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Sunshine Coast Council
Marine Turtle Conservation Plan
Making tracks together

Acknowledgement of Country

We acknowledge the Kabi Kabi peoples as the Traditional Custodians of the land and sea country covered by this marine turtle conservation plan—and recognise that these lands and sea country have always been places of cultural, spiritual, social, and economic significance.

We pay our respects to Elders, past, present, and emerging, and commit to continuing to build a shared positive future together.

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Front- and back-page photo credit: Adriana Watson Photography

Species identification photo credit: Dr Colin Limpus



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Reference document

Sunshine Coast Council (2023) Sunshine Coast Region Marine Turtle Conservation Plan (2023 – 2033),

“Making Tracks Together”. (Draft for public consultation).

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Consultation Preface

The Sunshine Coast is blessed with the wonders and richness of a biodiverse natural environment. Within a fast-growing urban community and popular tourism destination, our world-famous beaches and coastal waters provide critical habitat for six species of marine turtles. As the global environment changes, these habitats, together with our local climate, are forecast to be an important refuge for future populations of these marine turtles.

Ensuring that turtles and people co-exist in our region into the future provides both challenges and opportunities for our community. This Plan has been developed to explore and address these, and to map a path of action to ensure the best outcomes for all.

Marine turtles are long-lived animals—at least 100 years—foraging in waters along the Queensland coast and internationally. Every summer, the Sunshine Coast community welcomes the arrival of our two species of nesting marine turtles—the critically endangered loggerhead turtle and the green turtle. Between October and March, the loggerhead and green turtles can be found nesting on Sunshine Coast beaches, which is then followed by the emergence of hundreds of turtle hatchlings making their way to the ocean for their long journey ahead.

The Marine Turtle Conservation Plan (MTCP or the Plan) has been prepared in collaboration with Sunshine Coast Council officers and elected representatives, Kabi Kabi First Nation Peoples, state government representatives, scientific experts (through a Technical Advisory Panel) and community leaders of TurtleCare, Bribie Island Turtle Trackers and Coolum and North Shore Coast Care volunteers.

The Kabi Kabi First Nation Peoples are the traditional custodians for the land and sea country covered by this Plan and marine turtles are of enormous practical, cultural, and spiritual significance to them. This Plan therefore includes their input and prescribes involvement of Kabi Kabi peoples in current and future management.

The Sunshine Coast TurtleCare volunteers, Coolum and North Shore Coast Care and Bribie Island Turtle Trackers comprise more than 250 trained citizen scientist volunteers, who help manage and protect our nesting marine turtles and their hatchlings. The volunteers work on behalf of our Sunshine Coast community to ensure that the intergenerational responsibility of marine turtle conservation is achieved.

We, the community, and Sunshine Coast Council (SCC or council) that have created this Plan, recognise that risks arising from climate change are an overwhelming threat that require urgent action, and believe that our local actions can help deliver global benefits, and demonstrate global leadership, for marine turtles and people. Our Plan supports our vision to be Australia's most sustainable region—Healthy, Smart, Creative—and is a clear demonstration of our commitment to marine turtle conservation. The Plan recognises the need for people and turtles to co-exist and 'make tracks together' on the path to recovery.

We invite your feedback to improve this Plan and to further strengthen our shared capacity as a community to help recover the populations of marine turtles that call the Sunshine Coast home.

“The Sunshine Coast TurtleCare Program is one of the best community responses to care of turtles and their habitats that I have seen in more than 50 years of researching and managing marine turtles. Now more than ever we need more highly trained and dedicated community volunteers to help battle increasing threats such as climate change and marine pollution to bring our populations of marine turtles back from the brink of extinction. But we must work together and act now.”

Dr Colin Limpus (Chief Scientist, Aquatic Threatened Species, Queensland Government)



Executive Summary

Purpose of the Plan

This Marine Turtle Conservation Plan supports efforts by the Queensland and Australian Governments to stop the decline of depleted stocks, support recovery and maintain functional populations of marine turtles on the Sunshine Coast through managing threats to population viability. The Plan will guide council decision-making to achieve future conservation and management goals for nesting marine turtles and hatchlings within the Sunshine Coast Local Government Area (LGA). It is particularly focused on the nesting and hatchling success of the critically endangered loggerhead and vulnerable green turtle populations.

High Value Turtle Habitat – ‘Critical to Survival’

Marine turtles are an essential part of the Sunshine Coast environment, and the Sunshine Coast environment is essential to the future of marine turtles. The region, with relatively cooler temperatures than more northern turtle habitat, provides critical nesting sites that produce a higher proportion of the male hatchlings that are essential for long-term recovery of turtle populations. The Sunshine Coast environment is likely to become increasingly important in the future as predicted climate change progresses, and this Plan seeks to optimise the benefits for both marine turtles and people living in or visiting the region.

Threat Management

All populations of marine turtles found on the coast are depleted or severely depleted and subject to ongoing threats to the point that now every nest and every egg matter to population recovery, and direct management intervention will be increasingly required. The most significant threats to the region's marine turtles include altered temperatures from climate change, urban light pollution, terrestrial predation, entanglement by and ingestion of marine debris, habitat modification, recreational activities, accidental death as fisheries by-catch, chemical and terrestrial discharge, and vessel disturbance.

Vision

The long-term vision of this Plan is:

“Marine turtles surviving and thriving on the Sunshine Coast, co-existing in harmony with people.”

Achieving this vision will require a reduction in all manageable threats to allow for the conservation status of these marine turtles to improve to a point at which they can be removed from Queensland and Commonwealth threatened species lists by 2122¹.

Primary Goal

Recognising the long timeframes required to achieve our vision, a Primary Goal provides intermediate guidance for marine turtle management on the Sunshine Coast:

“Supporting the recovery of self-sustaining populations of marine turtles on the Sunshine Coast by reducing threats, improving habitat quality, and strengthening community-based management.”

¹ Three successive generations of sustained population growth are required before a species can be removed from the threatened species list—in the case of marine turtles that means about 100 years (and even then, the population is unlikely to return to original natural levels of abundance).

The Plan to Achieve our Vision

To achieve our long-term vision and primary goal, this Plan sets out desired outcomes and strategic directions under three overlapping and mutually supportive themes:

1. Strategic planning and policy guidance for turtle-sensitive lighting and coastal development
2. Regional marine turtle recovery actions
3. Sunshine Coast community based TurtleCare program delivery

The Plan identifies strategic directions and actions under each of these themes (attachment 1 – implementation plan)—to further strengthen the existing highly successful community-based volunteer TurtleCare program and associated citizen science activities. These actions include strong education, awareness, and ongoing engagement with Kabi Kabi First Nation Peoples and the broader community, ensuring people and marine turtles co-exist in harmony on the Sunshine Coast.

The Plan also proposes improved governance arrangements to coordinate ongoing implementation, evaluation, and improvement of the Plan, in partnership with a range of stakeholders across the broader Sunshine Coast region.

Greater levels of human intervention are likely to be required to achieve the nesting and hatchling success rates necessary for recovery of stocks found on the Sunshine Coast. Therefore, an adaptive management approach has been identified as essential to allow appropriate response, ensure learning, and improve approaches from ongoing experience.



1. Introduction

Marine turtles have been around for the best part of 240 million years—living, breeding, and nesting on the Sunshine Coast long before there were suburbs and town centres. The Sunshine Coast is a fast-growing urban community and a world-renowned tourism destination that is located about an hour (53 km) north of the Queensland capital, Brisbane. Most of the region's population of 300,000 (forecast to exceed 500,000 by 2041) live within 16 beach suburbs that stretch along a 52 km coastline of predominately white sandy beaches, punctuated by rocky headlands and coastal rivers and streams.

Despite having survived and thrived for millions of years, over the last several hundred years many marine turtle populations—including those found on the Sunshine Coast—have been pushed towards extinction by a combination of human-related threats. Urgent action is now required to reduce these threats, reverse the decline, and help recover self-sustaining populations of these iconic marine animals in our region.

Queensland was a pioneer in marine turtle management and continues to be a leader (1). The current community-based Sunshine Coast TurtleCare program is regarded as one of the best of its kind in Australia (2). These are part of a proud tradition and strong foundation on which future efforts will be built.

This Marine Turtle Conservation Plan represents the maturity of the TurtleCare program over the past 17 years and sets out the strategic directions for marine turtle management on the Sunshine Coast over the next decade and beyond. It has been prepared as a guide and information tool for a range of users including council, turtle volunteers, delivery partners and the broader community. The Plan considers threats and management arrangements at the international, national, state, and regional scale and identifies practical measures that can be implemented by local government and its partners on the sunshine coast, to help recover our local marine turtle populations—a case of thinking globally and acting locally.

The MTCP supplements a range of existing marine turtle recovery plans developed at the international, national, and state levels and provides considered best practice approaches that have been informed by experience from other jurisdictions (3) (1) (4). It builds on and should be read in conjunction with the national *Recovery Plan for Marine Turtles in Australia*, the Queensland Marine Turtle Conservation Strategy, and *Single Species Action Plan for the Loggerhead Turtle (Caretta caretta) in the South Pacific Ocean*.

Marine turtles that regularly forage or nest along the Sunshine Coast are part of genetically distinct populations (called stocks) that are severely depleted (by 90%) and subject to a range of continuing threats and pressures (3). Operating in combination, these threats must be reduced if the stocks are to recover to previous natural levels of abundance.

In the same way that threats are cumulative, so are the benefits of recovery actions—a combination of many targeted local actions can help aid population recovery while global efforts to address climate change and other overarching threats are implemented. Therefore, this Plan aims to further strengthen the national and international recovery efforts by addressing relevant threats that are under the control and influence of SCC and regional community. It provides partners, the community and decision-makers with a clear framework of actions for maintaining and recovering the marine turtle stocks of the Sunshine Coast marine turtle nesting bioregion (Figure 1).



Figure 1. Sunshine Coast marine turtle nesting bioregion

Purpose and Scope

The purpose of the Plan is to support a growing TurtleCare citizen science management program and guide council decision-making to achieve future conservation and management goals for nesting marine turtles and hatchlings within the Sunshine Coast LGA.

The Plan is particularly focused on the nesting and hatchling success of the critically endangered loggerhead and vulnerable green turtle populations, however, specific measures to recover these two stocks will have flow on benefits for all other marine turtle species found in the coastal waters of the Sunshine Coast.

2. The Journey Ahead: *Pathway to Marine Turtle Recovery*

Vision

Consistent with the National Recovery Plan and the Queensland Marine Turtle Conservation Strategy—this Plan aims to stop the decline and support the recovery of depleted stocks and maintain functional populations of the six species of marine turtles found on the Sunshine Coast. The focus of this Plan is on the nesting populations of loggerhead and green turtles. The long-term vision is:

Marine turtles surviving and thriving on the Sunshine Coast, co-existing in harmony with people.

Achieving the vision will require reduction in all manageable threats to allow the conservation status of these marine turtles to improve to a point at which they can be removed from Queensland and Commonwealth threatened species lists by 2122². Recognising the long timeframes required to achieve the vision, a Primary Goal provides intermediate guidance for marine turtle management on the Sunshine Coast.

Primary Goal

Supporting the recovery of self-sustaining populations of marine turtles on the Sunshine Coast by reducing threats, improving habitat quality, and strengthening community-based management.

Framework of actions

A comprehensive framework of actions and success indicators has been developed to guide the journey ahead and achieve the MTCP vision and primary goal. The details of this framework are included in **Attachment 1: Marine Turtle Conservation Plan Strategic Planning, Policy Guidance, and Implementation**—developed through stakeholder workshops and further refined and tested with expert panels and Sunshine Coast Council focus groups.

The framework, structured around three overlapping and mutually supportive themes, provides a strategically and practically aligned delivery model for the Plan. The themes are:

1. Turtle-sensitive lighting and coastal development.
2. Regional marine turtle recovery actions.
3. Sunshine Coast community based TurtleCare program delivery.

For each theme, the journey ahead is explained using:

- essential **background** information (where are we now?)
- long-term **desired outcome** (where do we want to be?)
- **strategic directions** and actions to achieve desired outcomes (how are we going to get there?)
- **success indicators** including targets and performance measures (are we on track?)

²Three successive generations of sustained population growth are required before a species can be removed from the threatened species list—in the case of marine turtles that means about 100 years (and even then, the population is unlikely to return to original natural levels of abundance).

Taken together, the actions identified under all three themes are expected to support the recovery of marine turtles on the Sunshine Coast in line with recognised contemporary practice (11).

The actions identified in the framework include an annual Implementation Plan in collaboration with delivery partners. The Implementation Plan includes proposed timings—now [1-2yrs], next [3-5yrs] and later [5-10yrs].

The actions described in the Plan are intentionally ambitious, necessarily realistic, and have been tested through Sunshine Coast Council expert focus groups and the Technical Advisory Panel. Some targets identified in the success indicators are higher than those in the National Recovery Plan and considered necessary to recover depleted stocks in the face of increasing threats such as climate change. The targets are ambitious but potentially achievable through the active support of a turtle-friendly community to implement the necessary recovery actions.



3. Context

The Sunshine Coast and marine turtles³

Six of the world's seven species of marine turtle have been recorded on the Sunshine Coast. The region is home to three species of marine turtle and three others have been recorded visiting adjacent marine waters or stranded (alive, dead, or moribund) on Sunshine Coast beaches. The six species found in the region are:

1. **Loggerhead turtle** - *Caretta caretta* (nesting on Sunshine Coast beaches; foraging and breeding in surrounding inshore and offshore reefs, rocky shores, and islands).
2. **Green turtle** - *Chelonia mydas* (nesting on Sunshine Coast beaches; foraging and breeding in surrounding inshore and offshore reefs, rocky shores, and islands).
3. **Hawksbill turtle** - *Eretmochyls imbricata* (foraging and breeding in surrounding inshore and offshore reefs, rocky shores, and islands).
4. **Olive ridley turtle** - *Lepidochelys olivacea* (vagrants uncommonly found in adjacent waters).
5. **Flatback turtle** - *Natator depressus* (vagrants uncommonly found in adjacent waters).
6. **Leatherback turtle** - *Dermochelys coriacea* (occasionally foraging and migrating in adjacent waters).

Marine turtles are migratory species and frequently travel long distances between breeding seasons and across international boundaries. In the case of the loggerhead turtle, hatchlings undergo a once-in-a-lifetime journey—travelling thousands of kilometres across the South Pacific Ocean to the coast of South America before returning to eastern Australian waters as sub-adults at about 16 years of age (5). Here they remain for the rest of their adult life.

The life history traits of marine turtles make them vulnerable to a wide range of anthropogenic threats. These traits include decades to reach maturity, high natural mortality of hatchlings and small juveniles, strong fidelity to breeding areas, migrating over long distances to breed, and use of both terrestrial and marine environments to complete their lifecycle. At the same time, marine turtles have traits that contribute to population resilience, including each stock being supported by multiple breeding locations and widely dispersed foraging populations.

Whilst all Sunshine Coast beaches have the potential for turtle nests, there are physical conditions which favour some nesting beaches. Buddina and Shelly beaches typically record many more nests than any other beaches. The top 9 nesting beaches are shown in Figure 2 (6)

³Profiles for the turtle stock nesting on the Sunshine Coast and for non-nesting turtle stock found on the Sunshine Coast are included in Appendix 2.



Figure 2. Important marine turtle nesting beaches on the Sunshine Coast

Conservation status and policy framework

Sunshine Coast marine turtle nesting beaches are “habitat critical to survival for the critically endangered loggerhead Turtle” (3).

All marine turtles are recognised as species of conservation concern under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention) and the 2000 IUCN (International Union for Conservation of Nature) Red List of Threatened Species.

All six species of marine turtles on the Sunshine Coast are protected under a range of international, national, state, and local mechanisms (see Appendix 1). Specifically, the leatherback, loggerhead, and olive ridley turtles are listed under the Australian Government’s *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Queensland *Nature Conservation Act 1992*, (NCA) as endangered and may become extinct if the threats to their survival continue. The green, hawksbill and flatback turtles are each listed as vulnerable under the EPBC (hawksbill are listed as endangered under the NCA) and may become endangered under the EPBC (or extinct under the NCA in the case of hawksbill) if threats continue.

Due to a significant decline in population numbers, the United Nations Environment Program (UNEP) prepared a *Single Species Action Plan for the Loggerhead Turtle (Caretta caretta) in the South Pacific Ocean*. This was ratified by the Australian Government and other international signatory states in 2014 (4). Further to this in 2017, the Commonwealth Government developed the *Recovery Plan for Marine Turtles in Australia* which identified the area from Pumicestone Passage to Double Island Point as ‘habitat critical to survival’ for the loggerhead turtle (3). In 2020 the Commonwealth also released *National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds* (8). Each of these documents are a foundation for management recommendations in this MTCP.

There is no contemporary practice of traditional hunting on the Sunshine Coast, however under section 211 of the *Native Title Act 1993*, turtles may be legally hunted by Aboriginal and Torres Strait Islander people for personal, domestic, or non-commercial communal needs. Analysis of the interplay between various State and Commonwealth laws relating to Indigenous harvest is complex and described in more detail in the national Recovery Plan.

The Sunshine Coast MTCP is complemented by the *Queensland Marine Turtle Conservation Strategy* (1) which has been developed by the Queensland Government as an update to the original 2018 strategy (7).

Other Sunshine Coast Council strategies relevant to marine turtle habitat and nesting requirements, include the Environment and Liveability Strategy, Coastal Hazard Adaptation Strategy, and Coastal Health Report. The Environment and Liveability Strategy is the head of power within a Sunshine Coast Council policy framework for this MTCP.

In 2022 the Sunshine Coast Council LGA was recognised by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) as an international site of excellence, known as a Biosphere Reserve. A Biosphere Reserve is a special place—where responsible development and people living sustainably sit alongside active conservation. Becoming a Biosphere Reserve is expected to enhance the Sunshine Coast’s national and international reputation and support the local economy, lifestyle, and environment for future generations. Recognition as a UNESCO Biosphere Reserve is an important step in the Sunshine Coast’s commitment to remain future-facing and focused on managing the environment in a holistic way from the mountains to the sea.



The values of marine turtle conservation on the Sunshine Coast

Marine turtles and the Sunshine Coast have a mutually dependent relationship—marine turtles are an essential part of the Sunshine Coast environment, and the Sunshine Coast environment is essential to the future of marine turtles. Maintaining healthy marine turtle populations is also important more broadly for Queensland's biodiversity, maintaining Indigenous cultural heritage, and supporting the Queensland economy by adding to world-class tourism and research opportunities.

The following values (Table 1) of marine turtles on the Sunshine Coast underpin the priorities identified later in the Plan. These values were identified through engagement with Sunshine Coast Council representatives, team leaders from TurtleCare, Coolum and North Shore Coast Care, Bribie Island Turtle Trackers, and Kabi Kabi First Nation Peoples.

It is clear from these values that the relationship between marine turtles and the Sunshine Coast environment is likely to become increasingly important in the future and this Plan seeks to optimise the benefits for both marine turtles and people living in or visiting the region.

Table 1. *The identified values of Marine Turtles and Marine Turtle Conservation on the Sunshine Coast*

Value	Significance – Sunshine Coast
Significant nesting population	Loggerhead turtles nesting on the Sunshine Coast make up approximately 4% of the south-west Pacific breeding population (anything above 1% is considered significant). The Sunshine Coast also provides a potential insurance population if the major loggerhead rookery at Mon Repos were to fail.
Highly regarded volunteer program, citizen science and long-term data	<p>With over 250 volunteers and 17 years of citizen science, the Sunshine Coast community-based volunteer turtle programs are regarded as among the best in Australia. The long-term data set collected by volunteers is critical to the success of the program.</p> <div> <p>Review of Sunshine Coast marine turtle nesting data (2005-2016) – Summary*</p> <ul style="list-style-type: none"> • Total of 742 clutches of Loggerhead turtle eggs were laid between Bribie Island and Noosa • 71 % of crawls up the beach resulted in a clutch of eggs being laid • 78 % of eggs resulted in hatchlings reaching the ocean • 30 % of nests were relocated due to threats such as erosion, storm tides and artificial light • Nesting population is neither increasing or decreasing, and shows normal demographic features for loggerhead and green turtles of Queensland <p><i>*Based on standardised data collected by Sunshine Coast citizen scientists - TurtleCare, Coolum and North Shore Coast Care and Bribie Island Turtle Trackers (6).</i></p> </div>
Majority male hatchlings (ecologically appropriate sex ratios)	Sunshine Coast beach sand temperatures are mostly cooler than other nesting areas in Queensland and therefore uniquely produce majority male hatchlings—except for Shelly Beach. Elsewhere in Queensland sand temperatures on nesting beaches are leading to an unsustainable feminisation and potential collapse of populations over the next generation (because there are too few males available for breeding) (1).
Climate change refugia	In response to increasing temperatures in higher latitudes, turtles are predicted to undertake a southward shift in nesting distribution over future decades and the Sunshine Coast is likely to provide increasingly important alternative nesting sites. Another potential response is that some species are nesting earlier in the season, during milder temperature conditions.
Kabi Kabi First Nations culture	This Plan provides an opportunity to celebrate and further strengthen Traditional Custodians' connections to turtles and the marine ecosystem.
Healthy coastal ecosystems	Marine turtles play an important ecological role in shaping and regulating coastal marine environments by contributing to complex coastal ecological food webs and beach sand nourishment processes.
Keystone species	Protecting and enhancing marine turtle habitats provide co-benefits for many native species and people (healthy turtles=healthy coast=healthy ecosystems=healthy community).

Regional drawcard and lifestyle quality	Marine Turtles are a locally iconic animal for the Sunshine Coast community and visitors. The cultural connections for the Kabi Kabi First Nation Peoples; history of citizen science and academic research; and community-led management are all potential drawcards and help make the Sunshine Coast a great place to live, work and play.
The long game—intergenerational stewardship	<p>Every year, when hatchlings emerge from the beach, a new page in the turtle story begins and an opportunity to build inter-generational connections within and between the population of people and marine turtles living on and visiting the Sunshine Coast.</p> <p>Every hatchling has a one in 1,000 chance of surviving ocean life and grows very slowly, reaching breeding age at around 30 years. With a growing marine turtle sensitive community, the hatchlings protected by this generation of Sunshine Coast residents and visitors will become the adult nesting females that return to our shores for future generations to see, experience and enjoy.</p>
A team of turtle ambassadors with the will and skill to intervene	Recovering marine turtle populations on the Sunshine Coast may increasingly need labour intensive interventions such as clutch relocations, intensive predator control, individual nest shading, targeted irrigation to maintain ideal sand moisture levels, and importantly, public education.
Healthy coastal environments—good for turtles, good for people	Marine turtles and humans both need and want healthy coastal environments—clean coastal waters and estuaries; sandy beaches with natural dune vegetation and shade for cool sand; popular surf beaches by day Turtle maternity sites by night; intact dune landscapes providing coastal stability essential for turtle nesting and protecting residential communities. These shared interests mean we can and should co-exist in harmony, safe in the knowledge that efforts to protect natural coastal habitats will benefit people as much as marine turtles.
Recognised as a turtle sensitive community—leading the way	Building on the highly successful TurtleCare program, the Sunshine Coast can be increasingly recognised as a global leader in community-based marine turtle conservation.
Part of our vision to be Australia's most sustainable region	Recovering marine turtle populations on the Sunshine Coast is consistent with council's aspiration to be <i>Australia's most sustainable region—healthy, smart, and creative</i> . Community stewardship for marine turtles also supports the SCC Biosphere Reserve, celebrating people living in harmony with nature.

4. Addressing Threats to Marine Turtles on the Sunshine Coast

Marine turtles that regularly forage or nest along the Sunshine Coast are part of genetically distinct populations (called stocks) that are severely depleted (by as much as 90%). Local management efforts on the Sunshine Coast are a small but essential piece in the global puzzle to recover all depleted marine turtle populations.

A combination of historic and continuing human-caused threats operating at the local to global scale hinder the recovery of marine turtle populations in this region. The risk posed by these threats varies depending on the unique characteristics of each marine turtle species and stock, the life phase and behaviour of individual turtles, and the strength of existing habitat protection and management arrangements. Using the same methods as the national Recovery Plan, the *Queensland Marine Turtle Conservation Strategy* (2022), provides an updated risk assessment for each marine turtle stock inhabiting the Sunshine Coast (3) (1).

Based on the National and Queensland threat assessments and consultation with experts and local stakeholders, priority threats to Sunshine Coast marine turtles were identified, with a focus on nesting beaches and inshore foraging habitat. Table 2 lists these threats, and Appendix 5 provides further detail.

Table 2. *Priority threats to marine turtles nesting and foraging on the Sunshine Coast beaches and offshore areas*

Threat	Significance - Sunshine Coast
Climate change and vulnerability	Increased sand temperature affects incubation success and sex determination. Sea level rise and extreme weather impact nests in beaches and dunes.
Light pollution	Artificial light at night (ALAN) associated with human development is an emerging threat to a wide range of wildlife worldwide (8). Changes in ambient light levels and the night sky horizon can cause a decline in successful marine turtle nesting and disrupt ocean-finding by emerging hatchlings (3) (1). With population growth and proximity to a major metropolitan area (Brisbane), the Sunshine Coast is an identified hotspot for altered light horizon impacts.
Terrestrial predation	Ongoing control measures (for example, installing fox exclusion devices on nests) have effectively reduced loss of eggs and hatchlings from predation on Sunshine Coast beaches, from an estimated 27% to less than 3% (10).
Marine debris	The East Australian Current and southeast Queensland are local hotspots for loggerhead turtles with ingested debris (17).
Habitat modification	Includes removal of coastal vegetation for views and infrastructure, beach modification for public access; hard infrastructure replacing dunes for erosion control. Where habitat is lost permanently there is likely to be an impact on the viability of the population utilising that habitat.
Recreation activities	When mismanaged, these operations have the potential for disturbing marine turtle nesting, interesting and foraging behaviour, ultimately impacting the viability of the population.
Fisheries by-catch and shark control nets	Reports of two leatherback deaths in south-east Queensland in 2020 appear linked to negative interactions with shark control nets. Trawl fisheries by-catch of breeding adults has been largely mitigated in Queensland waters by the legislated use of Turtle Exclusion Devices in 1999.
Chemical and terrestrial discharge	On the Sunshine Coast chemical and terrestrial discharge of sediment and other chemical pollutants can result from urban runoff, effluent treatment, and land use changes in the catchment.
Vessel disturbance	Waters off the Sunshine Coast are a major shipping channel and increasingly a fishing and recreational boating area. This is particularly an issue in shallow coastal foraging habitats (such as the Pumicestone Passage) and interesting areas.

All stocks of marine turtles found on the Coast are depleted or severely depleted and subject to ongoing threats to the point that now ‘every nest and every egg matter to population recovery’.

For most marine turtle populations, it is the cumulative impacts of multiple threats operating at different scales that need to be addressed to secure their recovery. However, in the same way that threats are cumulative, the benefits of individual recovery actions can also accumulate. This means that any actions taken locally, even to address relatively lower-level risks, can make a cumulative positive difference for the recovery of marine turtle stocks found along the Sunshine Coast.

Change for good—smart lighting saves more than turtles

Installing turtle-sensitive lighting on existing buildings is becoming easier to do and has multiple lasting benefits for tenants, turtles, and the environment. Addressing light pollution has practically no downsides:

- *Light pollution can be instantly cured.*
- *It is good for wildlife.*
- *It is good for human health.*
- *It is good for our carbon footprint.*
- *It is good for our bank balance.*

Case study: *A high-rise apartment building in Maroochydore, 3 km from a turtle nesting beach recently undertook a dark sky compliance refit of lighting. An audit identified 99 light fixtures to be changed on the outside of the building and a further 75 in the basement carpark. The retrofit was undertaken over 18 months at a total cost of \$18,000. The result was that light pollution from common area lighting reduced by an estimated 90 % and the quality of lighting dramatically improved. There were no complaints from residents of the 71 units, only compliments.*

The carbon footprint for the building reduced by more than 10 tonnes per month and electricity savings by over \$1,000 per month. After subtracting lights and installation costs, the building expects to save \$132,000 over ten years.

A change for good and a win/win/win for tenants, turtles and the environment (14).

<https://www.australasiandarkskyalliance.org/post/turtle-shields-creating-dark-sky-friendly-homes>

5. The Desired Future for Marine Turtles on the Sunshine Coast

In the context of the Vision, and Primary Goal—the desired outcomes for marine turtles on the Sunshine Coast are presented under three overlapping and mutually supportive themes as shown in Table 3.

Table 3. *The desired future for marine turtle conservation on the Sunshine Coast*

VISION		
Marine turtles surviving and thriving on the Sunshine Coast, co-existing in harmony with people.		
PRIMARY GOAL		
Supporting the recovery of self-sustaining populations of marine turtles on the Sunshine Coast by reducing threats, improving habitat quality, and strengthening community-based management		
DESIRED OUTCOMES		
Turtle-sensitive Lighting and Coastal Development	Regional Marine Turtle Recovery Actions	Community-based TurtleCare Program Delivery
<p>By 2032 to have:</p> <ul style="list-style-type: none"> strategic planning and policy guidance tools in place including: <ol style="list-style-type: none"> a regulatory framework for coastal development in the Sunshine Coast LGA that appropriately integrates State interests and the MTCP educational guidance tools to support the development sector, property owners and residents to seek to achieve world best practice turtle sensitive development outcomes development and implementation of lighting policies and standards that deliver a commitment to Dark Sky objectives and a naturally dark coastline at night, with minimisation of direct light sources and ambient light visible from sensitive nesting beaches and adjacent marine areas nesting beaches identified as future climate refugia and protected as part of integrated coastal hazard management 	<p>By 2032 to have:</p> <ul style="list-style-type: none"> the identified threats (that are under the influence of the Sunshine Coast Council) reduced to lowest residual risk level to minimise negative impacts on nesting marine turtle populations sufficient resilient essential habitat to support effective marine turtle nesting, foraging and courtship behaviour current male to female ratios maintained on the Sunshine Coast to ensure continued recruitment of male turtles to the breeding population 	<p>By 2032 to have:</p> <ul style="list-style-type: none"> the Sunshine Coast is recognised as a national and international leader in community-based marine turtle care program fully integrated into Queensland and Australian strategies secure, adequate funding for TurtleCare (and allied programs) allows optimal contribution to monitoring, managing, and recovering marine turtles in line with world best-practices. Kabi Kabi First Nation Peoples are fully integrated into marine turtle management – the knowledge, culture and traditions, traditional rights, interests, management capacity and customary obligations are respected, strengthened, valued, and promoted a community of residents and visitors value marine turtles and are engaged in turtle conservation –community custodians/stewards

For each theme and desired outcome, a detailed framework of actions and success indicators has been developed by stakeholder workshops and further refined and tested through expert panels and Sunshine Coast Council technical focus groups. The details of this framework are in **ATTACHMENT 1. Strategic Planning, Policy Guidance, and Implementation Plan**—this is an essential tool that will guide the journey over the next 10 years to achieve the aspirations of this Plan.



6. Governance, Implementing, Evaluating and Reviewing

Many groups have an interest in and are already contributing to marine turtle conservation on the Sunshine Coast (table 4).

Table 4. Key delivery partners and stakeholders

Delivery partners and stakeholders	Role/contribution in delivering the MTCP
Sunshine Coast Council	Lead implementation responsibilities and program coordination.
Kabi Kabi First Nation Peoples	Traditional custodians with cultural authority for land and sea country covered by this Plan.
SCC TurtleCare, Coolum and North Shore Coast Care, Bribie Island Turtle Trackers	Volunteers leading delivery of community education, engagement, and research and monitoring of nesting beaches.
Queensland Department of Environment and Science	Training, coordination, and authorising agency.
Technical Advisory Panel	Independent expert advice on program design and delivery.
South-east Queensland coastal councils (especially neighbouring Noosa and Moreton Bay)	Opportunities for regional collaboration and advocacy for improved management of risks and opportunities.
Broader community	Advocates and practitioners of turtle sensitive behaviour.

The MTCP seeks to: Improve coordination and communication between all groups; capitalise on emerging opportunities; and better utilise the collective resources available with a clear, agreed set of priorities and governance processes.

The Sunshine Coast Council is to have lead responsibility for plan implementation, in collaboration with the delivery partners and stakeholders listed above. The responsibilities of this leadership role include approving the Plan; identifying annual implementation priorities; co-ordinating inputs from others; reviewing progress towards the strategy objectives; and, considering opportunities to further improve for capacity to deliver the Plan.

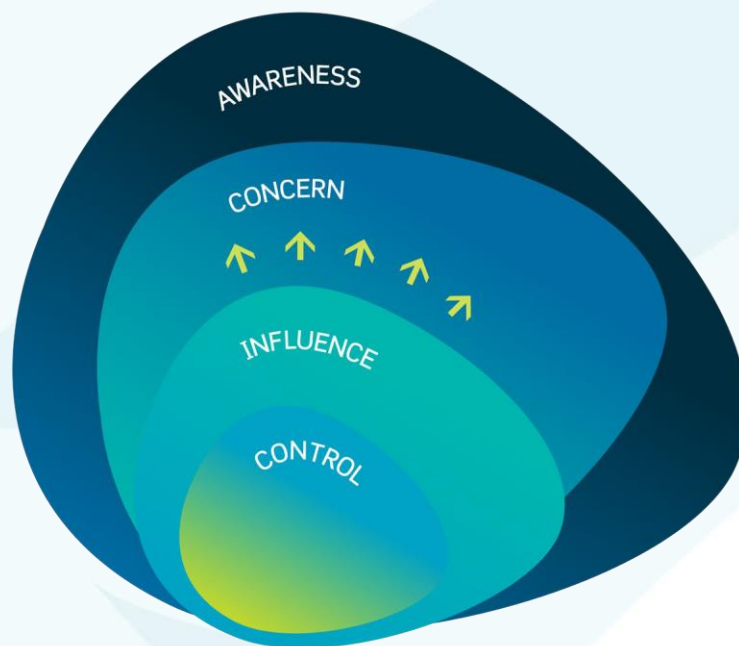
To facilitate collaboration and smooth implementation of the Plan, the establishment of a small Working Group is proposed. Membership will include representatives from Sunshine Coast Council, Kabi Kabi First Nation Peoples, neighbouring Local Government Areas, Queensland Parks and Wildlife Service, leaders from each primary turtle volunteer group and others as required.

Proposed key functions for the Working Group include:

- Sharing of information and facilitation of communication between stakeholders.
- Identification of ways to ensure community input is incorporated into ongoing planning and program delivery.
- Collaborative development of annual implementation plans, containing practical and agreed actions to achieve the short and long-term outcomes of the Plan.
- Development of requests for funding from council and other Program investors/sponsors.
- Monitoring, reporting on implementation and evaluation of progress towards the desired outcomes.
- Provision of reports to participating organisations, along with recommendations for ongoing review and improvement of the Plan and its implementation.

The circles of awareness, concern, influence, and control shown in Figure 3 provides a useful framework for understanding how council, Queensland Government and other collaborators can expand their spheres of control and influence, to increasingly address areas of broader concern. It is important to note that many marine turtle recovery actions require input from a range of organisations and council is not responsible for addressing all the identified threats. However, it can act as a champion to empower others.

Figure 3. *Expanding circles of control, influence, concern, and awareness for marine turtle conservation*



Implementation Plan

The key mechanism for achieving the desired outcomes of the Plan over 10 years is the Strategic Planning, Policy Guidance, and Implementation Plan – Attachment 1. This prioritises activities, identifies the responsibility for implementation, defines the timing of implementation, and identifies financial and other resources required.

To provide a longer-term approach while maintaining flexibility, it is proposed that the Implementation Plan be a three-year rolling plan with an annual review. Greater detail would be included for the upcoming financial year at each annual review. Individual implementation actions will be included in annual council work plans, and if required, in project plans involving external parties.

An annual report on activities, outcomes and expenditure will be provided as part of the SCC annual report and to meet specific reporting obligations to DES. A comprehensive evaluation and review of the Plan is to be undertaken every five years.

A small Technical Advisory Panel will be maintained to provide technical advice on implementing the Plan.

Learning and improving with experience

This Plan recognises there are many uncertainties and supports adaptive management through regular monitoring, evaluation, and review, leading to evidence-based decision-making. A ten-year technical report and a citizen science evaluation report, together, have already provided the foundation for the development of this MTCP and will assist with future reviews.

TurtleCare program – evaluation highlights

- *The program is well-organised and provides a positive, meaningful experience for volunteers, including opportunities to volunteer in other community activities.*
- *The leadership provided by the Sunshine Coast Council and its recognised expertise in sea turtle conservation is highly regarded.*
- *Community awareness of the TurtleCare program is very high (90%).*
- *The program is supporting the Guideline aim to sustain an ongoing marine turtle monitoring program.*
- *Almost three quarters (74%) of surveyed residents are aware of actions needed to protect marine turtles.*
- *More than half (56%) of surveyed residents reported learning about turtle conservation by observing TurtleCare volunteers in action.*

(Schaffer, V. Community Engagement Evaluation of the TurtleCare Program. University of the Sunshine Coast, 2019.)

The adaptive management cycle (think, plan, do, learn, and improve) facilitates continuous learning and improvement, based on real-world experience. The annual implementation planning and reporting processes, and working group and Technical Advisory Panel, provide the framework to implement the adaptive management approach.

Ongoing community engagement and empowerment

The Sunshine Coast nesting beaches fortuitously occur directly adjacent to a large urban population, which is home to a dedicated volunteer base. The fostering of conservation volunteerism provides a valuable means of combining community engagement, ecological research, and education to achieve conservation outcomes that might otherwise be unachievable. Ongoing community engagement will be achieved through actions identified in this Plan.

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Appendix 1. Turtle Conservation Mechanisms

International

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- United Nations Environment Program (UNEP) Convention on the Conservation of Migratory Species of Wild Animals (CMS) Single Species Action Plan for the Loggerhead Turtle (*Caretta caretta*) in the South Pacific Ocean 2014.
- Convention on the Conservation of Migratory Species of Wild Animals (CMS, or the Bonn Convention).
- IUCN (International Union for Conservation of Nature Red List of Threatened Species (2000).

National

- *Environment Protection and Biodiversity Conservation Act 1999.*
- Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017.
- National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, Commonwealth of Australia 2020.

State

- *Nature Conservation Act 1992.*
- Marine Turtle Conservation Strategy, 2018 - Queensland, Brisbane: Department of Environment and Science, Queensland Government.
- Queensland Marine Turtle Conservation Strategy 2021 (in prep).
- Model Code for Sea Turtle Sensitive Areas.

Local

Sunshine Coast Council Environment and Liveability Strategy.

Coastal Policy Provision

4.1: The natural values and function of coastal environments are preserved:

Native coastal fauna populations are maintained and enhanced

Action 24: Building our knowledge.

24.1. Undertake targeted monitoring, modelling, research, or other data collection.

24.4. Maintain and enhance partnerships with research institutions, government, and non-government organisations to grow our collective knowledge

24.5 Develop and trial new and emerging tools and technologies to improve knowledge

Action 25: The living lab

25.1 Investigate opportunities to establish a pilot eco-neighbourhood utilising a living lab approach, including the use of smart technologies to advance a range of neighbourhood sustainability and affordable living initiatives.

Other Sunshine Coast Council initiatives

- Marine Turtle Sensitive Area mapping.
- MTCP Communication Plan.
- Sunshine Coast Coastal Hazard Adaptation Strategy.
- Sunshine Coast Coastal Health Report.
- Sunshine Coast Biosphere Reserve.

Appendix 2. Turtle Profiles

Loggerhead turtle (*Caretta caretta*)

Stock: part of the loggerhead south-west Pacific (LH-swPac) stock

Status: IUCN Red List Critically Endangered (LH-swPac), Australia Endangered, Queensland Endangered

Preferred habitat: coral reefs, bays and estuaries in tropical and warm, temperate waters

Diet: carnivorous (shellfish, crabs, sea urchins and jellyfish)



Important nesting sites: southern Great Barrier Reef and adjacent mainland coastal areas, including Mon Repos, Wreck Rock, Wreck Island, Erskine Island, Tryon Island and Sunshine Coast

Mating: October–December (peak: November)

Nesting: October–March (peak: December–January)

Hatching: December–May (peak: February–March)

Physical characteristics:

Loggerhead Adult	Loggerhead Hatchling
	
<ul style="list-style-type: none"> • 5 pairs (rarely 6) of large scales on each side (costal scales) of the carapace • Non-overlapping carapace scales • Carapace longer than wide • Colour, red-brown to brown carapace, yellow plastron • Adult carapace approximately 1.0 m • Large head relative to body with strong jaws and parrot-like beak 	<ul style="list-style-type: none"> • Colour, dark brown to grey carapace, dark plastron • Carapace 4-4.8 cm long

Green turtle (*Chelonia mydas*)

Stock: part of the green Southern Great Barrier Reef (sGBR) stock

Status: Australia Vulnerable, Queensland Vulnerable

Preferred habitat: seaweed-rich coral reefs and inshore seagrass pastures in tropical and subtropical waters

Diet: adult green turtles feed mostly on seagrasses and algae although immature animals are carnivorous



Important nesting sites: islands of the Capricorn Bunker Group and minor breeding aggregations on mainland beaches from Bustard Head to Bundaberg and Sunshine Coast

Mating: September–November

Nesting: October–April (peak: late December–early January)

Hatching: December–May (peak: February–March)

Physical characteristics:

Green Adult	Green Hatchling
	
<ul style="list-style-type: none">• 4 pairs of large scales on each side (costal scales) of the carapace• Non-overlapping carapace scales• Carapace high domed• Colour, light to dark green carapace with dark mottling, cream-white plastron• Adult carapace approximately 1.0 m	<ul style="list-style-type: none">• Colour, black to dark brown carapace with white margins and white plastron• Carapace 5 cm long

Flatback turtle (*Natator depressus*)

Stock: part of the flatback Eastern Queensland (eQld) stock

Status: Australia Vulnerable, Queensland Vulnerable

Preferred habitat: shallow, soft-bottomed seabed habitats away from reefs

Diet: carnivorous (soft bodied prey such as sea cucumbers, soft corals and jellyfish)



Important nesting sites: Mon Repos in the south to Herald Island near Townsville in the north including Peak, Wild Duck, Avoid and Curtis Islands

Mating: Unknown

Nesting: October–January (peak: late November–early December)

Hatching: December–March (peak: February)

Physical characteristics:

Flatback Adult	Flatback Hatchling
	
<ul style="list-style-type: none">• 4 pairs or more of large scales on each side (costal scales) of the carapace• Non-overlapping carapace scales• Carapace low domed with upturned edges• Colour, olive grey carapace• Adult carapace approximately 0.9 metres	<ul style="list-style-type: none">• Colour, olive carapace, green plastron• Carapace 6 cm long

Leatherback turtle (*Dermochelys coriacea*)

Stock: part of the leatherback–Nesting in Australia (LB) stock

Status: Australia Endangered, Queensland Endangered

Preferred habitat: tropical and temperate waters including open ocean waters

Diet: carnivorous (jellyfish and other soft-bodied invertebrates)



Important nesting sites: none reported in Queensland since 1996 (previously Wreck Rock and Rules Beach)

Mating: December-January

Nesting: Functionally extinct in Eastern Queensland

Hatching: None in Queensland

Physical characteristics:

Leatherback Adult	Leatherback Hatchling
	
<ul style="list-style-type: none">• Carapace with 5 distinct ridges and no large scales• Colour, black with light spotting• Adult carapace approximately 1.6 metres	<ul style="list-style-type: none">• Colour, white blotched plastron• Carapace 5.88 cm long

Note: Leatherback turtles that feed and migrate through oceanic waters adjacent to the Sunshine Coast are the largest species (up to 2m in length), however their numbers are severely depleted. This species is of specific concern because they belong to a very small population that is subject to ongoing threats, and they are assumed to no longer nest in Queensland (1). An observation of mating leatherback turtles was, however, recorded in October 2021 on the southern Great Barrier Reef.

Hawksbill turtle (*Eretmochelys imbricata*)

Stock: part of the hawksbill – north Queensland (H-nQld) stock

Status: Australia Vulnerable, Queensland Endangered

Preferred habitat: tidal and sub-tidal coral and rocky reef habitats throughout tropical and warm temperate waters

Diet: Sponges, seagrasses, algae, soft corals and shellfish



Important nesting sites: northern Great Barrier Reef and Torres Strait including Long (Sassie), Hawkesbury, Milman, Boydong, Zuizin, Mimi, Bourke, Aukane, Layoak, Bet, Dadalai and Gebar Islands

Mating: year-round

Nesting: year-round (peak: December–February)

Hatching: year-round (peak: February–May)

Physical characteristics:

Hawksbill Adult	Hawksbill Hatchling
	
<ul style="list-style-type: none">• 4 pairs or more of large scales on either side (costal scales) of the carapace• Thick overlapping carapace scales• Carapace high domed• Colour, olive-green or brown, variegated with brown or black markings• Adult carapace approximately 0.8 metres• Distinctive parrot-like beak	<ul style="list-style-type: none">• Colour, brown/black plastron• Carapace 4 cm long

Olive Ridley turtle (*Lepidochelys olivacea*)

Stock: part of the olive ridley–north-western Cape York (O-nwCY) stock

Status: Australia Endangered, Queensland Endangered

Preferred habitat: shallow soft-bottomed habitats of protected tropical and subtropical waters

Diet: carnivorous (mostly shellfish and small crabs)



Important nesting sites: Low density nesting on western Cape York Peninsula between Weipa and Bamaga

Mating: February–September

Nesting: March–October (peak: August)

Hatching: (peak: May–December)

Physical characteristics:

Olive ridley Adult	Olive ridley Hatchling
	
<ul style="list-style-type: none">• 6 pairs or more of large scales on either side (costal scales) of the carapace• Carapace circular• Colour, grey green• Adult carapace approximately 0.7 metres	<ul style="list-style-type: none">• Colour, black with green plastron• Carapace 4-5 cm long

Appendix 3. Marine Turtle Biology and Ecology

Effective management requires a complete understanding of life history and habitat requirements for each species to determine the most responsive life history stages for management intervention.

Marine turtles have a complex lifecycle that spans a large geographic range over multiple habitats (Figure 3) and many decades (3). They are highly migratory during some life phases (see Figure 4), but during others show high site fidelity to small geographic areas, returning to the region where they hatched, to breed, resulting in discrete genetic stocks within each species (3).

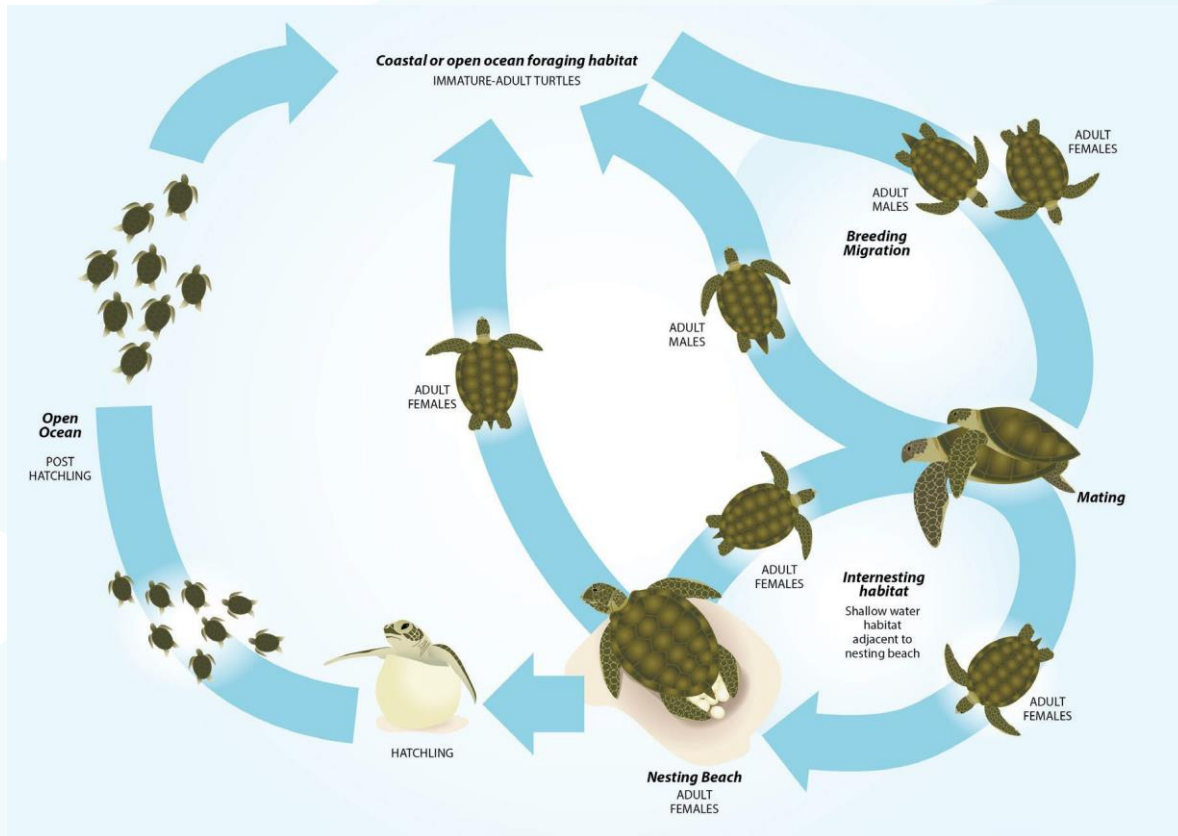


Figure 1. Indicative life cycle of marine turtles (3)

Nesting, incubation and emergence

Although marine turtles spend most of their lives in the ocean, adult female marine turtles come ashore to lay eggs in the sand above the high tide. Females lay on average two to six clutches per season and remain close to the nesting beach or rookery in between laying each clutch.

For successful incubation, marine turtle eggs must be buried in ventilated, high-humidity, sandy sites that are not subjected to flooding or tidal inundation and have a temperature range that persists within 22-33° C for the duration of incubation (9). Marine turtles have temperature-dependent sex determination. This means that the temperature during incubation determines the sex of hatchlings, with higher temperatures producing predominantly females. There are also upper and lower temperature thresholds for successful incubation. The time frame for incubation differs across species but is typically of about two months. Adult turtles provide no parental care to eggs or young.

Hatchlings emerge from the nest and orient towards the sea using the low elevation light horizon. After entering the water, hatchlings use a combination of cues (wave direction, current, and magnetic fields) to orient themselves and travel into deeper offshore waters. Crossing and swimming away from the beach is thought to enable hatchlings to imprint on the cues that will allow individuals to return to their natal region for breeding as adults.

The life stage after a hatchling leaves its natal beach and swims offshore, until it returns to coastal waters some years later as a small juvenile, is referred to as the post-hatchling or pelagic juvenile stage. Loggerhead turtle pelagic juveniles in the south-west Pacific migrate from eastern Australian rookeries to

South America and back using the predominant oceanic surface currents. There is high natural mortality during this pelagic life stage.



Figure 2. Indicative dispersal of loggerhead turtles in the South Pacific Ocean (adapted from (5))

After leaving the oceanic habitat, juvenile turtles (those not sexually mature) generally 'recruit' or take up residency in continental shelf waters where they inhabit sub-tidal and intertidal coral and rocky reefs and seagrass meadows, as well as deeper soft-bottomed habitats. In general, they do not form social groups, but feed as individuals. They tend to live year-round in coastal waters, often displaying small home ranges for foraging and migrating greater distances for nesting (Figure 4).

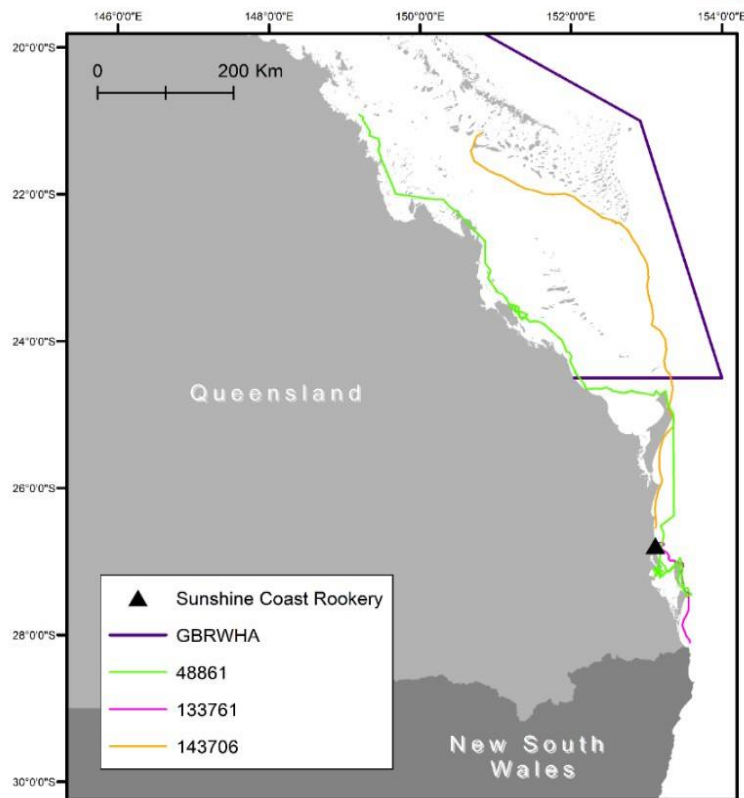


Figure 3. Post-nesting migration paths of three individuals from the Sunshine Coast Rookery in Queensland. Migration data range from 2012 to 2018 (18)

In general, marine turtle growth is slow and varies among species, habitats, sex and maturity. Marine turtles require 20-50 years to reach sexual maturity and females will only reproduce when they are able to obtain and store enough fat to make the breeding migration and produce eggs. The time between periods of female reproductive activity may vary from 1-8 years depending on species and food availability. Adult turtles show strong fidelity to both feeding and breeding grounds, migrating long distances (can be up to thousands of kilometres) to return to the region where they hatched. Fidelity to natal breeding grounds means that turtles that nest within a region are genetically more like one another than turtles that nest further away.

The life history traits of marine turtles make them vulnerable to a wide range of anthropogenic threats. These traits include decades to reach maturation, high natural mortality of hatchlings and small juveniles, strong fidelity to breeding areas, migrating over long distances to breed, and use of both terrestrial and marine environments to complete their lifecycle. At the same time, marine turtles have traits that contribute to population resilience including each stock being supported by multiple breeding locations and widely dispersed foraging populations.

Appendix 4. Conservation Values

Significant nesting population

Loggerhead turtles nesting on the Sunshine Coast make up about 4% of the south-west Pacific breeding population (anything above 1% is significant). The region is near the southern limit for marine turtle nesting in eastern Australia and the population has potential to increase in the long-term as a consequence of improved management over the last few decades (e.g. improved fisheries management, increased predator control, TurtleCare program, and recruitment of sub-adults born on Sunshine Coast). The Sunshine Coast also provides a potential insurance population if the major loggerhead rookery at Mon Repos were to fail.

Highly regarded volunteer program, citizen science and long-term data

With over 250 volunteers and 17 years of citizen science the Sunshine Coast community-based volunteer turtle programs (incorporating TurtleCare, Coolum and North Shore Coast Care and Bribie Island Turtle Trackers) are regarded as among the best in Australia. The long-term data set collected by volunteers is robust, extremely valuable, recognised nationally and provides an evidence base for future management improvement (see text box below).

Review of Sunshine Coast marine turtle nesting data (2005-2016) summary highlights

- Total of 742 clutches of Loggerhead turtle eggs were laid between Bribie Island and Noosa
- 71% of crawls up the beach resulted in a clutch of eggs being laid
- 78% of eggs resulted in hatchlings reaching the ocean
- 30% of nests were relocated due to threats such as erosion, storm tides and artificial light
- Nesting population is neither increasing nor decreasing, and shows normal demographic features for loggerhead and green turtles of Queensland

Based on standardised data collected by Sunshine Coast citizen scientists - TurtleCare, Coolum and North Shore Coast Care and Bribie Island Turtle Trackers (6).

Mostly male hatchlings (ecologically appropriate sex ratios)

Because gender is determined by nest incubation temperatures (for loggerheads, predominantly females are produced at temperatures above 28.6 degrees), cooler white sandy beaches on the Sunshine Coast have historically produced mostly male hatchlings and are expected to continue doing so. This is significant because elsewhere in Queensland increasing sand temperatures on nesting beaches are producing mostly female hatchlings, which is leading to an unsustainable feminisation and potential collapse of populations over the next generation (because there are too few males available for breeding) (1).

Climate change refugia

Global climate changes including rising sea levels, increasing temperatures and extreme weather events have significant local implications for marine turtles, including altered nesting and hatchling success and hatchling sex ratios (excessive sand temperatures can kill eggs and hatchlings in the nest). In response to increasing temperatures in higher latitudes, turtles are predicted to undertake a southward shift in nesting distribution over future decades and the Sunshine Coast is likely to provide increasingly important alternative nesting sites.

Sunshine Coast beaches are generally cooler (because of southern latitude, light sand colour and natural vegetation shading) and have elevated back dunes with potential to provide refugial nesting habitat under future sea level rise and retreating shoreline scenarios. With the southernmost nesting population, Sunshine Coast beaches are potentially the leading edge of a climate driven southern range expansion (a potential steppingstone for population adaptation to climate change).

Kabi Kabi First Nations culture

Turtles feature prominently within the knowledge systems, customary laws and livelihoods of many Indigenous coastal communities in Queensland, including for the Kabi Kabi Nation. This Plan provides an opportunity to celebrate and further strengthen Traditional Custodians' connections to turtles and the marine ecosystem more broadly.

Healthy coastal ecosystems

Marine turtles play an important ecological role in shaping and regulating coastal marine environments by contributing to complex coastal ecological food webs, placing grazing pressure on a diverse range of foraging resources (e.g. jelly fish, seagrass, corals and shellfish), modulating seagrass and coral reef habitats (by crushing shellfish, loggerheads help make beaches “one bite at a time”), facilitating nutrient cycling on land and at sea, and providing significant food resources for other species (most marine turtles are taken as prey before reaching sexual maturity).

Keystone species

Marine turtles are charismatic marine megafauna instantly recognised around the world. As an iconic species, they are often used as an indicator of broader ecological health in the marine environment. For these and other reasons, marine turtles provide a welcome invitation to educate the community about broader environmental challenges, advocate for changes in individual and community behaviour, and deliver benefits for a wide range of other species that rely on similar habitats. Protecting and enhancing marine turtle habitats provides co-benefits for many native species and people (healthy turtles=healthy coast=healthy ecosystems=healthy community).

Regional drawcard and lifestyle quality

Turtles are an iconic species and key attraction for Queensland tourism, particularly at Mon Repos, Heron Island and Lady Elliott Island, but potentially increasingly on the Sunshine Coast if marine turtle populations increase significantly. The presence of marine turtles, cultural connections with Kabi Kabi First Nation Peoples, the history of citizen science and academic research, and community-led management are all potential drawcards and help make the Sunshine Coast a great place to live, work and play.

The long game—intergenerational stewardship

Every year, when hatchlings emerge from the beach, a new page in the turtle story begins. Every hatchling has a one in 1,000 chance of surviving ocean life and grows very slowly, reaching breeding age at around 30 years. With luck and a bit of help from us, the hatchlings protected by this generation of Sunshine Coast residents and visitors will become the adult nesting females that return to our shores for future generations to see, experience and enjoy. To recover marine turtle populations is to play the long game. The positive effect of the TurtleCare program when it began in 2010 will only be seen in recruitment of adult females by 2040 (not withstanding other impacts).

In this way, marine turtle conservation necessitates and provides an opportunity to build inter-generational connections within and between the population of people and marine turtles living on and visiting the Sunshine Coast – ultimately resulting in a marine turtle sensitive community.

A team of turtle ambassadors with the skill to intervene

Recovering marine turtle populations on the Sunshine Coast may increasingly need labour-intensive interventions such as doomed clutch relocations, intensive predator control, individual nest shading, targeted irrigation to maintain ideal sand moisture levels, and public education. With a large and growing resident and visitor population, the region has the right characteristics, potential capacity and people power required to implement resilience measures that might otherwise be impractical on more remote island nesting beaches.

Healthy coastal environments—good for turtles, good for people

Marine turtles and humans both need and want healthy coastal environments. We share an attraction to clean coastal waters and estuaries, and undeveloped sandy beaches with natural dune vegetation. The beaches we surf and sunbathe on by day in summer are turtle maternity wards at night. Maintaining intact dune landscapes provides coastal stability that is essential for turtle nesting and protection of coastal residential communities. Climate change impacts are of common concern for marine turtles and people living on the Sunshine Coast. These shared concerns mean we can and should co-exist in harmony, safe in the knowledge that efforts to protect natural coastal habitats will benefit people as much as marine turtles.

Recognised as a turtle sensitive community—leading the way

Building on the highly successful TurtleCare program, the Sunshine Coast can be increasingly recognised as a global leader in community-based marine turtle conservation. This includes being a champion and

empowering the local community to lead marine turtle recovery actions on an ecologically meaningful scale elsewhere in Australia and the world.

Part of our vision to be Australia's most sustainable region

Recovering marine turtle populations on the Sunshine Coast is consistent with council's aspiration to be Australia's most sustainable region—healthy, smart, and creative. Community stewardship for marine turtles also supports the global recognition of the region as a Biosphere Reserve, celebrating people living in harmony with nature.

In summary, the relationship between marine turtles and the Sunshine Coast environment is likely to become increasingly important in the future and this Plan seeks to optimise the benefits for both marine turtles and people living in or visiting the region.

Appendix 5. Priority Threats to Sunshine Coast Marine Turtles

Climate change and variability

Climate change and variability is of particular concern for marine turtle nesting on the Sunshine Coast due to predicted changes to sand, air and sea temperatures, extreme weather, sea level rise, ocean acidification, reduced reproductive success, altered species ranges, nesting habitat availability, diminished survivorship and amplified coastal erosion that increases the risk of doomed clutches laid at or below the high tide level or exposed through extreme weather events.

Light pollution

With population growth and proximity to Brisbane, the Sunshine Coast is an identified hotspot for altered light horizon impacts. Dark skies along the Sunshine Coast nesting beaches are an essential requirement for nesting marine turtles and hatchling success. Light pollution (excess artificial light spill and sky glow) often increases with urban and/or industrial development in the vicinity of nesting beaches (including direct light fall on nesting beaches and adjacent coastal waters and ambient night glow from inland development, from industry, street lighting, community facilities and residential buildings). Increased sky-glow and altered light horizons at nesting beaches disrupt hatchling ocean-finding behaviour and cause increased hatchling mortality (8) (10). It can also alter adult turtle nest site selection with resulting reduction in adult female nesting population (e.g. altered adult flatback turtle ocean-finding behaviour has been identified up to 18km distant from an industrial plant on Boyne Island) (1).

Terrestrial predation

Terrestrial predation includes take by feral and native animals such as foxes, dogs, goannas, and birds. Excessive loss of eggs and hatchlings from feral and native predators of more than 30% of a season's egg or hatchling production, threatens the sustainability of the population. Ongoing control measures (for example, installing fox exclusion devices on nests) have effectively reduced loss of eggs and hatchlings by predation on Sunshine Coast beaches from an estimated 27% to less than 3% (10).

Marine debris

Marine debris, mostly synthetic items, can cause injury, illness or death of marine turtles from ingestion (e.g. post-hatchling turtles eating micro-plastics while foraging in surface waters) or entanglement (e.g. fishing nets, including discarded 'ghost nets', hooks, line or rope and beach debris). Micro-plastics (small particles of hard plastic) are now found everywhere in the marine environment and are being increasingly recognised as a chronic risk. The East Australian Current and south-east Queensland are local hotspots for loggerhead turtles with ingested debris. This can have a delayed impact on recruitment of large immature turtles into shallow coastal waters of Queensland some 16 years later.

Habitat modification

Habitat modification (including marine and terrestrial elements of the coastline) has the potential to spatially displace individuals or modify behaviour. Habitat modification includes the construction of ports and marinas, public infrastructure and coastal urbanisation, and removal of coastal vegetation to maintain or improve views. Loss or modification of habitat can result in short-term impacts such as physical displacement. Where habitat is lost permanently there is likely to be an impact on the viability of the stock utilising that habitat.

Recreation activities

Recreation activities that focus on or occur near marine turtle habitat can have great conservation value by raising public awareness of the issues relating to marine turtles (e.g. watching nesting females and hatchlings on the beach or turtles feeding on coral reefs). However, when mismanaged, these operations have the potential for disturbing marine turtle nesting, internesting and foraging behaviour, ultimately impacting the viability of the stock. In addition, disturbance of nesting behaviour by beach goers (e.g. beach

parties and fires, litter, and vehicles on beaches especially at night) can have negative unintended consequences for turtle nesting and hatching behaviour.

Fisheries by-catch

Fisheries by-catch (or incidental catch) includes all non-target interactions between fishing gear and marine turtles. Incidental catch can affect juvenile, sub-adult, and adult turtles in foraging areas, along migration routes or in internesting habitat. Interactions can be with commercial or recreational fisheries and includes shark control programs using baited drum lines and set nets. Reports of two leatherback deaths in south-east Queensland in 2020 appear linked to negative interaction with shark control nets.

Chemical and terrestrial discharge

Sediments, nutrients, and a wide variety of pollutants can enter marine turtle habitat through processes including dumping, run-off from urban, agricultural or industrial sources; effluents; atmospheric deposition; and leakage. On the Sunshine Coast, chemical and terrestrial discharge can result from urban runoff, effluent treatment and land use changes in the catchment. Discharge of increased nutrients, sediments and pesticides can occur from point source and non-point sources.

Vessel disturbance

Increased turtle/vessel interactions can disrupt important benthic feeding and internesting behaviours and cause serious injury and/or death to individual marine turtles. This is particularly an issue in shallow coastal foraging habitats (such as the Pumicestone Passage) and internesting areas where there are high numbers of recreational watercraft and commercial vessels, and in areas of marine development. Boat strike was the most frequent cause of marine turtle mortality in Queensland waters between 2000 - 2011. 'Go slow' zones in important marine turtle foraging habitats with high marine vessel traffic areas is an effective management approach.



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