of nests/species | | | | | | | | Predation | | | | | | Other impacts | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of tracks | Flatback turtle | Green turtle | Loggerhead turtle | Total successful nests | Number of nests emerged | Predator exclusion device (PEX) installed | Number of nest Relocations performed | Unsuccessful | Goanna | Fox | Dog | Unidentified | Human Interference | Erosion/Flooding | Heat Impacts | Light Impacts | Number of emergence success counts | Number of no evidence surveys (Oct-Mar) |
| **Konomie** | | | | | 0 | | | | | | | | | | | | | | 24 |
| **Wop-pa - Fishermans Bch** | 6 | 5 | | | 5 | 3 | 0 | 0 | | | | | | | 1 | | | 4 | |
| **Wop-pa - Putney Bch** | 3 | 2 | | | 2 | 2 | 0 | 0 | | | | | | | | | | 2 | |
| **Wop-pa - Leekes Bch** | 13 | 3 | 2 | | 5 | 4 | 0 | 0 | | | | | | | | | | 1 | |
| **Wop-pa - Second Bch** | 0 | | | | 0 | | | | | | | | | | | | | | |
| **Wop-pa - Svendsens/Palm Bch** | 0 | | | | 0 | | | | | | | | | | | | | | |
| **Wop-pa - Butterfish Bay Bch** | 7 | 3 | 2 | | 5 | 5 | 0 | 0 | | | | | | | | | | 5 | |
| **Wop-pa - Wreck Bay Bch** | 0 | | | | 0 | | | | | | | | | | | | | | |
| **Wop-pa - Long Bch** | 3 | 2 | 1 | | 3 | 3 | 0 | 0 | | | | | | | | | | 3 | |
| **Wop-pa - Monkey Bch** | 3 | 1 | | 2 | 3 | 2 | | | | | | | | | | | | 2 | |
| **Other Keppel Group Islands** | 1 | | | | 0 | | | | | | | | | | | | | | |
| **TOTALS** | **36** | **16** | **5** | **2** | **23** | **19** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **17** | **24** |

Notes - Other Keppel Group Islands - Conical, Wop-pa (Great Keppel Island)

*Table 2c - Turtle activity 2022-23 per beach surveyed – Capricorn Coast*

| Beach | # of nests/species | | | | Total successful nests | Number of nests emerged | Predator exclusion device (PEX) installed | Number of nest Relocations performed | Predation | | | | Other impacts | | | | | Number of emergence success counts | Number of no evidence surveys (Oct-Mar) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of tracks | Flatback turtle | Green turtle | Loggerhead turtle | | | | | Unsuccessful | Goanna | Fox | Dog | Unidentified | Human Interference | Erosion/Flooding | Heat Impacts | Light Impacts | | |
| Farnborough Bch North | 13 | 12 | 1 | | 13 | 12 | 0 | 4 | | | | | 1 | | 1 | | | 10 | 20 |
| Farnborough Bch South | 0 | | | | | | | | | | | | | | | | | | 39 |
| Barwells Ck Bch Bangalee | 2 | 1 | 1 | | 2 | 2 | 0 | 0 | | | | | | 1 | | | | 1 | 74 |
| Yeppoon Main Beach | 0 | | | | 0 | | | | | | | | | | | | | | 0 |
| Fishermans Bay Wave Pt | 0 | | | | 0 | | | | | | | | | | | | | | 35 |
| Cooee Bay Beach | 0 | | | | 0 | | | | | | | | | | | | | | 49 |
| Lammermoor Beach North | 3 | 3 | | | 3 | 3 | | | | | | | | | | | 2 | 3 | 132 |
| Lammermoor Beach South | 0 | | | | 0 | | | | | | | | | | | | | | 49 |
| Kemp Beach | 0 | | | | 0 | | | | | | | | | | | | | | 103 |
| Mulambin Beach | 1 | 1 | | | 1 | 1 | 1 | | | | | | | | | | | 1 | 40 |
| Kinka Beach | 0 | | | | 0 | | | | | | | | | | | | | | 0 |
| The Haven/Tanby Beach | 12 | 11 | 1 | | 12 | | 12 | | 7 | | 1 | | | | | | | 11 | 9 |
| Fishermans Bch Emu Park | 15 | 14 | | | 14 | 13 | 14 | 3 | 3 | | 1 | | | | 1 | | 1 | 13 | 59 |
| Emu Park Main Beach | 2 | 2 | | | 2 | 2 | 2 | 2 | | | 1 | | | | | | 1 | 1 | 88 |
| Ladies Beach Emu Park | 0 | | | | 0 | | | | | | | | | | | | | | 6 |
| Shelly's Beach Emu Park | 1 | 1 | | | 1 | 1 | 1 | | | | | | | | | | | 1 | 84 |
| Steps Beach | 0 | | | | 0 | | | | | | | | | | | | | | 1 |
| Coconut Pt/Muskers Beach | 2 | 1 | | | 1 | 1 | 1 | | | | | | | | | | | 1 | 6 |
| Zilzie Beach | 0 | | | | 0 | | | | | | | | | | | | | | 29 |
| **TOTALS** | **51** | **46** | **3** | **0** | **49** | **35** | **31** | **9** | **10** | **0** | **3** | **0** | **1** | **1** | **2** | **0** | **4** | **42** | **823** |

*Table 2d - Turtle activity 2022-23 per beach surveyed – Curtis Coast*

| Beach | Number of tracks | # of nests/species | | | Total successful nests | Number of nests emerged | Predator exclusion device (PEX) installed | Number of nest Relocations performed | Predation | | | | | Other impacts | | | Number of emergence success counts | Number of no evidence surveys (Oct-Mar) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flatback turtle | Green turtle | Loggerhead turtle | | | | | Unsuccessful | Goanna | Fox | Dog | Unidentified | Human Interference | Erosion/Flooding | Heat Impacts | Light Impacts | |
| Lillies Beach Boyne Island | 1 | 1 | | | 1 | 0 | 0 | 0 | | | | | | | 1 | | | 1 | 17 |
| Canoe Point Tannum Sands | 0 | | | | 0 | | | | | | | | | | | | | | 110 |
| Tannum Sands Main Beach | 1 | | | | 0 | | | | | | | | | | | | | | 109 |
| Wild Cattle Island North | 13 | 7 | 1 | | 8 | 4 | 8 | 0 | | | | | | | 1 | | | 7 | 118 |
| Wild Cattle Island South | 3 | | | | 0 | 0 | | | | | | | | | | | | | 0 |
| Other - Quoin Island | 0 | | | | 0 | | | | | | | | | | | | | | 0 |
| **TOTALS** | **18** | **8** | **1** | **0** | **9** | **4** | **8** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **2** | **0** | **0** | **8** | **354** |

*Table 2e - Turtle activity 2022-23 per beach surveyed – Facing Island*

| Beach (QPCT sector) | Number of tracks | # of nests/species | | | Total successful nests | Number of nests emerged | Predator exclusion device (PEX) installed | Number of nest Relocations performed | Predation | | | | | Other impacts | | | | Number of emergence success counts | Number of no evidence surveys (Oct-Mar) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flatback turtle | Green turtle | Loggerhead turtle | | | | | Unsuccessful | Goanna | Fox | Dog | Unidentified | Human Interference | Erosion/Flooding | Heat Impacts | Light Impacts | | |
| **Oaks Beaches (-1)** | 0 | | | | 0 | | | | | | | | | | | | | | NR |
| **Ocean Beach (North) (1)** | 214 | 152 | 5 | 0 | 157 | 143 | 0 | 5 | | 3 | | | | | | | | 131 | NR |
| **Ocean Beach (South) (2)** | 25 | 18 | | | 18 | NR | 0 | 0 | | | | | | | 2 | | | 1 | NR |
| **East Point Beach (3)** | 22 | 19 | | | 19 | NR | 0 | 0 | | 4 | | 2 | | | 1 | | | 8 | NR |
| **Little Settlement (East) (3)** | 10 | 7 | | | 7 | NR | 0 | 0 | 1 | 2 | | | | | | | | 3 | NR |
| **Settlement Bay (W)** | 151 | 121 | | | 121 | NR | 11 | 3 | 5 | 28 | 0 | 2 | | | 6 | | Yes | 81 | NR |
| **Gatcombe Heads (5)** | 8 | 1 | | 1 | 2 | 1 | 0 | 0 | | | | | | | 1 | | | 1 | NR |
| **Observation Point** | 0 | | | | 0 | | | | | | | | | | | | | | NR |
| **TOTALS** | **430** | **318** | **5** | **1** | **324** | **144** | **11** | **8** | **6** | **37** | **0** | **4** | **0** | **0** | **10** | **0** | **0** | **225** | **0** |

*NOTES: East Point Beach - Dog and goanna predation of 2 nests, Flooding/Erosion inferred, Light impacts observed for hatchlings.*

***Table 3 Flatback turtle clutch size and emergence success***
Comparisons for Facing Island, Capricorn Coast, Wop-pa and Curtis Coast beaches - 2022-23 season

| | Facing Island | | Capricorn Coast | | Wop-pa | | Curtis Coast | |
|---|---|---|---|---|---|---|---|---|
| | Number of Eggs | Emergence success % | Number of Eggs | Emergence success % | Number of Eggs | Emergence Success % | Number of Eggs | Emergence success % |
| **Min** | 2 | 0 | 38 | 0 | 43 | 0 | 44 | 0 |
| **Max** | 77 | 100 | 68 | 100 | 65 | 100 | 72 | 94,12 |
| **Average** | 52.495 | 84.360 | 54.225 | 88.320 | 55.417 | 84.670 | 56.571 | 46.185 |
| **Nests Counted** | 204 | | 40 | | 12 | | 7 | |

***Table 4 Average clutch size and percent emergence success***
TTCQ locations (multiple seasons)

| | Facing Island | | | Capricorn Coast | | | Wop-pa | | | Curtis Coast | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of eggs | %Emerg | Count | # of eggs | %Emerg | Count | # of eggs | %Emerg | Count | # of eggs | %Emerg | Count |
| **2016/17** | 53.24 | 72.44 | 18 | | | | | | | | | |
| **2017/18** | 53 | 86.2 | 10 | 49.75 | 77.28 | 12 | | | | | | |
| **2019/20** | 53.83 | 81.36 | 6 | 49.84 | 78.6 | 25 | | | | | | |
| **2020/21** | 53.28 | 89.89 | 53 | 50.6 | 82.65 | 30 | | | | 54 | 94.14 | 6 |
| **2021/22** | 50.14 | 78.67 | 94 | 50.33 | 80.73 | 27 | 59.92 | 83.48 | 13 | 50.58 | 92.08 | 12 |
| **2022/23** | 52.50 | 83.55 | 221 | 54.20 | 88.32 | 40 | 55.4 | 84.68 | 12 | 56.6 | 46.18 | 57 |
| **Count** | 6 | 6 | 6 | 5 | 5 | 5 | 2 | 2 | 2 | 3 | 3 | 3 |
| **Max** | 53.83 | 89.89 | 221 | 54.2 | 88.32 | 40 | 59.92 | 84.68 | 13 | 56.6 | 94.14 | 57 |
| **Min** | 50.14 | 72.44 | 6 | 49.75 | 77.28 | 12 | 55.4 | 83.48 | 12 | 50.58 | 46.18 | 6 |
| **Avg** | 52.67 | 82.02 | 67.00 | 50.94 | 81.52 | 26.80 | 57.66 | 84.08 | 12.50 | 53.73 | 77.47 | 25.00 |
| **Std Dev** | 1.310 | 6.0858 | 82.47 | 1.8535 | 4.3199 | 10.0846 | 3.1961 | 0.8485 | 0.707 | 3.019 | 27.11 | 27.8747 |

*Note: - 2016/17 Curtis Coast data included Facing Island, 2020-21 Capricorn Coast data included Wop-pa*

In comparison to long term QTCP census locations at Peak Island and Curtis Island, clutch size (number of eggs) and percent emergence success for the 2022-23 season are comparable. During the 2020-21 census period Curtis Island reported clutch sizes of 51.7 eggs (avg) and 80.0% emergence, whilst 49.3 eggs and 74.5% emergence were reported for Peak Island (Limpus et al., 2021).

### Tagged Turtles

Tagging of marine turtles is a major component of developing population estimates using a mark-recapture methodology. With several long-term QTCP monitoring beaches within the TTCQ footprint, it is likely that over time some tagged animals may be encountered, especially as volunteers gain more experience and participate in additional research activities.

Previously tagged animals were recorded on Facing Island Ocean Beach (North) and during the census period at Settlement Bay, Facing Island. Volunteers with appropriate authority tagged one new individual on the Capricorn Coast and 24 new animals on Facing Island. Facing Island tagging is included in the relevant census data section (Refer to Tables 6 and 7).

## Nest Protection

Turtle eggs are vulnerable to predation by a range of native and introduced predators, including goannas, dingoes, wild dogs, pigs and foxes. Two main methods of reducing nest predation are by installing Predator Exclusion Devices (PEX) and conducting predator control (usually limited to feral animals). Turtle nests are also vulnerable to tidal inundation and beach erosion. Nest relocation to higher ground protects nests from this threat.

TTCQ volunteer observations play an important role in identifying predation as it occurs and sharing this information with the relevant stakeholder. With experience, volunteers can act upon predator sightings and activity and adapt nest protection strategies as required.

### Predator Exclusion Devices (PEX)

Nest protection methods adhere to protocols established by the QTCP and are selected based on predator type, ease of monitoring the protected nest and the level of public usage of the target beach.

Predator exclusion devices include:

- 50mm plastic garden trellis mesh (approx. 1m2) with every second bar removed over the egg chamber to facilitate emergence of the larger flatback turtle hatchlings
- Heavy duty plastic industrial barrier mesh (approx. 1m2) with mesh spacing of approximately 75mm
- Aluminium security screen mesh with spacings of approximately 85mm (1m2) with fold down edges of 200mm.

Installation: the 1m$^2$ mesh is centred over the egg chamber with edges turned down to prevent tunnelling from the sides. The mesh is pegged down and buried to avoid detection. Due to concerns around hatchlings becoming entrapped in the mesh, nest protection can only be utilised on beaches which are surveyed daily by trained and authorised TTCQ volunteers.

***Figure 6**: Nest protection on a Capricorn Coast beach*

A total of 50 predator exclusion devices were deployed over the 2022-23 season:

- 11 on Facing Island (Settlement Bay) in response to goanna predation (while the team was in attendance)
- eight on Curtis Coast Beaches (Wild Cattle Island)
- 31 on Capricorn Coast beaches in response to past fox predation, centred on the Haven/Tanby Point and Emu Park Beaches.

No PEX were compromised this season on Wild Cattle Island, possibly indicating that the animal(s) responsible had either been controlled or moved on (likely dog or fox). As discussed and trialled last season, wildlife monitoring cameras were employed on nests on Wild Cattle Island. Foxes were observed regularly on the cameras, however predation was significantly reduced this season. As fox predation of turtle nests is a learned behaviour this supports the theory that the animals predating the nests last season have either been controlled or moved on.

This season saw the first damage to the plastic mesh from foxes on the Capricorn Coast and aluminium mesh was used to counter this. Use of the aluminium mesh does raise concerns over public safety and theft, so the mesh is buried approximately 200mm below the surface.

## Fox control - den detection and trapping

Foxes are recognised as significant local predators of turtle nests, with some exhibiting learned behaviour to locate and predate multiple nests within a home range. Partnerships continue with LSC, GRC and QPWS&P across multiple tenures to suppress fox populations to reduce pressure along known turtle rookery sites and shorebird habitat.

Both LSC and GRC continued with fox den detection and fumigation activities prior to the 2022-23 turtle season. Additionally, both councils proactively targeted foxes that were active on turtle nesting beaches across the nesting season. This included successful trapping and thermal ground shooting of foxes on Curtis Coast beaches and Discovery Coast beaches by the GRC Environment and Conservation team.

Fox den detection was carried out within parks and reserves from Corio Bay to Zilzie in the LSC area (five days) and at Boyne Island, Tannum Sands and Agnes Water within the GRC area (seven days) in July 2022. Fox den detection dogs located active dens which were then fumigated by a qualified contractor. This is a cost-effective method of fox control that avoids the need for poison baiting in public areas (e.g. along beaches) and is highly target specific.

LSC extended their search area range to 2,843 hectares, finding a total of 14 active dens. GRC revisited one den from the previous season and located four additional but inactive dens at Tannum Sands. In Agnes Water, six new but inactive dens were located in July, with three revisited and fumigated in September following observation of kits on camera trap images. Opportunistic cage trapping around Tannum Sands between February and June 2023 removed a further two adult foxes. A GRC 'Spot a Fox' campaign, encouraging the public to report fox sightings and dens, together with monitoring cameras on Agnes Water beaches, provided valuable information on fox movement aiding management strategy.

## Nest Relocations

In response to the threat of inundation or erosion, several nests were relocated to higher points on the beach by authorised TTCQ volunteers. Additionally, several nests were relocated on Farnborough Beach due to the heavy 4WD traffic on this beach.

A total of 17 nests were relocated - nine on the Capricorn Coast and eight on Facing Island. Average emergence success for these nests was 81.4%, which falls within the observed range for natural nest emergence (See table 4).

*Table 5 Summary of Survey Effort and Monitoring Activities since 2015*

| Season | Location | Beaches Surveyed | Vols engaged | Tracks Reported | Confirmed Nest | Emerged Clutches | Predation | | | | | Impacts | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Unsucessful | Goat | Fox | Dog | Unidentified | Human | Flood | Heat | Light | |
| **2015-16** | Capricorn Coast | 3 | 4 | 10 | 5 | 2 | | | 1 | | | | | | | |
| | Curtis Coast inc. Facing | 2 | CVA+3 | 5 | 3 | 1 | | | 1 | | | | | | | |
| | | 1 | | 39 | 16 | 2 | | 15 | | | | | | | | |
| | **TOTAL** | 6 | 4 | 54 | 24 | 5 | 0 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2016-17** | Capricorn Coast inc. Byfield | 7 | 16 | 23 | 15 | 11 | | | 4 | | | | | | | |
| | | 1 | 1 | 4 | NR | NR | | | | | | | | | | |
| | Curtis Coast inc. Facing | 3 | 1 | 10 | 3 | NR | | | 6 | | | | | | | |
| | | 1 | 2 | 10 | 3 | NR | | | 6 | | | | | | | |
| | Facing Island | 4 | 2 | 97 | 62 | 20 | | 18 | 6 | | | | | | | |
| | Keppel Bay Islands | 2 | 3 | 3 | 1 | NR | | | | | | | | | | |
| | **TOTAL** | 18 | 25 | 147 | 84 | 31 | 0 | 18 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2017-18** | Capricorn Coast | 6 | 9 | 30 | 12 | 11 | | | 3 | | | | | | | |
| | Curtis Coast | 3 | 1 | 6 | 1 | NR | | | | | | | | | | |
| | Facing Island | 5 | 5 | 95 | 59 | 13 | | 46 | | | | | | | | |
| | Stanage Bay/Byfield | 1 | 1 | 25 | 3 | 3 | | | 3 | | | | | | | |
| | **TOTAL** | 15 | 16 | 156 | 75 | 27 | 0 | 46 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2018-19** | Capricorn Coast | 8 | 10 | 13 | 10 | 8 | | | 1 | | | | | | | |
| | Curtis Coast | 2 | 2 | 1 | Nil | NR | | | | | | | | | | |
| | Stanage Bay/Byfield | 1 | 1 | 3+ | 3+ | 1 | | | | X | | | | | | |
| | Keppel Bay Islands | 1 | 1 | 1 | 1 | NR | | | | | | | | | | |
| | **TOTAL** | 12 | 14 | 15 | 11 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2019-20** | Capricorn Coast | 13 | 23 | 37 | 32 | 24 | | | 9 | | | | | | | |
| | Curtis Coast | 5 | 6 | 3 | 2 | NR | | | | | | | | | | |
| | Facing Island | 5 | 3 | 103 | 82 | 6 | | X | | X | | | | | | |

| Season | Location | Beaches Surveyed | Vols engaged | Tracks Reported | Confirmed Nest | Emerged Clutches | Predation | | | | | | Impacts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Unsucessful | Goat | Fox | Dog | Unidentified | Human | Flood | Heat | Light |
| | Stanage Bay/Langham | 2 | 4 + 3 FBA | 123 | 107 | 26 | | | | | | | | | |
| | Byfield | 3 | 3+QPWS&P | 6 | 3 | NR | | | | | | | | | |
| | Keppel Bay Islands | 4 | 4 | 8 | 6 | NR | | | | | | | | | |
| | **TOTAL** | 32 | 36 | 280 | 232 | 56 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2020-21** | Capricorn Coast | 11 | 27 | 48 | 38 | 21 | | | 1 | | | | 3 | | |
| | Curtis Coast | 5 | 13 | 33 | 19 | 7 | | | 3 | 3 | | | 1 | | |
| | Facing Island | 6 | 11 | 187 | 137 | 59 | | X | | 23 | | | | | |
| | Stanage Bay/Langham | 4 | 10 | 140 | 108 | 15 | | | | | | | | | |
| | Byfield | 1 | 2 | 2 | 1 | NR | | | | | | | | | |
| | Keppel Bay Islands | 12 | 8 | 41 | 27 | 16 | | 1 | | | | | 1 | | |
| | **TOTAL** | 39 | 71 | 451 | 330 | 118 | 0 | 1 | 4 | 26 | 0 | 0 | 5 | 0 | 0 |
| **2021-22** | Capricorn Coast | 19 | 34 | 47 | 36 | 28 | 3 | 1 | | 1 | 2 | 2 | 10 | | 4 |
| | Curtis Coast | 6 | 14 | 37 | 27 | 15 | 1 | | 13 | 1 | | | 7 | 1 | 2 |
| | Facing Island | 8 | 10 | 344 | 149 | 102 | 2 | 46 | | | | | 3 | | |
| | Stanage Bay/Langham | 2 | 10 | 85 | 75 | 21 | | | | 1 | | | 12 | | 4 |
| | Byfield | | 2 | | | | | | | | | | | | |
| | Keppel Bay Islands | 9 | 10 | 57 | 45 | 33 | | | | | | | 5 | | |
| | **TOTAL** | 44 | 80 | 570 | 332 | 199 | 6 | 47 | 13 | 3 | 2 | 2 | 37 | 1 | 10 |
| **2022-23** | Capricorn Coast | 19 | 40 | 51 | 49 | 35 | 10 | | 3 | | 1 | 1 | 2 | | 4 |
| | Curtis Coast | 5 | 15 | 18 | 9 | 4 | | | | | | | 2 | | |
| | Facing Island | 8 | 17 | 430 | 324 | 144 | 6 | 37 | | 4 | | | 10 | | X |
| | Stanage Bay/Langham | 2 | 5 | 59 | 38 | 28 | | | | | | | 5 | | |
| | Byfield | 1 | 1 | 1 | 0 | 0 | | | | | | | | | |
| | Keppel Bay Islands | 11 | 11 | 36 | 23 | 19 | | | | | | | 2 | | |
| | **TOTAL** | **46** | **89** | **595** | **443** | **230** | **16** | **37** | **3** | **4** | **1** | **1** | **21** | **0** | **4** |

Notes: NR = Not Recorded, X = recorded but not quantified, + = some volunteers reported more than once (if they covered several locations)

# Recommendations

The process of evaluation and continual improvement is now built into the program delivery of TTCQ and has become an ongoing, collaborative process.

The recommendations from the 2021-22 Summary Report continue to be relevant to 2022-23 and included:

- Improving data and data collection for ease of reporting, accuracy and alignment to QTCP datasets
- Building volunteer capacity and opportunities
- Targeting recruitment of volunteers for specific monitoring locations
- Strengthening partnerships for delivery, including welcoming partnerships with First Nations
- Continuing current threat reduction activities (predator related)
- Pursuing activities to mitigate against additional threats (e.g. light glow).

The associated improvements made this past season against these recommendations are reflected throughout this report. Progress on each of the recommendations has been achieved. The TTCQ project on the Capricorn Coast (as well as the Facing Island Census on the Curtis Coast), plus the Team Hatchling project have been key outcomes of this continuous improvement.

The data collected by the program is recognised by the QTCP as being a valuable complement to the State-wide datasets on turtle nesting behaviour, associated threats and emergence outcomes.

The focus for the 2023-24 season will be to continue expanding and adapting activities that meet the recommendations above, as well as ensuring the program retains its professionalism, its data quality and consistency, and relevance for key stakeholders and community. The longevity of the program is considered critical to the positive impact that can be achieved for turtles along our region's coastlines.

# Outcomes of previous recommendations

**Overhaul of BioCollect**.
The new iteration of BioCollect was an improvement on past versions and required less intervention by the project leads. There was some confusion over the incubation and emergence sections, and this will be addressed in this season's update. There were also a few issues with the platform self-populating fields.

The 'no evidence' survey was described as "easy to use" and provided a valuable means of capturing survey effort.

**Allocation of Beaches to volunteers**
As the program has grown it has become necessary to allocate volunteers to a particular "home" beach. This encourages ownership of a particular length of strand and helps build consistency in data collected. It was introduced to encourage subsequent data to be added to the original nesting report. This had been an issue in the past, with numerous records for a single nest. Volunteers become responsible for updating their own surveys for hatchling emergence. It does mean that cooperation between volunteers is required when nests and emergence are witnessed by different people.

**Improvements in training**
Data collected has steadily improved over the seasons since inception. This can be attributed to volunteers developing a commitment to the project.

There are still some issues with poor/non-existent photographic evidence, incorrect GPS locations and missing data. Whilst every effort had been made to verify these records, data that was incomplete or lacking photographic evidence was disregarded in this report and not uploaded to the QTCP database. Improvements to the dataset could occur with further training and checking data after entry to increase its accuracy.

Volunteers were introduced to each other at training events to facilitate mentoring and cooperation. Likewise, use of the group chat was encouraged to link volunteers and to ensure that emerged nests were added to the original nesting record.

**Expanded Nest Protection activities**
In response to predator reports from community, a more proactive response was coordinated using suitably trained TTCQ volunteers to install predator exclusion devices areas, including along the Capricorn Coast and on Wild Cattle Island. An increased number of PEX were installed this season with positive results.

TTCQ liaised with QPWS&P for pest management or predator control on Wild Cattle Island and Byfield/Corio Bay areas. This needs further investigation but contacts are known. QPWS&P supported trailcams on Wild Cattle Island this season and are keen for den detection works to continue the opportunity for collaboration.


***Figure 7**: fox photographed by a camera on Wild Cattle Island – 6 February 2023*

There are other sites where the management of predators could be beneficial to the successful nesting and hatching of marine turtles on our beaches, such as Shoalwater Bay, particularly the Military Training Area.

**Continued Engagement with community and stakeholders**
Both LSC and GRC engaged at stakeholder meetings and were supportive and proactive around predator programs and control, communication and engaging with TTCQ.

There were discussions at post-season wrap up events around alternative roles for people unable to monitor beaches. This may include checking of data for completeness, designing and delivering educational materials, and making presentations.

It was also noted that TTCQ should continue:

- Messaging around safe and responsible beach usage, including 4WD usage
- Light impact awareness raising and working with key stakeholders to reduce light impacts
- Working to reduce marine debris.

**Build on capacity of TTCQ**
TTCQ volunteers are offered additional training opportunities and experiences to enhance their skills and build on the capacity of the team as a whole. This includes:

- Training with QTCP at Mon Repos
- Marine Strandings Training
- Conservation activities on Facing Island or in Stanage Bay
- Mentoring by more experienced TTCQ members
- Identifying strengths of TTCQ volunteers and aligning tasks to these strengths
- Providing contacts for QTCP to interested volunteers
- Investigating options for generating greater engagement in the Curtis Coast region, particularly Facing Island, Wild Cattle Island and Lilley's Beach
- Seeking options for increased engagement in the north of the Fitzroy Region – Shoalwater Bay, Stanage Bay, Corio Bay and Byfield.

## Key Stakeholders and Opportunities for Partnerships

Opportunities to form additional partnerships may exist with:

**Gladstone Ports Corporation** – this organisation funded a full two-week census on Facing Island this season, involving two weeks of nest monitoring and two weeks of emergence monitoring. This is the first census of Facing Island marine turtle nesting to cover both nesting and emergence.

**Traditional Custodians** – Woppaburra Traditional Owner representatives were engaged with the nesting training delivered on Wop-pa. Engagement with the Port Curtis Coral Coast Aboriginal Peoples Charitable Trust has been ongoing. Darumbal and Woppaburra First Nations were involved this past year in the youth arm of the program – Team Hatchlings.

**Gladstone Regional Council** – both the Environment & Conservation and Pest Management Teams have been responsive to working with TTCQ to protect turtles on coastal beaches of the Curtis Coast. FBA and TTCQ have well established links with these teams, which may lead to opportunities to build on previous season's activities.

GRC has recently considered seasonal closure of Lilley's Beach. Currently in response to hooning activities and permit breaches, Council has installed surveillance cameras on Lilley's Beach, with increased and ongoing Police presence and patrols.

**Continued and expanded nest protection** – GRC, LSC and QPWS&P may be interested in continuing and expanding nest protection on beaches in general. Both Facing Island and Wild Cattle Island have on-going predator issues to be addressed.

- Bait shy animals may need to be specifically targeted. This has been proactively discussed by relevant councils to their credit.
- Feral Pigs may be a problem in some areas of the region as well.

**Shoalwater Bay Military Training Area** - Aerial surveys over this area in the 2020-21 season identified marine turtle nesting on beaches within the military training area, and pinpointed dog and pig activity on these nesting beaches.

## Light Pollution Management

Light pollution continues to be an issue within the region and one that impacts ocean finding behaviour of marine turtles and their hatchlings. Team Hatchlings encourage the community to reduce light pollution, and there are investigative and advocacy opportunities for TTCQ.

Capricorn Coast data reported several instances of disorientated hatchlings in response to light horizons again this season. Impacts of light pollution on other species is poorly known or understood and it would be pre-emptive to investigate options to minimise skyglow effects through reducing incident light, installing shields and shrouds, and switching lights off. Developing buffer zones of vegetation along known nesting beaches could help reduce light impacts, help reduce sand temperature and reduce heat impacts by throwing shade onto beaches.

Opportunity exists to train TTCQ volunteers to investigate turtles' ocean finding behaviour in response to light impacts. Basic ocean finding behaviour measurement protocols exist within the QTCP and could be implemented. A compass app (on mobile phone) can be used to investigate orientation of both adult and hatchling tracks in respect to the ocean. Capturing this data would help quantify and record areas of concern and add to baseline data for the region. A small-scale study was conducted on Facing Island this season using these protocols.

# Facing Island Nesting Census Findings - Settlement Bay

## Background

Facing Island was identified as a significant site for Flatback turtle nesting in the late 1960's (Limpus 1971). Two primary areas of nesting occur: at the northernmost end of the eastern Ocean Beach and on the small sandy coves on the southern end of the island, in particular the 600 metres of beach at Settlement Bay.

Settlement Bay was first surveyed for nesting between 1998 - 2003 (Clifton and Bell 2000; Clifton and Limpus 2001, 2002; Limpus and Gilmore 1998; D. Limpus et al.,1999). In 2015, in response to a lack of survey data from more recent years on Facing Island, TTCQ began small scale surveys to meet nest protection requirements of the project at that time. The increased likelihood of encountering a turtle made it an ideal and reasonably accessible location to train and upskill volunteers in QTCP methods. Trips were short in duration and generally timed within mid-season census to align data with QTCP protocols. As the program grew in 2021, TTCQ recruited two local volunteers who provided regular reports on Ocean Beach (North) and Settlement Bay. The 2021-22 season was the first organised nesting census of Settlement Bay in almost 20 years, providing a snapshot of nesting within a discrete area. As pressures on marine turtles and their habitat continued, it was timely that nesting surveys on Facing Island resume.

During the 2022/23 season, the first complete nesting and emergence monitoring census was carried out for Facing Island. Additionally, a TTCQ volunteer provided a full season of nesting and emergence success monitoring of Ocean Beach (North), and another conducted additional monitoring of Settlement Bay outside of the census period.

## Methods

A pre-season visit was conducted on 6 November to inspect the beach and beach sectors set up for monitoring. Posts were relocated and several missing posts were replaced. A Hobo data logger was installed mid-way along the beach at nest depth to record average incubation temperature. A second logger was also installed on Ocean Beach (North) within an area of known nesting.

### Monitoring

Settlement Bay was surveyed daily from the 19 November to 4 December 2022, coinciding with the peak period for nesting of flatback turtles (East Coast population). The beach was monitored for two - three hours either side of the evening high tide (or longer, depending on turtle activity). On late afternoon and early morning high tides, the team covered both tides. Nightly activities involved patrolling the beach looking for nesting turtles. Turtles encountered were allowed to nest and then checked for tags, tag scars and scanned for Passive Integrated Transponder (PIT) tags. Tags were recorded and each turtle's curved carapace length measured, using a flexible measuring tape over the midline. Measurements were performed in duplicate and re-measured if greater than 2 mm discrepancy occurred between measurements. Encountered turtles left the beach with two titanium flipper tags (in the standard axillary positions) and a PIT tag injected into the large muscle mass above the shoulder, just under the carapace. Any marked damage or anomaly of the animal was also recorded and photographed where possible.

### Nesting Activity and Eggs

Nesting activity outcomes were recorded and the nest's location marked by GPS. Nesting sector and beach habitat were also recorded. A length of flagging tape with the tag number and date was placed in the egg chamber to facilitate nest identification during emergence monitoring.

Where possible, clutch counts, egg measurements and nest relocations (only if necessary) were performed.

For egg measurements, a subset of 10 randomly selected eggs were cleansed of sand and then measured using vernier callipers to determine maximum and minimum diameter and then weighed to the nearest 0.1g with a top

pan balance. Rotation and time exposed were kept to a minimum to reduce the likelihood of movement-induced mortality of the eggs. All eggs were returned to their egg chamber within two hours of being laid. All activities performed were in line with standard QTCP protocols as outlined in Limpus et al., (2019) and were performed by trained and QTCP authorised volunteers.

### Nest Emergence

Confirmed nests were triangulated from the sector posts using a standard 30 metre fibreglass tape, to facilitate their relocation after incubation. Additional nests of known laid date from prior to the census period were also mapped to ensure sufficient nests would be available to provide statistically relevant emergence success counts. This was to account for potential predation of census nests during incubation.

From 9 - 22 January 2023, a TTCQ team carried out emergence success monitoring of nests marked during the census period. This visit was timed to coincide with the expected peak emergence of the census nests based on a 50-day incubation period.

### Excavated Nets

Emerged nests were relocated using either the nest measurements from sector posts or from direct evidence of hatchling emergence – a depression or divot in the sand where the egg chamber had collapsed in response to the hatching and emergence of hatchlings.

Nests were excavated using the latest methodology as used at Mon Repos by the QTCP. The eggs were exposed and dug around, and the entire egg mass was removed as much as possible in one single excavation to minimise tearing and damage to the eggshell fragments. Egg shells were then gently sifted from the sand through one's fingers.

### Egg Counting

Hatched eggs were counted based on empty eggshells greater than 50% of an entire egg. Live and dead hatchlings within the nest were also recorded, along with predated eggs and the cause of predation/loss.

All unhatched eggs were subsequently opened, and the stage of development recorded. Eggs with no signs of embryo formation were recorded as undeveloped and any with formed embryos were graded according to the stage of development protocols, based on Miller et al., (2017).

An additional follow up visit was conducted on 3 - 5 March to finalise nest digs of other marked nests recorded by the local TTCQ volunteer.


***Figure 8**: TTCQ Facing Island monitoring activities 2022-23*

## Facing Island Census Results

TTCQ's local volunteer records indicate nesting commenced on 28 October on Ocean Beach (North) and 2 November on Settlement Bay. Last observed nests laid for the season were 14 and 18 January respectively. Their data adds to that collected during the two-week census period. This section of the report is primarily focused on data collected during the census activities.

## Nesting Activity, Tagging and Recaptures

A total of 98 tracks were recorded during the census period. Of these, 51 tracks were recorded on Settlement Bay. All tracks were of Flatback turtles, with no Green or Loggerhead turtles recorded during the census period. A Loggerhead turtle was recorded on Gatcombe Head beaches outside of the census period and seven Green turtles were recorded for Ocean Beach North. Flatback turtle nesting crawls were reported from Ocean Beach (North) (south of Possum Point -23.79771S 151.35850E, the extent monitored by the local TTCQ volunteer from The Oaks) as well as Ocean Beach (South), East Point Beach and Little Settlement (East) Beach. Over the 14-night census period the average nesting crawls equalled 3.6 turtles per night (range 0-9).

A total of 24 turtles were tagged for the first time. A further two individuals had tag scars on the front flippers, indicating they had been previously tagged and had lost their tags. They were checked for PIT tags, none were found, and thus original tagging history could not be ascertained. A further five animals were recaptures from previous seasons at Facing Island. Two recaptures were originally tagged at other nesting colonies - one, identified by PIT only, was first tagged on Curtis Island and the other was originally tagged on Peak Island off the southern Capricorn Coast. Only one animal was recorded twice during the census period, however a further five within season returns were recorded outside of the census period.

Additionally, a further eight animals were tagged for the first time on Ocean Beach (North). Ocean Beach (North) data also returned one Facing Island recapture, QA85232, tagged in 2020 and a third change of colony, QA85766, originally tagged on Curtis Island in 2018. Tag Status and Recapture data is displayed in Tables 6 and 7.

***Table 6*** *Tag status of turtles encountered on Facing Island 2022-23 season*

| Census Count | QTCP code | Tag Status | Tag Status - Description | Count outside of census |
|---|---|---|---|---|
| 24 | P | Primary | No tag scars, tagged first time | 8 # |
| 2 | ISR RTA | Inter season return retag | Turtles with tag scars but no tags and therefore no tag history; animal retagged | |
| 2 | ISCHCOL | Inter season change of Colony | Turtle tagged nesting elsewhere and changed colony between nesting seasons | 1 # |
| 5 | ISR | Inter season return | Turtle tagged at this nesting colony in a previous nesting season | 1 # |
| 1 | WSR | Within season return | Turtle already recorded this season | 5 * |

*NOTES: All records are Flatback turtles, # Ocean Beach (North), * Settlement Bay*

***Table 7*** *Recapture turtle tag history (Beach of Original Tagging) Facing Island 2022-23*

| Tag Number | Date | Species | Location | Tag Status | Tagging History | Description - where recorded |
|---|---|---|---|---|---|---|
| K33666 | 22/11/22 | Flatback | Settlement Bay Census | ISR | FI99/01 | Facing Island 1999, 2001 |
| K33574 | 25/11/22 | Flatback | Settlement Bay Census | ISR | FI99/01/03/17 | Facing Island 1999, 2001, 2003, 2017 |
| K20224 | 28/11/22 | Flatback | Settlement Bay Census | ISR | FI00 | Facing Island 2000; assisted laying due to damage |
| QA85229 | 01/12/22 | Flatback | Settlement Bay Census | ISR | FI20 | Facing Island 2020 - Settlement Bay |
| QA85202 | 02/12/22 | Flatback | Settlement Bay Census | ISR | FI17 | Facing Island 2017 - Settlement Bay |
| QA85232 | 25/11/22 | Flatback | Ocean Beach (North) | ISR | FI20 | Facing Island 2020 - Ocean Beach North |
| QB9317 | 22/11/22 | Flatback | Settlement Bay Census | ISCHCOL | CI04 | Curtis Island 2004 |
| T83481 | 26/11/22 | Flatback | Settlement Bay Census | ISCHCOL | PI94/09/15/20 | Peak Island 1994, 2009,2015, 2020 |
| QA85329 | 17/11/22 | Flatback | Ocean Beach (North) | ISCHCOL | CI18/21 | Curtis Island 2018, 2020 |

Data in Table 7 shows both high fidelity to nesting beaches (animals returning season after season to the same nesting beach) on rare occasions some animals will move large distances to new nesting areas, the data collected reflected this, however, reasons for this are unknown at this stage. Whilst the nesting areas of South End Beach, Curtis Island and Ocean Beach are relatively close, Peak Island is located some 75km as the crow flies from Settlement Bay. The individuals that recorded nesting in 2020 are unlikely to have nested elsewhere based on the 2.2 years inter-nesting interval of Flatbacks (Limpus, 2007).

Seventeen turtles were missed during the census period. This can be attributed to turtles emerging outside of the times the team were on the beach and poor weather, including severe storms and gales, during the census period. Wild weather not only impacts the effectiveness of the monitoring team on the ground but may also affect behaviour of nesting marine turtles. Nine of those missed occurred on the one stormy night after the team had left the beach, three hours after high tide and after recording no turtle activity.

A total of 44 confirmed nests were laid during the census period. A further two nests from missed turtles were recorded as unconfirmed. As there was no emergence recorded from either of these nests, it is likely they did not lay. Nesting success for the census period was 86.3%, a 20% increase on last season (FBA, 2022).

## Size of Nesting Turtles

Average curved carapace length as measured for the encountered Flatback turtles for this season was 93.4 cm - Standard Deviation (Std Dev) 2.13, Range 88.cm1 – 98.5cm, Number = 61. This is comparable to last season's average of 93.2cm (FBA, 2022) and past averages of 93.6cm (Clifton and Limpus, 2002). See Table 8 for further details.

***Figure 9**: Laying Flatback turtle on 1 December 2022*

As has been reported for other locations (Limpus et al., 2021), turtles with previous breeding histories (remigrants) had a larger average curved carapace length (93.8cm) than primary turtles tagged for the first time (92.9cm).

***Table 8** Size of Nesting Turtles based on tagging status - curved carapace length (cm)*

| | All turtles | Primary tagging | Remigrants |
|---|---|---|---|
| Count | 61 | 32 | 11 |
| Max | 98.5 | 97.6 | 95.4 |
| Min | 88.1 | 88.1 | 91.7 |
| Avg | 93.4 | 92.9 | 93.8 |
| Std Dev | 2.13 | 2.38 | 1.22 |

***Figure 10**: TTCQ volunteers processing a nesting Flatback turtle on 26 November 2022*

***Table 9** Nightly Nesting summary for Settlement Bay census period – Flatback turtles*

| Weather (cloud, wind, rain) | Date | Nightly Track Count | Nightly Clutches Laid | Clutches Predated or Collected | Clutches emerged | Nesting turtles Dying or Dead | Tagged Turtles | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | New | Recaptures |
| | 19-Nov | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cloudy, Stormy | 20-Nov | 2 | 1 | 0 | 0 | 0 | 1 | 0 |
| Cloudy, Stormy | 21-Nov | 2 | 2 | 0 | 0 | 0 | 2 | |
| Clear | 22-Nov | 7 | 7 | 0 | 0 | 0 | 5 | 2 |
| Light Cloud wind 14km E | 23-Nov | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Cloudy Wind 6km SW | 24-Nov | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Clear Calm 4kn NNE | 25-Nov | 6 | 6 | 0 | 0 | 0 | 5 | 1 |
| Clear Calm 6kn NNW | 26-Nov | 5 | 5 | 0 | 0 | 0 | 3 | 1 |
| 7/8 Low Cloud 8kn NNE | 27-Nov | 2 | 2 | 0 | 0 | 0 | 1 | 0 |
| Stormy Rain 41mm | 28-Nov | 2 | 2 | 1 | 0 | 0 | 1 | 1 |
| 8/8 Low Cloud 10kn E | 29-Nov | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 8/8 Cloud Rain/Storms.30+kn SE gales | 30-Nov | 9 | 6 | 0 | 0 | 0 | | |
| Cloudy 8kn SSW | 1-Dec | 4 | 2 | 1 | 0 | 0 | 2 | 1 |
| 6/8 Cloud Wind inc to 15/20kn SE | 2-Dec | 8 | 5 | 1 | 0 | 0 | 4 | 2 |
| 1/2 moon clear bright windy | 3-Dec | 3 | 3 | 0 | 0 | 0 | 1 | 0 |
| Count | 15 | | | 4 | | | | |
| Sum | | 51 | 42 | 4 | 0 | 0 | 26 | 8 |
| Max | | 9 | 7 | 1 | 0 | 0 | 5 | 2 |
| Min | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Avg | | 3.4 | 2.8 | 0.26 | 0 | 0 | 1.87 | 0.61 |

## Clutch Counts and Egg Measurements

Twelve clutches of Flatback turtle eggs were counted during the census period (see Table 10). The average clutch size was 50.9 eggs with a range of 2-70 eggs. This is comparable with QTCP data obtained for index beaches in the region.

***Table 10*** *Clutch counts (at Laying) on Facing Island, compared to QTCP Index beaches in the local region (QTCP data 2020-21 Limpus et al., 2021)*

| Clutch Counts | | | |
|---|---|---|---|
| **Locale** | Facing Island | Curtis Island | Peak Island |
| **Count** | 12 | 25 | 37 |
| **Max** | 70 | 69 | 65 |
| **Min** | 2 | 30 | 31 |
| **Avg** | 50.9 | 51.7 | 49.3 |
| **Std Dev** | 16.4 | 7.4 | 8.2 |

The adult that laid just two eggs appeared to be struggling, taking a long time to chamber and to lay. Breathing was noted as being laboured and the animal bled upon insertion of the PIT tag.

The adult that laid 70 eggs only dug a 35cm deep egg chamber and some 25 eggs overflowed the chamber. The eggs were removed to prevent breakage during filling. A clutch count and egg measurements were performed before reburying the clutch in a deepened chamber. The eggs were also noted to be at the higher end of the average range for flatback turtle eggs at 54.0mm diameter and 84.3g in weight.

Nine clutches had samples of ten eggs selected at random to perform egg measurements. Average egg diameter for the 90 eggs measured was 51.74mm and average weight was 75.0grams. This is virtually indistinguishable from averages obtained for Curtis Island in the 20/21 season (Limpus et al., 2022). See Table 11 below.

***Table 11*** *Average egg measurement data for Facing Island (Diameter and Weight) including comparable data for Curtis Island 2020/21 season (n=89) (Limpus et al., 2022)*

| Average Egg Diameter (mm) | | | | | Average Egg Weight (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Clutch #** | MAX | MIN | AVG | SD | **Clutch #** | MAX | MIN | AVG | SD |
| **1** | 50.25 | 49.00 | 50.04 | 0.375 | **1** | 71.6 | 66.5 | 68.4 | 1.582 |
| **2** | 52.80 | 50.65 | 51.80 | 0.642 | **2** | 79.3 | 72.9 | 75.6 | 2.121 |
| **3** | 53.10 | 51.80 | 52.37 | 0.358 | **3** | 78.4 | 73.4 | 77.1 | 1.500 |
| **4** | 53.05 | 50.50 | 51.73 | 0.774 | **4** | 81.7 | 70.1 | 75.0 | 3.273 |
| **5** | 53.60 | 49.90 | 51.77 | 1.024 | **5** | 77.6 | 68.3 | 74.0 | 3.229 |
| **6** | 55.75 | 52.90 | 54.00 | 0.818 | **6** | 91.2 | 80.0 | 84.3 | 3.524 |
| **7** | 52.55 | 51.00 | 51.74 | 0.550 | **7** | 77.4 | 73.3 | 75.2 | 1.598 |
| **8** | 51.10 | 49.85 | 50.58 | 0.437 | **8** | 72.9 | 64.4 | 70.3 | 2.719 |
| **9** | 53.05 | 50.65 | 51.69 | 0.681 | **9** | 80.4 | 72.7 | 75.2 | 2.246 |
| **Max** | 55.75 | 52.90 | 54.00 | 1.024 | **Max** | 91.2 | 80.0 | 84.3 | 3.524 |
| **Min** | 50.25 | 49.00 | 50.04 | 0.358 | **Min** | 71.6 | 64.4 | 68.4 | 1.500 |
| **Avg** | 52.81 | 50.69 | 51.74 | 0.629 | **Avg** | 78.9478 | 71.286 | 75.01 | 2.421 |
| **Std Dev** | 1.542 | 1.142 | 1.103 | 0.223 | **Std Dev** | 5.655 | 4.601 | 4.454 | 0.793 |
| **Curtis Is.** | 54.8 | 48.3 | 51.1 | 0.13 | **Curtis Is.** | 87.0 | 63.6 | 74.7 | 4.59 |

## Predators and Predation

The loss of nests to dog predation was reduced to zero for the 2021-2022 season after significant control of the wild dog population was enacted on Facing Island. However, the rate of goanna predation started to rise. Goanna predation had been significant prior to the dogs becoming an issue. The dogs likely outcompeted and/or preyed on the goannas.

Goanna tracks were observed daily on the beach. Two nests were predated by goannas during the nesting census period. Additionally, one nest was predated by a dog and there was an unsuccessful attempt on a further nest by the same dog. This nest had a trail camera set on it but unfortunately the camera failed to trigger, possibly due to its orientation towards the sunrise. The dog was active while the team was present on the beach. It is likely the team returning along the beach disturbed it. The dog prints were large and disappeared into the bush at the back of Settlement Bay. No large local dogs were present at the Gatcombe settlement during this season.

Further predation was recorded during the emergence monitoring period. A total of 28 nests were predated by goannas, two by dogs and there were a further five unsuccessful predation attempts recorded for Settlement Bay. Additionally, two nests on East Point Beach were predated by dogs, but these nests had also been targeted by goannas. It is therefore difficult to identify whether the dog was just scavenging nests already partially predated by the goannas or vice versa.

Post emergence scavenging of nests by goannas became an issue as it impacted our ability to collect emergence data. To counter this, some nests were not left the full 48 hours after emerging and other recently emerged nests were covered with predator exclusion mesh when available.

***Figure 11**: Temporary exclusion mesh applied to a nest by volunteers on 14 January 2023*

***Figure 12**: Predated nest discovered on 10 January 2023*

## Other Impacts

One relocated nest was lost to flooding from runoff during storms and a further five nests were likely lost to erosion and inundation from tidal impacts throughout the incubation period. Erosion on Settlement Bay was not as pronounced as on Ocean Beach (North) despite heavy seas and strong onshore winds during the nesting census period. An erosion bank of approximately one metre in height formed on much of Ocean beach over the season. Wave run up onto the vegetated dune slope was observed during the emergence monitoring on Settlement Bay in January (coinciding with the king tides). However, only a small erosion bank of around 30-50cm was formed. Dune vegetation on the island has thrived in the absence of extensive macropod grazing and in response to two wetter than average seasons. Vegetation on the dunes was observed to have extended some 10-15m seawards in the past two seasons.

***Figure 13**: Erosion bank around 50cm depth on 3 March 2023*

Three adult turtles were assessed to determine whether there was any disorientation related to artificial light horizons and skyglow. This is too small of a sample size to make any informed assessment on disorientation and was collected predominantly to trial and familiarise the volunteers with the methodology.

## Emergence Success Monitoring

Predation and impacts accounted for the loss of six of the 44 confirmed census nests laid. This equates to an emergence success of 86.4% for the census period. Of the 121 nests recorded for Settlement Bay for the season, 28 were lost, resulting in a 76.9% emergence success.

Marine turtles have temperature-dependant sex determination, with the incubation temperature during the middle third of the incubation period determining the sex of the hatchlings. For Flatback turtles 29.3°C is the theoretical pivotal temperature at which equal numbers of male and female hatchlings are produced (Limpus, 2007). Additionally, it has been observed that the duration of incubation is tied to temperature. At 29.3°C Flatback turtles' average incubation period is 52 days (Limpus et al., 2022). The duration of the incubation period can be used to infer the sex ratio of the hatchlings. Allowing time for hatchlings to dig to the surface, the period to emergence for Flatback turtles at pivotal temperature is approximately 54 days. Longer incubation (and period to emergence) is indicative of cooler incubation conditions and will result in an increased ratio of male hatchlings. Warmer, shorter incubations result in higher ratios of female hatchlings (Limpus et al., 2022).

Average period to emergence for census nests was 52.8 days (N=33, Std Dev=2.26, Range=48-58), indicating a slight bias towards female production, despite a wetter season. Likewise, average period to emergence for the entire season at Settlement Bay (i.e. including nests outside of census period) was 52.6 days (n=47, Std Dev=2.75, Range=46-58). The Ocean Beach (North) period to emergence was also slightly biased towards female production at 52.4 days (n=129, Std Dev=2.4, Range=47-60).

***Figure 14**: A volunteer with turtle specialist Karl French conduct an emergence success count on 22 January 2023*

Temperature data at nest depth for both Settlement Bay and Ocean Beach North was recorded by a Hobo data-logger at 30 second intervals throughout the season. Data obtained from these is displayed graphically in Figures 15 and 16. Significant rainfall and cooler weather in both the nesting census period and during emergence monitoring can be seen to have impacted temperature at nest depth.

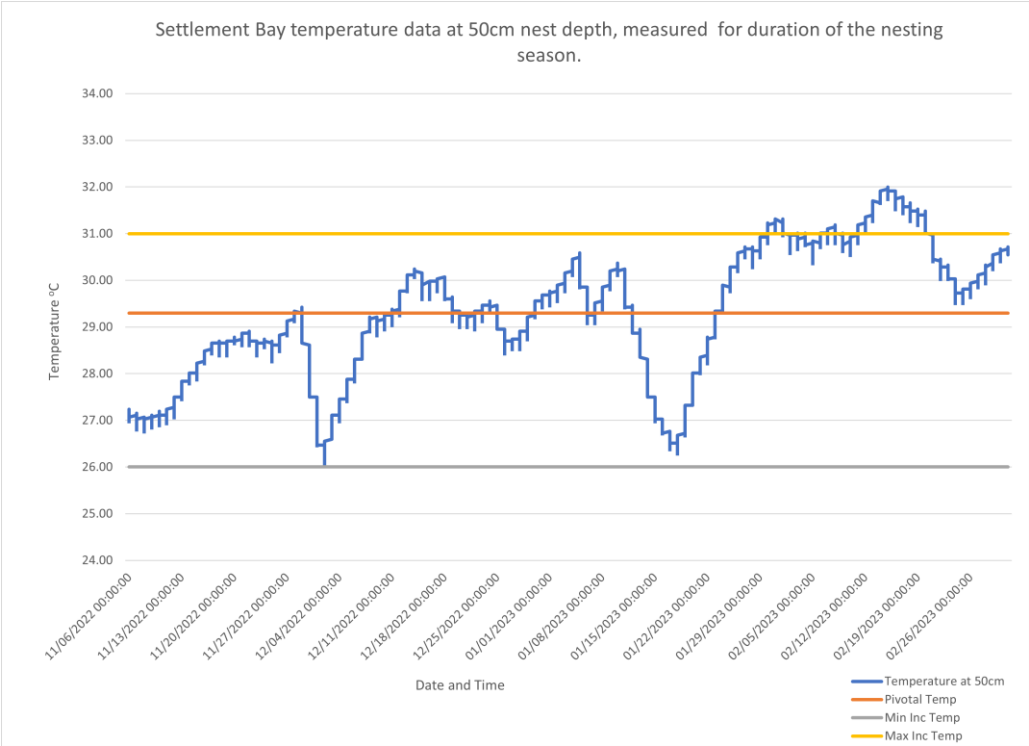


***Figure 15**: Temperature data recorded at nest depth by Hobo Data Logger for 2022-23 nesting season Settlement Bay.* (Limits of x-axis of graph indicate lethal temperatures for incubation, red line indicates pivotal temp of 29.3°C).

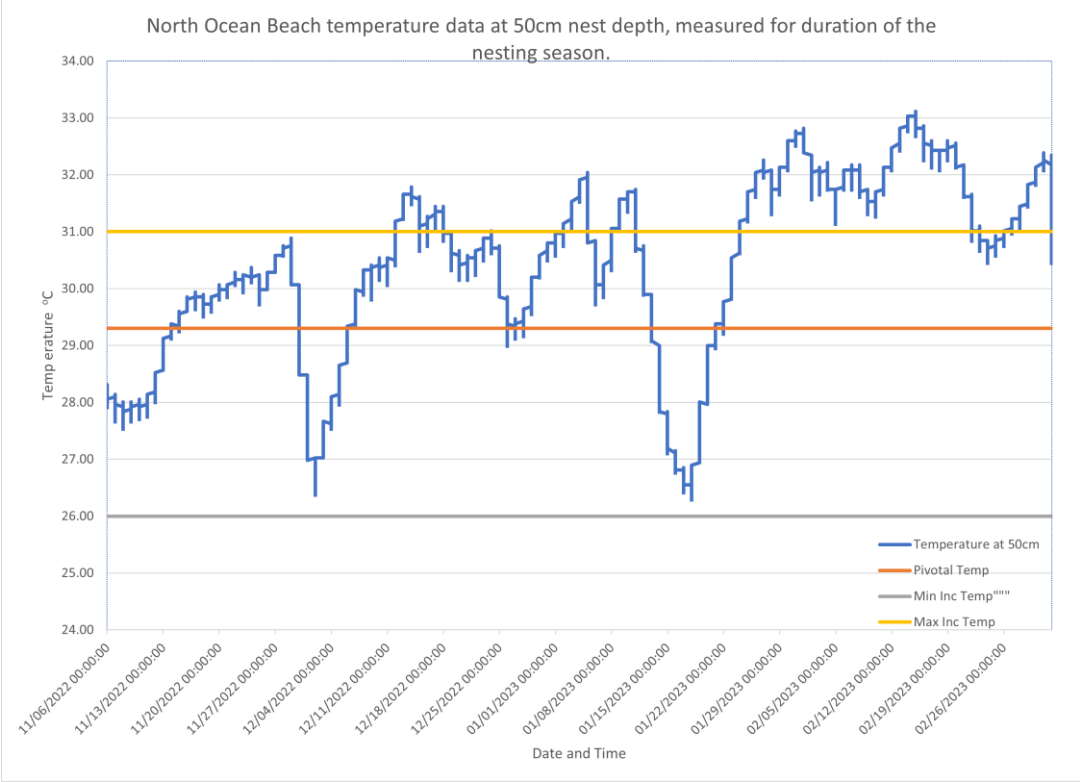


***Figure 16**: Temperature data recorded at nest depth by Hobo Data Logger for 2022-23 Nesting Season, Ocean Beach (North)* (Limits of x-axis of graph indicate lethal temperatures for incubation, red line indicates pivotal temp of 29.3°C).

The Settlement Bay temperature logger was deployed on 6 November 2022 and retrieved on 3 March 2023. The first nesting was reported on 2 November and the last nest was due to emerge around 7 March, but it was predated. Temperature data was therefore obtained for almost the entirety of the season. Temperature dipped during the nesting census almost to the minimum incubation temperature. However, temperature was above the pivotal temperature for much of the season. Average temperature over the entire season was 29.3°C (pivotal) with a range of 26.08-32.00 °C and Std Dev of 1.35. Even early season nests were incubating at sand temperatures above the pivotal temperature.

Temperatures at Ocean Beach (North) were similar, with the average incubation temperature 30.39°C across the season, with a range of 26.3-33.12, and Std Dev of 1.55. Both data loggers were in similar full sun positions.

A total of 33 of the 44 recorded census nests were located after emergence and counts were performed. An additional 48 non-census nests were located and counted for Settlement Bay. A total of 208 emergence success monitoring counts were performed across the island for the entire season, including counts on Settlement Bay, Ocean Beach (North) and East Point Beach. Incubation success for Facing Island was comparable to that obtained for the 20-21 season on Curtis Island - 78.0 avg %, Std Dev=25.1, Range=0-100, n=213 (Limpus et al., 2021).

***Table 12*** *Emergence success counts, total eggs recorded, number unsuccessful and percent hatched for census period - Settlement Bay and for Facing Island as a whole*

| Census Period | | | | Settlement Bay | | | Facing Island (all beaches) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total eggs | Unsuccessful | % hatched | Total Eggs | Unsuccessful | %hatched | Total Eggs | Unsuccessful | %hatched |
| **Count** | 33 | 33 | 33 | 81 | 81 | 81 | 208 | 208 | 208 |
| **Max** | 70 | 61 | 100 | 77 | 61 | 100 | 96 | 61 | 100 |
| **Min** | 45 | 0 | 0 | 4 | 0 | 0 | 2 | 0 | 0 |
| **Avg** | 54.39 | 14.61 | 73.61 | 51.95 | 11.69 | 77.64 | 53.13 | 8.04 | 84.49 |
| **Std Dev** | 6.39 | 15.62 | 27.43 | 10.90 | 14.16 | 25.24 | 12.14 | 10.57 | 19.75 |
| **Sum** | 1,795 | 482 | | 4,208 | 947 | | 11,051 | 1,672 | |

No observed heat-induced mortality of emerging hatchlings was encountered as rainfall cooled the sand. However, the wetter conditions promote more vigorous plant growth, resulting in some hatchlings becoming entangled in roots.

***Figure 17**: Facing Island Flatback turtle hatchling*

The developmental stage of unhatched eggs was recorded where possible. Early stages of embryological development can be difficult to detect, especially when combined with putrefaction of the embryo/egg. Extended time since laying compounded this, making identification of developmental stages difficult. A predominance of early/mid stage mortality can point to flooding, and late-stage mortality (as the embryos pip from the shell) may indicate heat-induced mortality. This data has not been evaluated to determine any significant pattern or conclusions to make for this season.

Twenty hatchlings (from two clutches) were weighed and measured this season, predominantly as a training exercise. Straight carapace length, head width and weight were recorded. Hatchlings were also photographed to record scale arrangement.

***Table 13** Average weights and measures of hatchlings from census nests on Settlement Bay N=20 (2 x clutches)*

| | Straight carapace length (mm) | Head width (mm) | Weight (g) |
|---|---|---|---|
| **Max** | 64.7 | 17.9 | 52.48 |
| **Min** | 59.4 | 16.4 | 43 |
| **Avg** | 62.03 | 17.24 | 47.38 |
| **Std Dev** | 1.63 | 0.45 | 2.84 |

An investigation into hatchling orientation in response to altered light horizons was performed. Sixteen hatchling fans were measured out using QTCP protocols based on Pendoley (2005). This data has not been scrutinised to date due to the small sample size and the complexity of the analysis. It was observed that nests emerging in the dune swale travelled parallel to the beach until topography allowed them to visually sight the ocean (findings observed by Pendoley Environmental (2014) and Kamrowski (2014)). Hatchlings emerging in sectors to the east of Settlement Bay were observed to head straight in the direction of the point light source of Boyne Smelters Limited. Clifton and Limpus (2003) note that the "lights from the smelter ... throw a shadow on the beach at Settlement Bay when there is no moon". Bearings to this light source were recorded at each sector post for future investigations.

## Conclusion

Determining the size of a nesting population of marine turtles is difficult as they show considerable seasonal variation in nesting numbers. Additionally, they do not nest annually, and their longevity and slow attainment of sexual maturity requires long term monitoring to determine trends in their natural populations (Parmenter and Limpus, 1995). Intermittent monitoring since 1999 indicates that there is a sizeable population of Flatback turtles nesting on Facing Island with two main aggregations: Settlement Bay in the south and at Ocean Beach (North). The Facing Island population is possibly of a comparable size to the small/medium sized nesting population on Curtis Island's South End Beach.

Recent industrial development on Curtis Island has the potential to disrupt adult nesting activity and ocean finding behaviour of hatchlings. The Flatback turtle nesting population at Curtis Island has also declined by around half in the past decade (Limpus et al., 2018). It is valuable to assess other nearby nesting beaches to determine if there has been a concurrent increase in nesting population.

***Figure 18**: Flatback turtle returning to the waters off Facing Island on 1 December 2022*

As a census beach, Settlement Bay has the advantage that it is a discrete, short beach, making it suitable to be surveyed on foot with a small team. Nesting density is also relatively high as a factor of the beach length. The relative isolation and difficulty of access afford a reasonable level of protection for the nesting turtles.

Nesting beach fidelity is evident through continued recaptures of animals recorded nesting in previous seasons on Settlement Bay. Primary tagged animals exhibit a smaller curved carapace length than remigrants as evidenced for populations elsewhere. PIT tagging allowed identification of another individual that was lacking titanium flipper tags, highlighting again the importance of this method of tagging.

Incubation and emergence success is comparable to other beaches surveyed across the region. Clutch size and egg measurements are average for the species. Despite significant storm activity, there was no significant erosion on Settlement Bay and the dune vegetation appears healthy.

Goanna predation is an ongoing problem and predator exclusion mesh is not a satisfactory option due to the potential for hatchlings to become entrapped as the beach is not regularly patrolled by trained volunteers. An alternative might be aluminium mesh hatcheries. However, this requires volunteer resources to locate and move clutches at appropriate phases in the incubation period. Also, there is the risk of vandalism or damage if not regularly monitored.

In response to last season's recommendations (FBA, 2022), TTCQ commenced PIT tagging this season to enable animals to be followed long term and preliminary orientation studies were commenced in respect to altered light horizons. Emergence success monitoring facilitated greater understanding of incubation success, impacts on clutches, and provided inferred sex ratios based on incubation temperature and period to emergence.

Further investigation of light impacts is warranted given the observation of hatchlings diverting towards the light of Boyne Smelters. In-water assessment of hatchling disorientation may also be of value. The southern entrance to Gladstone Harbour is located off Gatcombe Heads. Hatchlings entering the water at Settlement Bay would be exposed to the lights of much of the southern harbour, including South Trees wharf and Queensland Alumina Limited. Rather than moving offshore, there is a likelihood that the hatchlings will remain inshore and possibly even be swept into Gladstone Harbour.

As highlighted elsewhere in this report commitment to monitoring marine turtles over extended periods is required to capture significant data to indicate trends. Due to their life histories, it is difficult to assess their population status based on short term studies. It is recommended that monitoring of the Facing Island population continues, particularly with increasing pressures on marine turtles as a result of climate change, coastal development and marine pollution.

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