LUKAOTEM GUD MAUNTEN
KASEM SOLWOTA

A REVIEW OF THE

MANAGEMENT & CONSERVATION OF SEA TURTLES

IN VANUATU

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Cover image: Edgar Hinge (Matasangvulu) creating a Bwatu Uliuli (Vanuatu sand drawing) of an Avua (sea turtle). This Bwatu Uliuli describes that Vanuatu people are born with a totem of the sea and land. If your totem is a sea turtle, it is your traditional obligation to “lukoutem gud” (protect) these sea animals from extinction. Bwatu Uliuli is made up of stories, songs, and knowledge with sacred meanings, and is an endangered form of cultural communication protected by UNESCO. Edgar is from Pentecost Island and is a well-known advocate for traditional knowledge and practices, and environmental conservation in Vanuatu. © SPREP/Kuautonga N./Hinge E.

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A resilient Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

A review of the management and conservation of sea turtles in Vanuatu

Francis Hickey, Donald Aromalo and Tiffany Straza

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List of Abbreviations

CBAO	Community-based Authorised Officers
CCA	Community Conservation Area
CCL	Curved carapace length
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMM	Conservation and Management Measure
CMS	Convention on the Conservation of Migratory Species of Wild Animals
DEPC	Department of Environmental Protection and Conservation
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
IUCN	International Union for Conservation of Nature
IMO	International Maritime Organization
RMU	Regional Management Unit
NGO	Non-governmental organisation
NPOA	National Plan of Action
SPC	Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
SPRFMO	South Pacific Regional Fisheries Management Organisation
TREDS	Turtle Research and Monitoring Database System
TRM	Traditional Resource Management
VFD	Vanuatu Fisheries Department
WCPFC	Western Central Pacific Fisheries Commission
WSB	Wan Smolbag
WWF	World Wide Fund for Nature

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This report is dedicated to the memory of the late George Petro who laboured tirelessly since 1995 to successfully initiate the Turtle Monitor Network, which later evolved into the Vanua-tai Resource Monitor Network under the NGO, Wan Smolbag (WSB).

Hatchling sea turtle © Freepik

Foreword

The Marine Turtle Review report for Vanuatu was completed in 2022. The recommendations in this report provide guidance on the way forward to improving management and conservation of sea turtles in Vanuatu. The report was produced through a literature review and consultations with key stakeholders, including the Vanua-tai Turtle Monitors Network, the Vanuatu Fisheries Department, the Department of Environmental Protection and Conservation, the Vanuatu Cultural Centre, the Department of Tourism and SPREP.

Marine turtles have long been an important part of the Vanuatu people's cultural heritage. The value of a large adult live turtle is equivalent to that of a mature tasked pig; turtles are traditionally gifted by high chiefs of coastal areas to inland communities. Marine turtle meat and eggs have been an important source of protein for many coastal communities while turtle shell was used to make jewelry and sold as souvenirs. Although commercial fishing and trade is not encouraged, turtles continue to be harvested for subsistence in the country. This, along with turtle capture for tourism, fisheries by-catch and coastal land-use change and pollution are the main threats to turtles in Vanuatu. Climate change is also affecting their habitats and food sources.

Marine turtles are globally threatened and listed as vulnerable, endangered or critically endangered on the International Union for Conservation of Nature (IUCN) Red List of ThreateneCd Species. A global management effort is needed to protect sea turtles, which are highly migratory animals that transcend maritime boundaries. Locally, joint efforts are needed between communities and islands to effectively protect turtles throughout their life cycle – from breeding, nesting and laying through incubation and when the juveniles leave the nest.

Vanuatu has been part of the global campaign to save sea turtles since the 1990s. This has included turtle head start programmes, adult turtle tagging, awareness campaigns conducted by the Vanuatu Fisheries Department and with the regional support of SPREP. These efforts saw the birth of the Wan Smol Bag Vanuatai Turtle Monitors, community volunteers responsible for checking tags and raising awareness on regulations relating to the harvesting of eggs and disturbance of breeding females.

While the volunteers continue to play an integral role in the management of sea turtles in Vanuatu, there is a need for more organised approaches supported by legislation and by-laws. Some of the important nesting sites such as Moso Island on Efate, Bamboo Bay and Wiawi have established turtle management committees, which continue to be active today.

The Fisheries Department introduced a permitting system in 2009 allowing turtle take for subsistence use in certain customary ceremonies such as the new yam harvest ceremony. This created its own challenges as communities took this as a permit to allow fishing of turtles and came up with new custom practices to qualify them for a permit. Enforcement of existing fisheries regulations has its own challenges, including costs of investigating breaches and prosecution. The regulations also discourage keeping young and adult turtles in captivity for the purposes of eco-tourism activities.

The National Plan of Action on Marine turtles 2016–2020 (NPOA) has provided policy direction to mitigate sea turtle by-catch in Vanuatu's industrial longline fishing fleet operating offshore. The NPOA is currently under review and will be informed by this review. It will incorporate turtle by-catch mitigation in the territorial waters and a turtle nest management plan will cover management and protection of turtle nests. These two policies will complement each other to enable the protection of sea turtles from nest to coastal waters and in the ocean.

The new management regime requires that the Government takes the leadership role in providing the scientific authority for management of marine turtles in Vanuatu. However, we cannot do this alone, and we will work closely with our coastal communities and with the support of the Vanuatu Fisheries Department, Vanua-tai Turtle Monitors Network, Wan Smol Bag, the Vanuatu Cultural Centre, the Department of Tourism and local businesses.

Vanuatu's marine turtle review is a key activity of the By-catch and Integrated Ecosystem Management (BIEM) Initiative being implemented by the Secretariat of the Pacific Regional Environment Program (SPREP) with Vanuatu government agencies and community partners. The BIEM Initiative is a component of the Pacific-European Union Marine Partnership (PEUMP) Programme funded by the European Union and the Government of Sweden. The review included consultations with key stakeholders, including the Vanua-tai Turtle Monitors Network, the Vanuatu Fisheries Department, the Department of Environmental Protection and Conservation, the Vanuatu Cultural Centre, the Department of Tourism and SPREP. The recommendations in this review report provide guidance on the way forward to improving management and conservation of sea turtles in Vanuatu.

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Bwatu Uliuli (sand drawing) of an adult sea turtle, Efate. ©SPREP/Kuautonga/Hinge

1. Executive Summary

Sea turtles are culturally and socio-economically important in Vanuatu. Five species of sea turtle are found in Vanuatu's coastal and marine environments. The global and/or regional populations of these sea turtle species are considered threatened: Vulnerable for loggerhead and olive ridley turtles, Endangered for green turtles, and Critically Endangered for hawksbill and leatherback sea turtles.

This review, undertaken for the Vanuatu Government, summarises existing knowledge about sea turtle research, monitoring and knowledge management, the threats to sea turtles, and the management systems in place. It also identifies gaps in knowledge and practice and makes recommendations to strengthen turtle monitoring and research, building upon the significant positive engagement by Vanuatu communities in sea turtle programmes.

Vanuatu has been a pioneer in enacting policies and legislation pertaining to the conservation and management of sea turtles for nearly 30 years. The efforts of Government have been supported by a community monitoring network in place for over 25 years to track sea turtle nesting at multiple nesting beaches in Vanuatu. Research projects have also been conducted sporadically alongside this monitoring programme. While the efforts of all involved are to be commended, enforcement of existing policies and legislation is limited and inconsistent; and monitoring remains spatially restricted, patchy, and with significant data gaps. This creates challenges in understanding the status of Vanuatu's sea turtles. Limited capacity and lack of funding for sustained sea turtle programmes have been key contributors.

As migratory animals, sea turtles found in Vanuatu also use habitats in many other countries and territories across the Pacific, including Australia, New Caledonia and Solomon Islands. Early genetic research indicates that some sea turtles present in Vanuatu, such as green sea turtles, may be distinct from other populations, requiring specific management efforts. International and regional partnerships are central to

effective sea turtle conservation and management. Vanuatu is a signatory of multiple international agreements focused on improving the conservation and management of migratory and threatened and endangered marine species such as sea turtles.

Sea turtles face several threats in Vanuatu. From the perspective of local management, the leading direct impacts are from offshore fisheries by-catch, local harvest for traditional use, and tourism. Sea turtles in Vanuatu are also being impacted by coastal land-use change, nearshore pollution and climate change. The impact of these threats on sea turtle populations is unclear in Vanuatu and there is an urgent need to strengthen monitoring and data collection activities to inform management. Key areas for focus include:

- **Traditional Harvest:** Sea turtles and their eggs have been targeted traditionally as food since the Lapita people first colonised Vanuatu some 3,000 years ago, and turtle consumption has continued in many areas. Now restricted to just a few communities, the drivers of present turtle take include ceremonial, food security, and taste factors. Between 2018 and mid-2021, 141 turtles were documented as permitted for take or illegally killed and reported; historically, take may have been over 400 or more sea turtles per year.
- **Tourism, including capture:** Sea turtles are used as a tourist attraction, with tourist operators marketing both chance encounters and the opportunity to swim with turtles, which involves holding onto or touching the turtles. Interactions at captive turtle facilities also allow handling of hatchlings, juveniles and adult sea turtles. Handling, capture and use of turtles in this manner violate Vanuatu's Fisheries Legislation. Currently, there are no turtle related wildlife activity minimum standards for Vanuatu.
- **By-catch:** Sea turtles are air-breathing reptiles and can drown when entangled or caught in fishing gear (actively used gear or lost or discarded gear), on top of direct mortality or injury from fishing-related interactions. Vanuatu is party to regional mandates for offshore fisheries mitigation and monitoring of sea turtle by-catch. Within the region of the Western and Central Pacific Fisheries Commission, an average of 285 turtles per year were reported as by-catch in purse seine fisheries between 2003 and 2020, peaking in 2013 with 482 reported individuals. Gaps remain in our understanding of the level and impacts of turtle by-catch in nearshore and offshore fisheries.
- **Village-based traditional governance** and **traditional management systems** need strengthening, along with tenure systems and the use of traditional knowledge to continue to enable communities to effectively manage their own resources under their tenure.
- **Coastal land-use change:** Sea turtles must nest on land, digging nests into soft sand. Many turtles return to the island or beach of their own hatching to lay their eggs, decades later. Nearshore developments and/or hardscaping threaten the availability and quality of turtle nesting beaches.
- **Pollution:** multiple types of pollution, not limited to plastics and nutrient or sediment pollution, affect sea turtles and their habitat or food sources.
- **Climate change** is affecting sea turtles, turtle habitat and their food sources.

Like many countries, Vanuatu faces key knowledge gaps about sea turtles, including:

- distribution and abundance: status and trends which are incomplete or unknown;
- social, cultural and economic value(s) and perceived value(s): a 2016–2017 survey provided valuable insight into the prevalence and drivers of turtle use and by-catch retention and the values ascribed to sea turtles by ni-Vanuatu. At present, there are no plans to repeat or build upon this research;
- trends in turtle encounters and/or use (including consumption as food):

    - permitted take for research or traditional harvest: the Vanuatu Fisheries Department maintains records of permit requests, but data are limited or difficult to access for actual take compared to permitted take;
    - tourism: data is poorly quantified, however, there are some validated reports of illegal sale and purchase of turtle hatchlings and adults, and of harmful practices in the captivity and handling of sea turtles; and
- trends in anthropogenic mortality of sea turtles, such as mortality due to:
    - by-catch in offshore fisheries. This is monitored for vessels carrying observers (targets: 5 per cent of longline vessels, 100 per cent of purse seine vessels), but there is limited, ad hoc by-catch monitoring and reporting for nearshore fisheries; and
    - illegal take, including egg consumption, which is incompletely known.

Existing data-based knowledge demonstrates the importance of sea turtles to ni-Vanuatu indigenous communities, and the ongoing threats to sea turtles from direct human actions. Vanuatu leadership has shown strong political will for the conservation and management of sea turtles, evidenced by multiple policy and legislative interventions and a National Plan of Action for Turtles. Combined with a well-established community-based NGO network of Vanua-tai members throughout the archipelago, the stage is set for a transition to more sustainable conservation and management of sea turtles in Vanuatu.

Section 6 provides high-level recommendations and suggested actions to address gaps or issues identified from this review for sea turtle management and conservation in Vanuatu. These recommendations provide guidance to strengthen outcomes for Vanuatu's sea turtles, across the following priority areas:

1. The policy and legislative framework in Vanuatu for effective sea turtle management.
2. Wildlife health and welfare in Vanuatu using best practices for animal encounters and wildlife tourism.
3. Management and mitigation of sea turtle by-catch in nearshore and offshore fisheries.
4. Knowledge and information collection about traditional turtle use in Vanuatu, including strengthened data collection in the Maskelynes around the New Yam Festival.
5. Capacity for sea turtle monitoring, management and enforcement in Vanuatu.
6. Capacity for scientific research on sea turtles and support targeted scientific research on sea turtles in Vanuatu, including research underpinning sea turtle management.
7. Knowledge custodianship of turtle-related data, information, and practices in Vanuatu.

A hawksbill turtle foraging amongst healthy corals in Moso Island © F. Hickey

2. Introduction

Vanuatu is an archipelago in the southwest Pacific with 82 inhabited islands of primarily volcanic origin and an Exclusive Economic Zone of 680,000 square kilometres (see 'Annex A: Map of Vanuatu'). An additional area of 230,000 square kilometres surrounding the small, uninhabited southern islands of Matthew and Hunter is currently disputed with France. The population of Vanuatu is estimated to be just over 300,000 as of 2020 (Vanuatu national census; see also SPC Statistics for Development Division). Nearly 80 per cent of the population resides in rural areas and lives a predominantly traditional lifestyle based on agricultural, animal husbandry and fishing activities.

Sea turtles and their eggs have been targeted traditionally as food since the Lapita people first colonised Vanuatu some 3,000 years ago, and turtle consumption has continued in many areas of Vanuatu, as evidenced in archaeological records (Bedford 2006: 228,229; Hawkins 2015). Archaeological records (Kirch 1997:202) suggest that consumption of sea turtles by early Lapita colonists was also common throughout the southwest Pacific and remote Oceania, likely due to their reliance on wild foods in the period before sufficient produce was available from gardens and the rearing of pigs and chickens. Recent archaeological research has revealed that Vanuatu also had an endemic species of tortoise that was targeted by Lapita people, as they were much easier to catch, and were quickly depleted to extinction within a generation or so shortly after the arrival of the Lapita people (Hawkins et al. 2016). Sea turtles continue to have important cultural values for many of the approximately 138 cultural-linguistic groups found today throughout Vanuatu (François et al. 2015), with traditional beliefs and practices that have served to manage sea turtles (Hickey 2006, 2007a, Hickey and Petro 2005; see '5.1.4 Traditional management measures'). Hawksbill turtle shells were also highly valued for making earrings, bracelets and other ornaments that were traded between islands (F. Hickey, unpublished data).

Sea turtles take decades to reach sexual maturity, reproducing at the age of 25 years or older, with some species returning to their natal beach to nest (Pilcher 2021). Their long lives, late maturity, and reliance on specific beach conditions at specific sites increases their vulnerability to a range of human-caused (anthropogenic) and environmental pressures.

Globally, sea turtles are threatened, with the status of the five species present in Vanuatu ranging from Vulnerable to Critically Endangered (Table 1). The populations of these species of sea turtles show a declining trend in abundance globally (IUCN Red List; Table 1).

Globally, sea turtle populations face pressure from direct harvesting of turtles and their eggs for food; land-use change restricting turtle access to or stability of nesting beaches; temperature change and the impact of warming on the sex ratio of turtle hatchlings; fisheries by-catch; pollution and entanglement hazards; and other stressors of natural or human origin (Wyneken et al. 2013, Pilcher 2021). Disruption of nesting turtles is prohibited, and consumption of sea turtles and their eggs for food in Vanuatu is regulated (see '5. Management of sea turtles in Vanuatu'). Turtle by-catch of offshore fisheries is monitored under national and regional frameworks (see '4.6 Turtle by-catch: offshore commercial fisheries'). Other stressors are broader and unregulated or difficult to regulate.

Communities in Vanuatu made a clear response to the awareness-raising associated with the Secretariat of the Pacific Regional Environmental Programme (SPREP) Year of the Turtle in 1995. In Vanuatu, the 1995 Year of the Turtle activities were focused through the local non-governmental organisation (NGO) Wan Smolbag (WSB). When the WSB Vanua-tai Resource Monitors started to work with community leaders around north Efate to introduce a ten-year taboo on turtle and egg consumption, most communities agreed that the taboo was necessary because they had witnessed a decline in turtle abundance over the years. It is estimated that over the ten-year period from 1995 to 2005, 1,000 fewer green and hawksbill turtles were consumed around north Efate (Hickey and Petro 2005). Community-based turtle conservation has been in place for only the last 27 years in Vanuatu as a whole and for less time in the far northern and southern islands. Given this short timeframe relative to turtle lifespans and the limited data currently available, it is difficult to identify clear trends in turtle abundance and turtle nesting for most locations. Compounding these limitations, sampling effort has not been uniform for many nesting sites, nor has monitoring effort been systematically quantified. However, the index site for green turtles at Bamboo Bay, Malekula[1], which is regularly monitored for nesters, shows a clear increase in nesting (see '7. Species summaries: Green turtle').

A drop in turtle consumption between the mid-1990s and 2010s, is likely although unquantified, with the change credited to community-based conservation efforts that commenced in 1995; legislation passed by the Vanuatu Fisheries Department (VFD) prohibiting the killing of any of the three main species of turtle (green, hawksbill and leatherback turtles) from 2005; and further protection provided in 2009 (Hickey and Petro 2005). During the 1980s and early 1990s, turtles and their eggs were consumed whenever possible in many areas, either targeted or harvested opportunistically (Hickey and Petro 2005). The population of Vanuatu in 1990 was approximately 90,000 people, implying comparatively less pressure on marine resources.

Because turtles found nesting or foraging in Vanuatu migrate to other countries in the region, the stability and growth of these turtle populations depends on cooperative conservation efforts in those countries and on the high seas where pollution, entanglement and by-catch from industrial fisheries take their toll. For these reasons, it is important to know where Vanuatu's nesting turtles go to forage and where foraging turtles go to nest, with an aim of ensuring that the management of this shared resource is coordinated regionally and internationally. It is also important to know where the migratory corridors are, using tagging and satellite telemetry.

In Vanuatu, the WSB Vanua-tai Resource Monitors monitor turtle nesting beaches and contribute to tagging efforts. The resulting information is held by WSB and government agencies. In addition, SPREP maintains the Turtle Research and Monitoring Database System (TREDS) to collate data from strandings, tagging, nesting, emergence, and beach surveys as well as other biological data on sea turtles in the Pacific Ocean.

[1] The spelling of village names and other terms can vary due to transliteration into English from Bislama and other languages of Vanuatu. The English spelling used here reflects the most common form used by ni-Vanuatu authorities and/or a single spelling selected for consistency, without prejudice.

With a regional scope, TREDS collations can provide information on marine turtle populations as well as their nesting and foraging sites. TREDS relies on data inputs from local data holders. Of note, there is no single repository for Vanuatu turtle data nor is there a systematic archiving system for information on sea turtles, for use in status assessments.

With more consistent survey effort over more sites, population trends will become clearer. Currently, the areas with the most consistent survey effort include Bamboo Bay (primarily green turtles) and Wiawi (primarily hawksbill turtles) on the west coast of Malekula. However, many other sites, such as the hawksbill rookery on Moso Island off Efate, had good baseline data collected for nesters and flipper tagging between 2007 and 2012. The key areas where leatherbacks are now known to nest in Vanuatu – at Votlo on Epi and Maranata on Ambrym – also have some baseline data from 2007 to 2012. In more recent years, it has been difficult to sustain the beach monitoring of these long nesting beaches by community-based volunteers. The effort required hinders the use of a voluntary-based network to sustain consistent nesting sampling over kilometres of remote nesting beaches, with specific equipment needs. This reality has become a significant restraint over the last decade. Sources of funding are necessary to support and improve consistent ongoing data collection.

There are many areas in Vanuatu where anecdotal feedback from community members indicates that turtle numbers have noticeably rebounded after some 25 years of conservation. These positive stories generally concern green and hawksbill turtles in areas with good turtle habitat and include north Efate, Lamen Bay on Epi (Shefa Province); Aneityum and Futuna Islands (Tafea Province in the south); Uri and Uripiv islands and Port Stanley on Malekula (Malampa Province); and Uraparapara Island, the Alget River and Quanlap village area of eastern Vanua Lava in the Banks Island (Torba Province). There may be many other areas where turtle population trends have changed. There are also several areas suspected of being important nesting areas that have never been fully investigated to confirm the extent of nesting by species or local threats. Complete assessments of these sites will require support. Some residents report that their seagrasses are being over-used as the turtles continue to feed on the seagrass. This phenomenon has been documented in other areas of the world where turtles have been well protected (Christianen et al. 2021). On some of these islands, it was suggested that the elders maintained a balance by occasionally consuming some of the turtles, so that seagrasses were not destroyed (F. Hickey pers. comm.). This concept was important to fishers because seagrasses are used by a variety of fishes, such as Siganids and *Lethrinus* spp., along with shellfish and a variety of invertebrates as well as dugongs.

Coastal land in Vanuatu faces continued development pressure, from resorts to coastal housing and infrastructure developments undertaken by the government to build roads, bridges and wharves throughout the islands. These pressures highlight the importance of ensuring that the government agencies responsible for monitoring and enforcing the environmental policies and legislation can keep up with the pace of development and provide sufficient protection of habitat important to sea turtles (and the resources on which turtles rely) throughout their lifecycle. Due to the complex life cycle of sea turtles, their range of habitats includes beaches, coastal forests, nearshore reefs, seagrass meadows and mangroves, neritic zones, and offshore pelagic areas that include international waters where migrations of up to thousands of kilometres are made. Each of these habitat zones has its own unique lists of threats, along with some common ones such as climate change and development pressure.

As Vanuatu approaches over 25 years of concerted local efforts for the conservation of sea turtles, clearer trends in recruitment may emerge as long-term datasets begin to fall within the range of time it takes for turtles to sexually mature. Any population change will also depend on how well the current turtle legislation is enforced to control turtle and egg harvest and use. This document outlines the next best steps for Vanuatu's sea turtle conservation and management, building on the high values ascribed to sea turtles by Vanuatu's people.

Hatchling of the Endangered Hawksbill Sea Turtle (Eretmochelys imbricata) on Western Malekula, Vanuatu © SPREP/C. Bartlett

3. Sea turtles in Vanuatu

This section provides a snapshot of information and the latest knowledge about sea turtle species found in Vanuatu, key data sources available and relied on, and the research and monitoring activities underway.

3.1 Species and threat status

At least five species of sea turtle are found in Vanuatu, with each considered threatened or vulnerable on the Red List of Threatened Species maintained by the International Union for the Conservation of Nature (Table 1). Although flatback (*Nattator depressus)* turtle distribution is normally considered limited to Australia and southern Papua New Guinea, flatback turtles may be found within Vanuatu's Exclusive Economic Zone (EEZ) (see '4.6 Turtle by-catch: offshore commercial fisheries'). Flatback turtle populations were last assessed in 1996 for the IUCN Red List and are ranked as Data Deficient (Red List Standards & Petitions Subcommittee 1996).

Table 1: IUCN Red List status of the five species of sea turtle found in Vanuatu, 2021

Common name	Scientific name	Status	Most recent year assessed
Green turtle	*Chelonia mydas*	Endangered	2004
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered[a]	2008
Leatherback turtle	*Dermochelys coriacea*	Critically Endangered[b]	2013
Olive ridley turtle	*Lepidochelys olivacea*	Vulnerable	2008
Loggerhead turtle	*Caretta caretta*	Vulnerable	2015

[a] A crisis category reserved for species that, among other things, are characterised by having sustained "an observed, estimated, inferred or suspected reduction of at least 80 per cent over the last 10 years or three generations"

[b] Western Pacific Regional Listing for leatherback turtles (see Wallace et al. 2013a)

Source: IUCN Red List of Threatened Species, https://www.iucnredlist.org/ (accessed February 2022)

All species of sea turtles are long-lived, slow-growing species, with a complex life cycle using a wide range of coastal and marine habitats (VFD 2015, Pilcher 2021). Sexual maturity varies between 20 and 50 years, with many species returning to the beach where they were born to lay their eggs (Pilcher 2021). Once reaching maturity, a female turtle will nest every two to three years (Wyneken et al. 2013), often undertaking a long migration from foraging grounds to a nesting beach. Female turtles lay 50 to 130 eggs per nest, dug into sandy beaches. Some turtles will lay multiple nests in a single nesting season, which in Vanuatu spans August to March with variation among species (see '3.4 Turtle nesting in Vanuatu'). After a period of 45 to 65 days, depending on the species,[2] turtle hatchlings crawl to the sea and spend much of their life cycle in the open ocean, but frequent the coast for feeding and breeding (Wyneken et al. 2013).

[2] Time from egg-laying to hatching can range from 50 to 55 days for leatherback, 60 days for green, 45 to 65 days for olive ridley, to 60 days for hawksbill turtles (Wyneken et al. 2013)

Philip Vanua holding hatchlings caught by roots in a hawksbill turtle nest. Bamboo Bay, Malekula © SPREP/C. Bartlett

3.2 Genetic diversity of Vanuatu turtles

Genetic analyses of sea turtles present in Vanuatu are limited, however, genetic research is emerging. Genetic studies can support effective management based on distinct populations. Genetic studies can also be used when determining sources of illegal trade in turtles.[3]

Read et al. (2015) found that Vanuatu's green turtles formed a unique Management Unit (MU), separate from the d'Entrecasteaux and Chesterfield–Coral Sea MUs. The researchers used 31 samples from the largest known rookery at Bamboo Bay, Malekula, with an estimated 25 to 50 females nesting annually. However, the latest monitoring for 2021/2022 nesting season at Bamboo Bay reported 103 green turtles and 107 hawksbills (James Aromalo, pers. com.). Further sampling from other reported nesting sites in Vanuatu, which extend up to 400 kilometres away from Bamboo Bay, would be required to determine whether they are part of the same MU.

Analysis of previous[4] sampling of tissues from Vanuatu turtles for mtDNA has been carried out by Dr Nancy FitzSimmons (formerly Australia National University; currently Griffith University, Australia) (Table 2). In addition to the green turtle samples, a limited number of leatherback and hawksbill tissue samples were taken at other sites (Table 2). Early findings are available from these samples (N. FitzSimmons pers. comm.):

[3] Regional workshops on how to undertake genetic sampling for the purposes of tracking illegal trade are planned for 2022 under the BIEM Initiative, led by SPREP, in partnership with Lamarve (K. Baird pers. comm.).

[4] Previous sampling coordinated by the late George Petro on work carried out by the Environment Programme of Wan Smolbag Theatre, working with the Vanua-Tai resource monitors. Core funding was received from Australian Aid and the New Zealand Aid Programme; additional funding was supplied by the USA National Marine Fisheries Service Southwest Regional Office of the National Oceanic and Atmospheric Administration for the project "Sea turtle nesting beach monitoring/survey, outreach and education in Vanuatu" 2004–2012.

- Preliminary genetic analysis of six leatherback turtles nesting at Votlo, Epi, and Maranata, Ambrym, shows the dominant Dc9.1 haplotype characteristic of the Western Pacific meta-population that nests in Papua, Papua New Guinea and Solomon Islands.
- Nesting green turtles and hatchlings (26) from Bamboo Bay, Malekula Island, show a dominant haplotype CmP91.1 that appears to be unique for the Pacific but is also found in nesters at Aru Island, Indonesia and in low numbers in a few Malaysian rookeries. This haplotype has been found in foraging turtles in New Caledonia (Read et al. 2015).
- Nesting hawksbill females (16) from Wiawi, Malekula Island, showed two haplotypes: EilP04 and EilP33. EilP04 appears to be rare, known only from two nesters from Milman Island, Australia, while EilP33 is common from rookeries in the Solomon Islands and the Indian Ocean/Arabian Sea.

The analysis and additional advice from Dr FitzSimmons has been used by WSB in planning for future collection of tissues and related training, pending future resourcing. Tissue samples will only be collected from newly tagged turtles with no previous tag scars on flippers, to avoid turtles previously sampled.

The following questions are presented as a starting point for future research proposals (Dr Kenneth MacKay pers. comm.).

- *Is there genetic variability among Vanuatu green rookeries?* Ideally, distant rookeries from the southern and northern islands would be sampled; however, this is not logistically possible given the large distances and limited budget. Instead, the focus will be on obtaining roughly 25 additional tissue samples from green turtles at Wiawi (35 kilometres north of Bamboo Bay) and the Votlo leatherback nesting site (150 kilometres south of Bamboo Bay), where greens also nest.
- *What is the origin of Vanuatu foraging green turtles?* In-water sampling has been proposed at Wiawi, Malekula Island (also a nesting site) and Gaua in the northern islands. Sampling will be carried out at Wiawi in conjunction with the nesting beach surveys in the future, but in-water collected turtles over 80 cm will not be sampled. The sampling in Gaua will be carried out when funds are available. Up to 80 samples may be needed for a mixed stock analysis.
- *What is the haplotype composition of central Vanuatu hawksbills?* Some samples (15) from Wiawi have been analysed that do identify a unique haplotype. Additional samples (about 20) will be obtained from Wiawi and Bamboo Bay. A nesting rookery on Moso Island, off North Efate, will also be sampled to obtain 15–20 tissue samples.
- *What are the haplotypes of leatherback turtles in Vanuatu?* Tissues will be collected at the two known leatherback nesting beaches on Epi and Ambrym Islands with the hope of collecting five to ten more samples.

Table 2: Genetic sampling of sea turtles in Vanuatu, 2004–2012 (exact dates uncertain). Five haplotypes were found for green turtles, two for hawksbill, and one for leatherback. Source: N. FitzSimmons pers. comm.

Species	Location	Field status	Haplotype	Number	Notes
Green	Bamboo Bay, Malekula	Nesting adults and hatchlings	CmP91.1	18	
			CmP47.1	1	
			CmP47.2	6	
			CmP20.1	1	
	Wiawi, Malekula	Nesting adults	CMP91.1	2	
			CmP47.2	1	
	Wiawi, Malekula	In water foraging	CmP65.1	2	
			CmP20.1	2	
Hawksbill	Wiawi, Malekula	Nesting adults	EilP04	9	
			EilP33	6	
	Malokilikili, Malo Is.	Hatchling	EilP33	1	
Leatherback	Maranata, Ambrym	Nesting adult	Dc 9.1	1	
	Votlo, Epi	Nesting adults and hatchlings	Dc 9.1	5	One appeared to be a green CmP65.1

As part of the research permitting process, mechanisms to ensure that the samples are preserved and exported to a suitable laboratory for analysis must be decided prior to and be part of the protocol for any new collections. Without these mechanisms, research efforts may be wasted or significantly delayed. For example, 33 skin samples were taken from sea turtles between 2011 and 2015 by Ken McKay and left with WSB. The samples are currently, as of 2022, in a freezer; in 2019, attempts were made to send the samples for analysis. The Vanuatu Government approved an export permit one week before the six-month validity of the Australian import permit expired, but that approval arrived two days after flights leaving Vanuatu stopped because of COVID-19 pandemic restrictions in March 2020 (C. Shaw pers. comm.). The viability of the samples is uncertain because the initial preservation methods may have been inadequate.

The Vanuatu National Museum has been collecting hawksbill tissue samples in participation with WWF's Marine Turtle Use and Trade Initiative (2018–2026).

A hawksbill post nesting turtle on Moso returning to sea with a Telonics Iridium satellite tag © F. Hickey

3.3 Research and monitoring activities

3.3.1. Early scientific research on sea turtles in Vanuatu

The Department of Environmental Protection and Conservation (formerly the Vanuatu Environment Unit) initiated a nation-wide postal survey in 1989 of turtles and confirmed that at least four species of marine turtle were found in Vanuatu waters: green, hawksbill, loggerhead and leatherback turtles. Green and hawksbill turtles were confirmed to nest in Vanuatu. The survey further revealed that turtles were subject to "heavy exploitation in some islands like Malekula, while elsewhere there seems to be little or no pressure on these resources." This finding was interpreted to mean "either these animals are declining in numbers, are rare or [are] not being harvested due to custom or religious beliefs" (Environment Unit 1990). This information was expanded on: "The killing of turtles for consumption does not occur on all islands in Vanuatu. The survey showed that on some of the islands the killing of such animals is a taboo and on others, only the chief is allowed to kill or can permit such a killing" (SPREP 1990).

Subsequent to the postal survey, the Department of Environment and Conservation (DEPC) initiated the first turtle tagging programme of nesting turtles with the support of SPREP at four key sites between 1992 and 1994 (Table 3). Of significance in this early survey is the recording of loggerhead nesting sites at Wiawi and Votlo on Malekula and Epi, respectively. Loggerhead and olive ridley nesting sites are the most data-deficient nationally. By contrast, key hawksbill, green and leatherback turtle nesting sites have largely been documented, according to Hickey (2020).

Table 3: Results of the DEPC (Vanuatu Environment Unit's) first turtle tagging study, 1992–1994. Source: Hickey 2020

Location	Date	Species tagged	Observations
Maskelynes	10–21 November 1992	3 Green 3 Hawksbill	No nesting observed; locals report a decline in turtle nesting and numbers
Mota Lava/Reef Islands	25 February–4 March 1993	1 nesting Green	On uninhabited reef islands, several nests had been disturbed
Wiawi – NE Malekula	November 1993	9 Green 2 Loggerhead	Identified as an important turtle nesting area
Votlo, SE Epi	January 1994	1 Loggerhead	Numerous nesting crawls observed; local informants identify Votlo as an important leatherback nesting area

3.3.2. Present data collection and custodianship in Vanuatu

There are three main sources of data about sea turtles in Vanuatu:

- Vanuatu Fisheries Department (VFD) traditional take permit requests; also records of reported unsanctioned harvest of turtles;
- VFD offshore by-catch records; and
- WSB community nesting site monitoring and tagging.

In addition, a community use survey was conducted throughout Vanuatu in 2016 and 2017 with several questions pertaining to sea turtles (see ‘

3.6 Vanuatu fishers survey’).

VFD maintains records of turtle take requests and permits granted under the exemptions for traditional take and research[5]. There has only been limited data collection of traditional turtle take regarding numbers or species actually taken and/or consumed (versus permitted) along with sex, size and state of health. See ‘4.3 Traditional Take Permits and Harvest Data’.

Turtle by-catch in offshore commercial fisheries from the Vanuatu national fleet and relevant international vessels is monitored and reported according to the Western Central Pacific Fisheries Commission (WCPFC) guidance. See ‘4.6 Turtle by-catch: offshore commercial fisheries’ for impacts. By-catch in coastal and artisanal fisheries is not monitored. Reporting of turtle by-catch or strandings is opportunistic. To assist with enforcement within communities, in 2014, the VFD initiated a programme to train community members to act as Community-based Authorised Officers (CBAOs) to monitor and report fisheries infractions at the village level, including turtle-related infractions. CBAOs are therefore well placed to monitor turtle by-catch in coastal and artisanal fisheries.

In Vanuatu, as in the rest of the world, the bulk of turtle research and information collection is conducted at turtle nesting beaches with nesting females and turtle hatchlings. Turtle tagging and nest monitoring is largely undertaken by WSB via the Vanua-tai community-based network, and the tagging and nesting data are compiled and submitted to SPREP for entry into the TREDS database, coordinated by SPREP. The other main tagging operation is Tranquillity Resort on Moso Island that has a head-start programme for hawksbill turtles (unsanctioned, see 4. Threats to sea turtles in Vanuatu’); again, tagging is reported for entry into TREDS.

There is no single repository for Vanuatu turtle data or knowledge nor is there a systematic archiving system for information on sea turtles, for use in status assessments. TREDS is the most comprehensive turtle data collation in place, although for sea turtles in Vanuatu TREDS currently only holds tagging and nesting records.

The TREDs database was extensively upgraded in 2021 with an online interface, hosted by SPREP, that will allow member country data managers to input and retrieve their own data. Training will be required for WSB and other organisations for using the new TREDS interface.

While annual summary reports based on data within TREDS are provided by SPREP to WSB and Vanuatu authorities, Vanua-tai members have had little opportunity to obtain feedback on their efforts to know how the data they collect and provide is being used for management purposes (Jodi Devine pers. comm.). At the Vanua-tai network Annual General Meetings, around 100 Vanua-tai come together to network and report on their community-based activities as well as receive training on relevant topics. This meeting provides an opportunity for knowledge sharing, including about TREDS-based knowledge products.

[5] From 2019 turtle research permits are issued by the DEPC.

Strengthening turtle data collection in Vanuatu using technology such as smartphones and tablets during turtle surveys would also support data management and the ability to upload the data to a central location, such as WSB headquarters, for back-up, storage and analyses. These changes could also support more timely input into the TREDS system. Currently, field data sheets are stored in villages for about six months before being hand-delivered at the annual general meeting. This approach leaves these data sheets vulnerable to loss or damage, including cyclone damage. TREDS now offers an offline data form to facilitate data collection in the field, using a smartphone or tablet. The Vanua-tai community members will require training in the use of the new forms associated with this update. About 20 Vanua-tai members have now also become CBAOs under the VFD and have received some training in the use of tablets using the TAILs program to record fisheries-related data, including for sea turtles. The CBAO could also assist in the recording and digital storage of data in the islands as well as uploading data to head office.

Resource limitations challenge turtle research in Vanuatu. Regular monitoring requires support for labour, transport, and other resources. Travel to multiple islands is required to achieve adequate representation across Vanuatu. Turtle monitoring often involves expenses, such as the costs for truck or boat transport, torches (turtle nesting activity peaks during the night) and batteries, as well as food and shelter for the volunteers. In many cases to date, Vanua-tai resource monitors have been expected to provide much of the required equipment and other resources at their own expense. For these and other reasons, existing nesting surveys are scattered and likely do not meet the effort requirements for comprehensive surveys of turtle nesting beaches in Vanuatu (C. Shaw pers. comm.).

At present, a comprehensive national monitoring programme is not in place for turtle abundance, by-catch in nearshore and artisanal fisheries, perceptions relating to turtles, or the drivers of turtle use, including repetition of the survey in 2016–2017 (see ‘

3.6 Vanuatu fishers survey’). Future turtle monitoring could build on the existing dataset from the 2016–2017 questionnaire and other research. Repeating the survey could be part of assessments of change following awareness-building programmes or legislative changes.

In 2021–2022, financial assistance was provided to WSB to place temperature recorders within the nesting grounds to monitor nest temperatures at Bamboo Bay and Wiawi by the SPREP By-catch and Integrated Ecosystem Management (BIEM) Initiative, active in Vanuatu from 2019 to 2022. The BIEM Initiative is also funding Dr Christopher Bartlett to work with the communities at these sites to develop community-based turtle management plans to help strengthen the monitoring and conservation of turtles nesting at these sites.

To strengthen knowledge in Vanuatu relating to trends in turtle abundance, by-catch, and the social drivers of turtle use, several key factors will need to be addressed, including:

- key drivers for turtle encounters as a part of tourism activities;
- levels of and drivers for hunting, consumption, or use or turtle eggs or hatchlings;
- income generated from turtle use;
- by-catch in offshore as well as coastal and artisanal fisheries;
- abundance assessments for each species; and
- impacts of climate change on hatchlings, including through changes in sand temperatures on nesting beaches, as well as the washing out of nests by flooding and cyclones.

Protecting a sea turtle nest from predation by wild dogs with woven bamboo. Bamboo Bay, Malekula © SPREP/Bartlett

3.4 Turtle nesting in Vanuatu

Turtles are most vulnerable to human impact during the nearshore phase of their nesting migration and beach nesting activity. Turtle nesting is also vulnerable to land-use change, given the requirement for space and appropriate sand to dig a nest, over the decades between a given turtle's hatching and return to nest.

Turtle nesting in Vanuatu spans August to March, with variation among species (Hickey 2020). For more about turtle nesting in Vanuatu, see '7. Species summaries' and 'Supplement 1: Sea turtle data relevant for Vanuatu'.

As noted above, loggerhead and olive ridley nesting sites are the most data-deficient nationally; by contrast, key hawksbill, green and leatherback turtle nesting sites have been better documented according to Hickey (2020) (see 'Supplement 1: Sea turtle data relevant for Vanuatu'), although monitoring activities are irregular.

Information collected at WSB Vanua-tai workshops in 2007 and 2008 identified over 189 nesting sites on 33 islands of Vanuatu, with approximately 200 turtles (both green and hawksbill) nesting at Malekula Island per year (Fletcher and Petro unpublished 2009, Hickey 2020). Espiritu Santo Island[6], including the offshore island of Thion, supports some 50 or more nesting turtles per year, and approximately 30 turtles nest annually at Tegua and Hiu islands in the Torres Group in northern Vanuatu (Hickey 2020).

Because survey coverage of Vanuatu's beaches is not yet comprehensive, total nesting activity is likely underestimated. Important sites include Bamboo Bay/Dixon Reef area on west Malekula for green turtles, Moso Island (off north Efate) and Wiawi on west Malekula for hawksbills, and Votlo on Epi followed by Maranata on Ambrym Island as the two main leatherback nesting beaches (see '7. Species summaries').

[6] Santo Island is officially referred to as Espiritu Santo and often just referred to as Santo.

Noel Kaibaba and Philip Vanua entering sea turtle data into new online, tablet-based, sea turtle management system. Bamboo Bay, Malekula © SPREP/Bartlett

3.5 Turtle tagging in Vanuatu

In Vanuatu, information about sea turtle populations is incomplete (VFD 2015). The number of turtles tagged, and tags reported are used as an incomplete proxy of turtle abundance, based on the number of interactions. On average, 103 turtles were tagged annually from 2000 to 2018, with high variability from year to year (Figure 1).

Between 1991 and 2018, 15,712 tags were distributed to WSB, DEPC, VFD, Nguna Pele MPA and Tranquility Resort by SPREP. Of those, only 4,607 (29.3 per cent) had been reported as used, representing 2,596 turtles tagged in Vanuatu and recorded in TREDS (TREDS, accessed January 2022). Most tagged turtles were hawksbill (1,692), followed by green (653), unidentified (225), leatherback (15), loggerhead (7), and olive ridley (4).

Of 3,004 encounters with sea turtles in Vanuatu reported in TREDS, 2,556 encounters were reported as primary tagging (TREDS, accessed January 2022). Siota (2015) reported that since 2010, the majority of tagged turtles were juveniles from ‘head-start’ programmes that were tagged prior to release from captivity (see ‘Annex E: Turtle tourism’), however, only 55 encounter entries on TREDS specify that the turtle was tagged as part of a head-start programme.

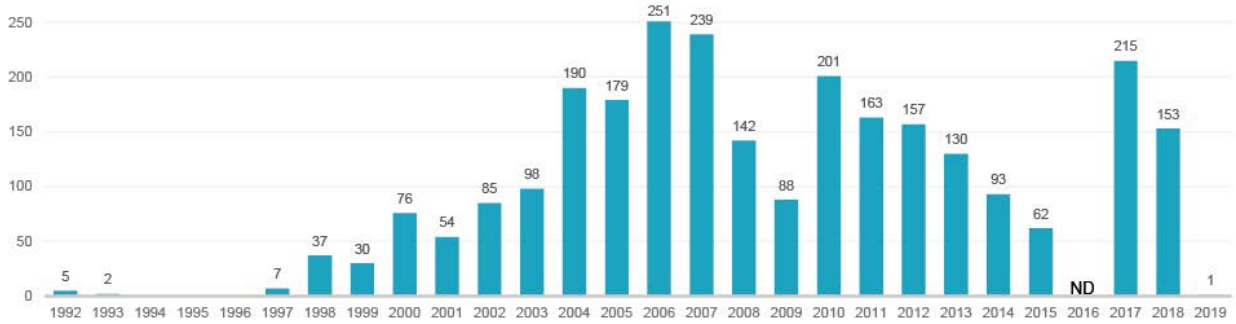


Figure 1: Number of turtle tags applied per year, 1991–2015. Numbers here include re-tagging. In the case of a discrepancy between Siota (2015) and TREDS entries, the larger number was used. The 2019 record submissions are incomplete. Source: Siota 2015; for 2002 onward: TREDS records of WSB entries (accessed January 2022); for 2017 and 2018: Ward 2019.

The number of tag recoveries is strikingly low compared to the number of tags applied. Of the 3,004 turtle encounters in Vanuatu reported in TREDS over 1991–2019, 208 encounters reported recapture of a previously tagged turtle (TREDS, accessed January 2022). Only 63 turtles were reported as both tagged and recovered within Vanuatu as of 2015 (Siota 2015). Seven tagged turtles (five green and two hawksbill) were recovered in Vanuatu having been tagged elsewhere. One turtle (hawksbill) was tagged in Vanuatu in 2009 and recovered stranded in Australia in 2010, having died; there are no other reports of Vanuatu-tagged turtles recovered elsewhere (Siota 2015). Over 2017–2018, only eight of the 368 turtles tagged were recovered within Vanuatu, seven tagged turtles were recovered in Vanuatu having been tagged elsewhere, and one turtle tagged in Vanuatu was recovered elsewhere (Ward 2019). Support for continued flipper tagging activities, including tag reporting, can help to clarify regional connectivity, track take, provide information about other threats to turtles, and clarify foraging patterns by location, species and size. This may require ongoing support to assist trained Vanua-tai members to tag and collect data on foraging activities. Data on important foraging areas throughout the islands will be useful for informing Environmental Impact Assessments for infrastructure developments throughout the islands. The findings would also be useful for informing VFD responses to traditional take requests for turtles. See ‘Box 1. Why are sea turtles tagged?’ for more information on turtle tagging.

Tagging efforts in Vanuatu would benefit from greater coordination and custodianship of tags and tag data. This measure would avoid the repeat of a historic problem: more tags were distributed to WSB than were entered into TREDs, which resulted in SPREP limiting additional distribution of tags in 2008 and again more recently. In some cases, this meant that tags were not available for use in some areas. SPREP is currently developing a regional sea turtle tagging and monitoring manual and strengthening management protocols for tag distribution and use (see ‘Annex D: Active and upcoming projects supporting sea turtle management in Vanuatu’).

Box 1. Why are sea turtles tagged?

The purpose of turtle tagging is to track where turtles go. Knowing where turtles move throughout their lifetime supports effective management by identifying factors such as management partners (including other countries), where the turtles are nesting, important habitats for turtles, and zones of high turtle mortality. Tag tracking can also support research into the tagged turtle's lifespan, condition throughout its life, and other life-history factors.

Tagging alone is not enough. Tag reporting is an essential component for the success of a tagging programme.

There are two main categories of tags: satellite tags and flipper tags.

1) **Satellite relay data loggers (also called satellite tags, transmitter tags, or tracking tags) send a signal that is picked up by satellite networks to pinpoint the tag's location and show where the turtle travels. Satellite tags are more costly, and larger but provide regular, automatic updates of the tagged turtle's location. In other words, satellite tags do their own reporting. Satellite-tagging programmes tend to be short-term because the tag stays on the turtles for a defined period before detaching itself, or the battery expires.**

2) **By contrast, flipper tags are simple and low-cost, as they are merely numeric bands applied to the flipper. Their effectiveness relies on tag recovery and reporting. Flipper tags that are lost or removed without reporting make that tagged turtle 'invisible' to sampling studies. Flipper tag studies are often called "capture-mark-recapture" studies. Flipper tags enable long-term studies because ideally the tag is a permanent identification of the turtle.**

Previously tagged turtles may have scars on their flipper(s) where a tag had been applied. Such scars should be noted and reported in the record of a newly applied tag.

It is critically important that existing tags be left on any turtle encountered. Any use of tagging data, such as the number of tags applied per year, to estimate turtle abundance is dependent on the use of unique tags per turtle. Removing an old tag and applying a new one, without reporting that action under both tag numbers, can undermine tag-based studies.

Only juveniles (at least one-year-old) and adult turtles can be flipper-tagged, due to the size of the tag and the stress of the tagging procedure. The size restrictions for tagging is another reason why turtle hatchlings should not be disturbed or captured.

The health of the turtle comes first. If encountering an untagged turtle without tagging gear to hand, the best practice is to leave the turtle alone. Flipping over a turtle on the beach, tethering a turtle in the water, or otherwise trapping the turtle is harmful to the turtle and to be avoided.

A captured green turtle in the Maskelynes © F. Hickey

3.6 Vanuatu fishers survey[7]

A community survey on sea turtles was conducted throughout Vanuatu between 2016 and 2017 using a modified version of the Convention on Migratory Species (CMS) Standardised Dugong Catch/By-Catch Questionnaire ('Supplement 2: Survey questionnaire'), as part of the Dugong and Seagrass Conservation Project funded by the Global Environment Facility (VESS 2017). The survey team conducted 537 interviews on visits to 32 islands, targeting community fishers; the responses are considered largely representative of the relevant Vanuatu population, because fishers are the most likely to interact with marine species, such as sea turtles. In addition, most ni-Vanuatu fish for subsistence primarily, or to sell locally. Very few are commercial fishers.

To take advantage of this survey process, turtle-related questions were added to obtain a snapshot of turtle take (accidental and intentional), the nature of encounters with turtles, and perceptions of turtles and their abundance. In total, 35 turtle-related questions were asked in the modified survey, and the extensive turtle-related results have not yet been fully analysed. The information provided below is a selection of the survey findings, kindly released by VESS in advance of complete analysis and publication.

A total of 441 people responded to questions about sea turtles, representing all six provinces of Vanuatu.

Almost all (98.6%) of the survey respondents believed that sea turtles are important. A total of 346 people gave reason(s) for their belief that turtles are important, with these reasons of significant interest for future management interventions (Figure 2). Examining results, tourism and associated revenue was the most common importance attributed to sea turtles, identified by 26.0% of respondents. A simple interpretation is

[7] Source for the section 'Vanuatu fishers survey'*:* preliminary analysis of VESS unpublished data: Christina Shaw and Alexandra Comino; for details of the survey and the results regarding the respondents, fishing practices, and dugong, see VESS 2017.

that the practice of tourism can alter the importance/valuation of turtles. Further analyses could consider the location-specific patterns, accounting for areas where tourism is more prevalent.

The importance of turtles because of their use as a food source was identified by only 6.9% of respondents, outranked by many other values associated with turtles.

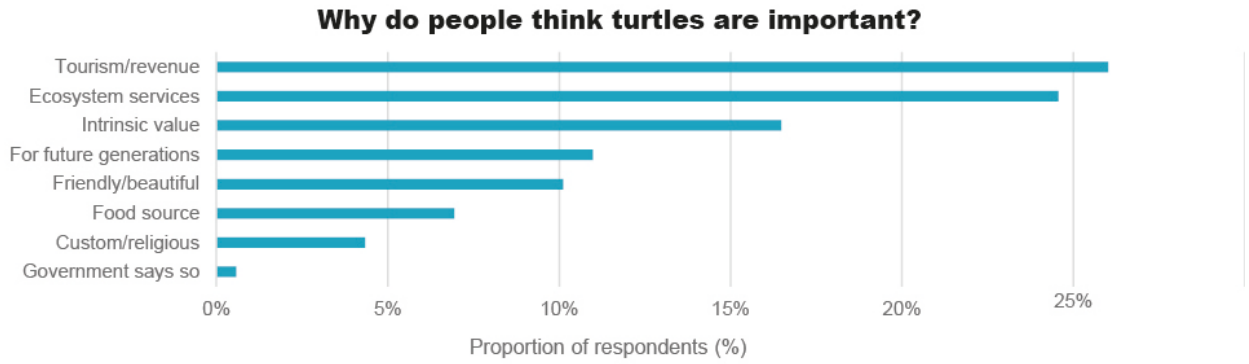


Figure 2: Reasons for believing turtles are important in Vanuatu by share of respondents, 2016–2017. A total of 346 people responded to this query. Source: VESS Unpublished Data

Knowledge about turtle-related customs, stories and legends is held unevenly among community members. About one in five people (21.9%; 96 of 438 respondents) reported that they knew or were aware of a custom, belief, story, ritual, or other social connection with sea turtles. Another 2% said they did not know whether those connections existed.

The majority (96%) of the 441 respondents had seen a sea turtle within the past year. Turtles were most encountered when people were fishing for target species other than turtle (35.4% of reported encounter types) or travelling to and from fishing areas (30.0%), followed by encounters on the beach (14.7%) when the turtle was most likely nesting. Hunting for turtles accounted for only 5.8% of encounters, similar to the level of encounters of turtles trapped in nets (5.8%) or stranded (3.2%).

Turtles were seen consistently throughout the year, ranging from 8.2% of encounters occurring in each of March and August to 8.7% of encounters occurring in December (401 respondents). Similarly, turtles were reported as captured throughout the year, based on responses from 43 people, with a peak in March (12.3% of captures) and low points of 6.7% of captures occurring in February and August. The majority (45.9%) of turtle captures were conducted with a harpoon/speargun, followed by diving while the turtle was sleeping (25.2%) and capture with nets (23.7%).

Roughly one third of 410 respondents had caught a turtle within the past five years, with 6.6% having caught one turtle, 18.9% having caught two to ten turtles, and 10.0% having caught more than ten turtles.

Most respondents perceived turtle take to be intentional throughout Vanuatu. Nearly half of the respondents who knew of captured turtles reported that the catch was intentional (47.4% in other villages, 49.4% in the respondent's own village), and another 36.6% (own village) to 43.3% (other villages) reported that catch was both accidental and intentional. Only 9.4% (other villages) to 14.0% (own village) of respondents believed that turtle catches were only accidental.

Although the reasons for turtle capture were not extensively surveyed, 26 respondents indicated that turtles were caught for special occasions or major community events. Two people noted that turtles provided part of their food security following the disaster of Cyclone Pam in 2015, after misinterpreting a radio discussion on measures that could be used to support communities after the disaster.

Over half the respondents (59.9%) reported that they would eat a sea turtle that had been caught intentionally (Figure 3) while 58.5% reported that they would release a turtle that had been caught accidentally, and 72% said they would release a turtle found stranded (Figure 4). It is not clear if the respondents considered turtle eggs or hatchlings in any of the questions about turtle capture; therefore, the proportion (6.5%) who reported they might sell a turtle may not fully encompass those who would capture and sell turtle hatchlings. At least one respondent indicated that their fellow villagers caught hatchlings and released them after a few months.

Thirty of the 418 respondents specified the action that they would take if they found a dead turtle (Figure 5). Twelve (40.0%) said that they would eat a turtle that they found dead, if the carcass appeared fresh enough. One said they would take the shell. One person did not know what they would decide to do. The remaining 16 people (53.3%) said that they would discard or leave the turtle; of interest is that eight respondents said they would bury the turtle.

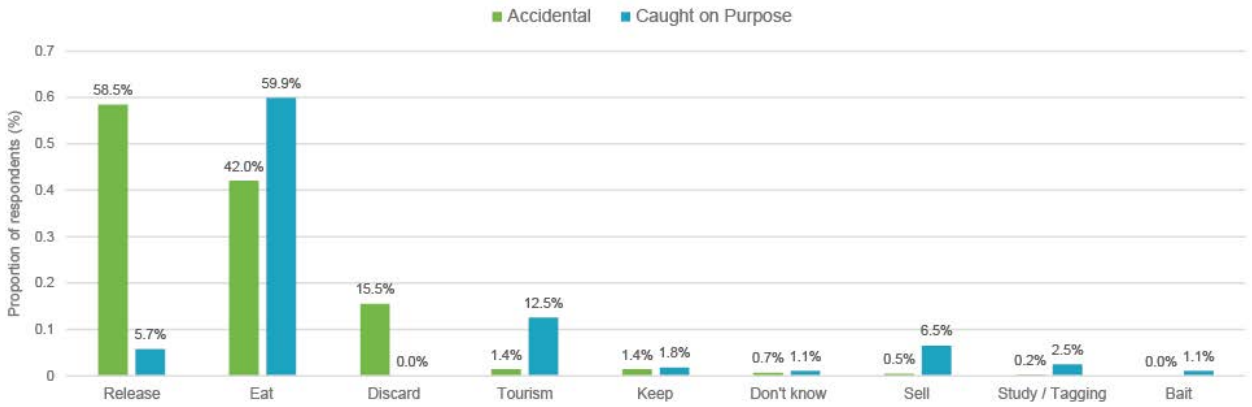


Figure 3: Fates of captured turtles as reported by survey respondents (n = 438 for accidental capture, n = 279 for intentional capture), 2016–2017. The sum of the percentages may exceed 100% because each respondent had the option of reporting multiple possible fates. Query number refers to the survey questionnaire. Source: VESS unpublished data.

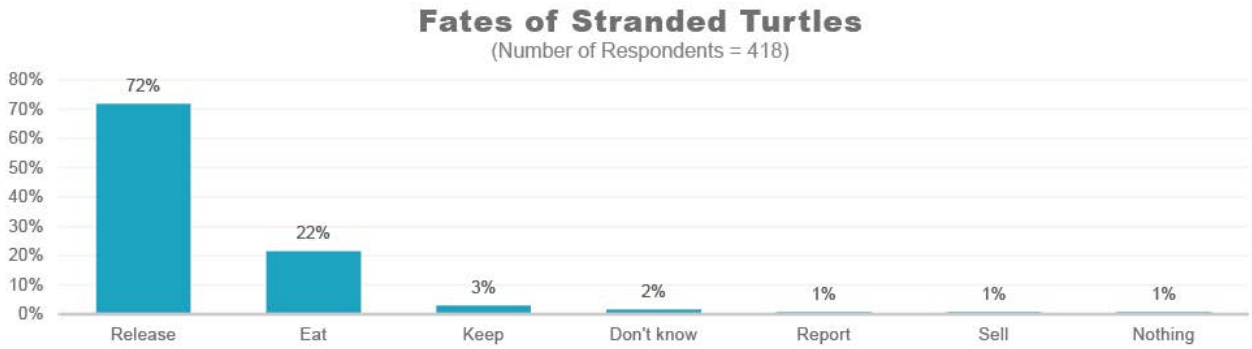


Figure 4: Fates of stranded turtles as reported by survey respondents (n = 418), 2016–2017. Query number refers to the survey questionnaire. Source: VESS unpublished data.

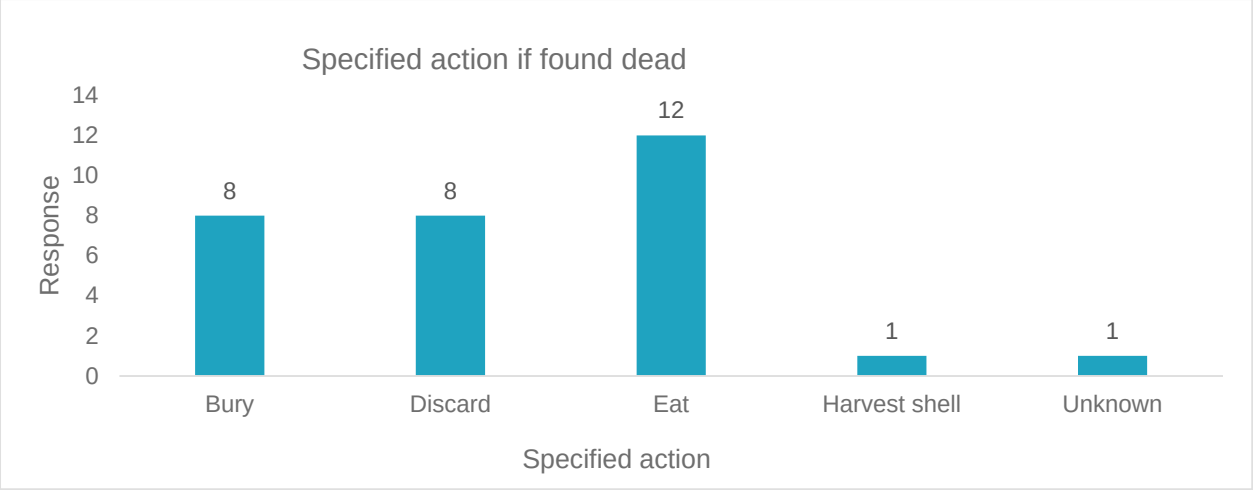


Figure 5: Specific action if turtle is found dead as reported by survey respondents (n = 30), 2016–2017. Source: VESS unpublished data.

The survey data provides information on perceived trends in local sea turtle populations. Most (63.6%) of the 207 people who replied to questions about their perception of a trend in turtle abundance believed that turtle populations in their area have been increasing since they started fishing. Another 24.6% thought that turtle populations were declining, 4.6% considered turtle populations stable, and 7.1% did not know. Perceived increases in local turtle abundance run counter to the global trends in populations of the five turtle species present in Vanuatu (see Table 1). However, the likelihood of seeing more turtles in the short term is likely an outcome of the increased conservation efforts (awareness and enforcement of legislation) over many years which results in turtles losing their wariness – they become ecologically naïve, and consequently, more observations of turtles are made as turtles move in from other areas. This has been observed in many areas provided sea turtles remain untargeted. (F. Hickey, pers. obs., Johannes and Hickey 2004).

Population assessments of sea turtles in Vanuatu would be necessary to obtain accurate abundance data. Accompanying social research may be used to identify drivers of the perceived trends, which may relate to changes in the awareness of turtles or their 'noteworthiness', changes in the shared spaces used by turtles and people, or other factors.

Of the 84 people who believed sea turtles were decreasing in abundance, the vast majority (76.2%) believed that direct killing was the driver of the decline. By contrast, among 209 people who believed turtle populations were increasing, the perceived drivers were comparatively evenly spread among perceived decreases in hunting (26.3%), practice of turtle-related law (24.9%), high turtle reproduction (23.9%), and turtle conservation and protection (20.6%). People valued Vanuatu's conservation efforts, with a third (27.7%) of 289 respondents crediting conservation for the presence of sea turtles in Vanuatu into the future.

One in four respondents reported knowing of tourism activities wherein turtles could be viewed (24.1%) or visited in captivity (26.0%). Of the 136 people who described how turtles were viewed in tourism activities, the majority (52.9%) reported turtle viewing in captivity (Figure 6). This knowledge is expected to vary by location, relating to proximity to and engagement in tourism facilities and activities. Note that Vanuatu Fisheries legislation prohibits the capture, sale, and possession of sea turtles; see '5.1.2 Conservation through national regulations'.

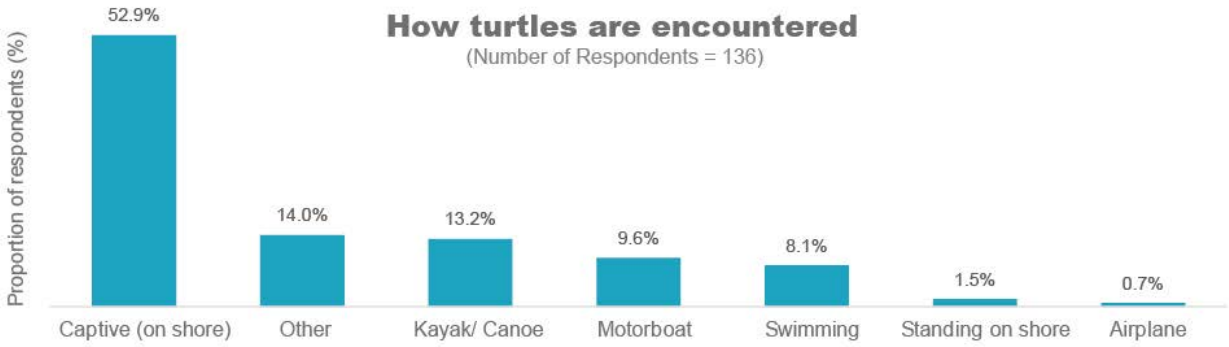


Figure 6: Activities during which turtles are encountered, as reported by survey respondents (n = 136), 2016–2017. Query number refers to the survey questionnaire. Source: VESS unpublished data.

Baiting turtles with food was a common practice, with 68.2% reporting this method out of 110 people who replied regarding methods for attracting turtles.

Of the 61 respondents describing interactions with turtles in captivity, 23 (37.7%) reported that tourists were allowed to touch turtles during their visit and another 23 (37.7%) reported that tourists were allowed to enter the water with the turtles. Again, among those visiting captive turtles, 41 people (67.7%) said that instructions were given prior to their interaction with the turtles. When instruction was described for turtle-specific activities, the most common instruction was about *how* to touch or feed a turtle (7 of 16 responses), whereas only two people reported instructions prohibiting physical contact with turtles.

3.7 Relevant management partners

Based on tagging data, turtles found in Vanuatu have been documented using habitat in the following states and territories (Miller et al. 1998, Siota 2015, Hickey 2020):

- American Samoa
- Australia
- Cook Islands
- Fiji
- French Polynesia
- New Caledonia
- Niue
- Papua New Guinea
- Samoa
- Tonga.

In practical terms, sea turtle populations are divided into regional management units (RMU). The relevant RMU for Vanuatu is noted for each species in the species summaries in Section 7. Additional genetic research may refine or change the designation of management units (see '3.2 Genetic diversity of Vanuatu turtles'). Based on these RMU, several additional countries and territories beyond the list above are relevant management partners, including but not limited to all 14 Pacific Island countries and seven Pacific Island territories and protectorates that are members of SPREP and SPC (Work et al. 2020).

The Regional Marine Species Programme 2022–2026 (SPREP 2022) Marine Turtle Action Plan was completed and released in June 2022 for the Pacific Islands region. A Regional Turtle Extinction Risk Assessment is underway for all five species of sea turtle present in Vanuatu. For more about ongoing actions within Vanuatu and across the region, see 'Annex D: Active and upcoming projects supporting sea turtle management in Vanuatu'. NGOs are also actively working on turtle conservation within the region; for instance, the World Wide Fund for Nature (WWF) is working to reduce hawksbill turtle harvest and trade across the Coral Triangle, working intensively in Malaysia; WWF is also active in satellite tagging projects and advocacy for eliminating turtle by-catch. The Hawaii Preparatory Academy has sponsored three years of satellite tagging in Vanuatu (2018–2020) of nesting hawksbill turtles on Moso Island in partnership with the Vanuatu National Museum and Vanua-tai. This programme is scheduled to continue in 2023, as the years 2021 and 2022 were interrupted by COVID-19 protocols that restricted travel into Vanuatu.

Bwatu Ulilili (sand drawing) of juvenile sea turtle, Pentecost Island © L. Sine

4. Threats to sea turtles in Vanuatu

4.1. Natural mortality

Sea turtle eggs and hatchlings are particularly susceptible to predators, although adult turtles also face predation. Predation rates at sea are not well known (Wyneken et al. 2013, Pilcher 2021).

In Vanuatu, on land, the line is blurring between natural and human-caused (anthropogenic) mortality because human-introduced species, such as pigs and dogs, prey upon turtle eggs and hatchlings. Existing policies and legislation support the general protection of nesting turtles and turtle nests but do not specify control of domestic animals near nesting beaches (see '5.1.2 Conservation through national regulations').

Survivorship of hatchlings in Vanuatu is largely unstudied. Limited data from 2020–2021 suggest that most turtle eggs at Votlo village on Epi Island nests hatch successfully (Figure 7), but emergence success and post-hatching survival is unknown. Survivorship for turtles at other sites is also understudied but varies from 40% for hatchlings to over 80% for adults, varying among species and sites (Pilcher 2021). For the eastern Pacific population of leatherback turtles, as few as 31% of hatchlings may survive to reach the water and only 6% survive their first year (Laúd OPO 2020 cited by Pilcher 2021). Hatchling survival declines as the time between hatching and reaching the ocean increases, as may occur if the hatchlings suffer disorientation (see the discussion of light pollution in '4.7 Threats to nests and nesting beaches (excluding direct take) or are interrupted by humans (Putnam et al. 2010, Trullas et al. 2006).

Figure 7: Survival of turtle hatchlings at nest sites in Votlo, Vanuatu, in the 2020/2021 nesting season, based on the 16 nests found during a survey of three kilometres of beach. Only 6% of the hatchlings were observed to be dead in nests, with an additional 7% of eggs unhatched. These hatching success rates are high compared to studies in other locations (Pilcher 2021). Additional data may be available from Wan Smolbag for other sites or years. Source: Falia David, Vanuatai monitor; species illustrations © NOAA Fisheries

Sea turtles face diseases at each life stage. Health risks include fibropapillomatosis, a tumorous disease that can kill turtles, which may be associated with nutrient pollution and eutrophication (Dujon et al. 2021). A study of more than 6,000 stranded green turtles over 30 years in Hawaii ranked the causes of stranding as follows: fibropapillomatosis, hook and line trauma, miscellaneous causes not specified, gillnets, boat strikes, and shark predation (cited by Work et al. 2015). Excluding fibropapillomatosis, among 153 known causes of death in turtles retrieved across a range of islands with connections to the United States between1993 and 2011, 64% of deaths were due to trauma, followed by infectious/inflammatory disease (18%), nutritional abnormalities (16%), and physiologic abnormalities (1%) (Work et al. 2015). The presence or prevalence of fibropapillomatosis and its likely cause, the Chelonid Herpesvirus 5 Virus, are unknown in Vanuatu (Dujon et al. 2021).

Other diseases are less well studied, but there are hints that ocean temperature rise may worsen health risks as the infectivity of viruses increases in warmer water, as is the case for the herpesvirus that causes grey-patch disease in green turtles (Dujon et al. 2021, Mashkour et al. 2020). Human activity may increase the risk of disease transmission if turtles are kept in water warmer than ambient sea temperature or in close proximity to other turtles (Mashkour et al. 2020). The risk of disease transmission between turtles by human handling or by releasing turtles that have been held in captivity, often with multiple turtles per enclosure, is unknown for Vanuatu.

Based on the limited studies to date, controllable mortality hazards, such as trauma and entanglement, outrank diseases as a priority for management in Vanuatu. That said, disease risk assessments should be part of risk assessments for turtle projects and facilities (Mashkour et al. 2020).

Healthy populations rely on genetic diversity. Genetic studies, along with mobility studies as facilitated by satellite tracking or tagging (and reporting), are used to direct turtle management using RMUs. The effective conservation of sea turtles will rely on preservation of a sufficiently diverse breeding population; in other words, waiting to act and then attempting to rebuild a population from a very small number of adult turtles is riskier and less likely to succeed than protection efforts that begin with a sizeable number of distantly related adults. Genetic research on sea turtle diversity in Vanuatu remains limited; see ‘3.2 Genetic diversity of Vanuatu turtles’ for a summary of present knowledge and planned research. Vanuatu’s green turtles may be a unique population (Read et al. 2015), increasing their priority for management from the perspective of maintaining biodiversity. Changes in the sex ratios of turtle hatchlings have been documented in other parts of the world, providing further incentive to monitor turtle populations in Vanuatu as the size and characteristics of the breeding populations may be changing, with these shifts compounded by the potential presence of genetically distinct subpopulations (Patrício et al. 2021).

4.2 Direct harvest, traditional take and human manipulation

Harvesting of sea turtles for consumption remains active but incompletely quantified in Vanuatu; there is more information about adult turtle take but egg collection from turtle nests may still occur. It is known that hatchlings are sold to tourism programmes, but this trade has not been quantified. Turtles are acknowledged as a traditional food in the National Plan of Action on Sea Turtles (NPOA Turtles) 2016–2022 (VFD 2015). Compared to traditional foods like fish, crab, and marine invertebrates, turtles have an elevated status in many of Vanuatu's customs, equal to that of pigs.

The Lapita people who initially colonised Vanuatu, consumed turtles some 3,000 years ago (Bedford, 2006:228-229), as was also observed in the archaeological record for the southwest Pacific and Remote Oceania[8] (Kirch 1997:202). The archaeological record of Lapita sites throughout the Pacific tells us that turtles were a central feature of the diet (along with fish, shellfish, etc.) as the colonists had yet to establish extensive food gardens upon arrival. Tortoises were also targeted, but being so easy to catch, and impacted by coastal land use changes introduced by the Lapita people, including the use of fire to clear gardens, they were quickly rendered extinct. The limited numbers of pigs and chickens that Lapita colonists brought were kept as breeders to build up stocks and they remain common and highly valued in villages today. Before domesticated stocks of food reached abundance, wild and highly nutritious foods such as turtle were integral to food security. Turtles have remained part of people's diet over millennia and contribute to food and social security, while also being customary. This contribution has been partially offset by the introduction of cattle and other livestock like goats, sheep and European pigs during colonial times, which provides alternative sources of animal protein.

Turtles also feature prominently in oral histories of Vanuatu, including their consumption. Turtles are considered a status food equal to consuming pig. There is also evidence of turtles being traded between coastal communities and communities in inland areas, who would repay the debt with yam, taro and banana (Hickey 2006, 2007a). Turtles, along with other marine life, were also managed through the imposition of regular taboos creating spatial/temporal refugia, as observed in the early 1900's, as well as in the present (Flexner et al. 2019). On Tanna and other nearby islands, ritual specialists were responsible for increasing these marine resources, including for turtles, using "power stones" and controlling access to them as an integral part of their cosmologies and traditional resource management strategies (Flexner et al. 2019).

Sale, purchase, and/or consumption of turtle meat, eggs, or parts have been prohibited under Vanuatu law since 2005, with measures protecting nests reaching back to 1983. Specific, limited exemptions are available for traditional take requests (see Chapter '5. Management of sea turtles in Vanuatu'). Consumption of a turtle found dead is also prohibited, although awareness of this rule is not as well known. For instance, 12 of 30 respondents indicated that they would likely eat a turtle found dead, for example, if caught as by-catch in a gillnet (see '3.6 Vanuatu fishers survey'). For this practice to change, transparent discussions are required among community members and enforcement officials, recognising that one person may interpret avoiding the consumption of a found-dead turtle to be effective conservation, while another might interpret it as disrespectful waste of the gifts of nature. Effective enforcement of laws preventing this consumption will rely on awareness and consideration of multiple factors, such as the risks to human health from turtles which died of unknown causes or an unknown time ago, the ecological factors around the fate of a dead turtle in the ecosystem, and the social and conservation factors associated with consumption versus release of a dead turtle.

There are multiple drivers of turtle capture and use (including, but not limited to, consumption as food) in Vanuatu. Traditional take for consumption is primarily for special occasions, such as the New Yam Festival

[8] Remote Oceania extends from Vanuatu eastward to Rapa Nui, and north to FSM, Marshall Islands and Hawaii as well as all the islands south to New Zealand. Prior to the arrival of the Lapita people circa 3000 BP, there were no known people living in this vast area of the Pacific Ocean.

or a specific custom ceremony, like the annual Chiefs' Day, celebrated as a national holiday to acknowledge the ongoing role of chiefs in Vanuatu's society. It can also occur for the opening of a new nakamal (traditional meeting house) or church (see '4.3 Traditional Take Permits and Harvest Data'). This take is in alignment with the high cultural value of turtles, requiring chiefly permission or oversight for intentional harvest. However, turtles appear to be a welcomed food at other times as well. A high proportion of people reported that they would likely eat turtles that are caught by accident (42% of 438 respondents) or found stranded (22% of 418 respondents) (VESS unpublished; see '3.6 Vanuatu fishers survey'). One respondent indicated that they believed turtles were hunted because turtles were too abundant and harming food sources for other valued marine animals.

Take by species appears to be largely opportunistic, with more abundant species more likely to be represented in the harvest. In the Maskelyne Islands, there is a slight taste preference for green turtles over hawksbill, as hawksbill have a less-preferred odour, but either species would be taken if encountered during the traditional hunt and would be shared in the same manner (J. Laggat, CBAO and Vanua-tai, pers. comm.). It is also noted that hawksbills are more likely to bite fishers and cause serious injuries, so are not targeted for this reason. There was also a case of chelonitoxism in 2006, where three people died in the Maskelynes, resulting in people avoiding targeting hawksbills. (F. Hickey pers. obs.).

The drivers of turtle take in Vanuatu vary over time and seasonally. However, Vanuatu fishers report that turtles are caught throughout the year (see '3.6 Vanuatu fishers survey').

The main, and only formally recognised area that has an annual customary practice of turtle consumption, linked to new yam harvesting ceremonies, is the Maskelyne Islands off south Malekula Island. Residents have previously legally consumed well over 100 turtles annually, in addition to 40 during new yam ceremonies (Hickey and Petro 2005; see '4.3 Traditional Take Permits and Harvest Data'). Green and hawksbill turtles continue to be consumed annually as part of new yam ceremonies under a permit, with 23 consumed in early 2017 (J. Laggat pers. comm.). As of early 2018, the VFD attempted to limit the consumption of turtles to one turtle per nasara (traditional descent lineage) for a total of 26 nasaras in the Maskelyne area (William Naviti, former Director of Fisheries, pers. comm.). However, this is not currently followed, and numbers are negotiated village-by-village.

The management and conservation of turtles in the Maskelynes is undermined by the harvest of adult turtles while they are still actively nesting. From the perspective of sea turtle management, the key issue is the alignment of the nesting season (roughly August to March, peaking in December to February) with the annual celebration of the Maskelyne New Yam Festival. This festival occurs every year on 4 February for the main Maskelyne Islands, including the villages of Lutes, Pellonk and Peskarus (all located on the island of Uliveo). The smaller communities of Avok, Haiumb Island, Hokai and Nerinium celebrate New Yam a month later (4 March), the day before Chiefs' Day, a national holiday.

In past practice, the Maskelynes villages of Lutes, Pellonk and Peskarus commenced harvesting turtles in January and corralled the turtles harvested in the mangroves near their villages (F. Hickey pers. obs.). They stockpiled the turtles well in advance to ensure they had many turtles for the event, but collection coincided with peak nesting. First-hand observations of the New Yam celebration on 4 February 2004, when stockpiling turtles commenced in January, found immature egg follicles in some of the female turtles as they were being prepared for cooking (F. Hickey pers. obs). This indicated that female turtles that were ready to nest were being harvested and consumed during the festival prior to them having a chance to nest. It also meant that turtles were being consumed when their fat reserves were at a minimum as these reserves were exhausted in supporting egg development, making the meat much drier and less appealing.

Currently, turtles for the Maskelynes New Yam Festival must be collected over the week or two preceding New Yam Festival on 4 February, or whatever period VFD specifies as a condition to the traditional take permit. In 2022, the three villages of Uliveo began harvesting turtles in the two weeks prior to the day of the

festival (Joby Siba, VFD, pers comm). They were required to only use traditional methods of catching the turtles, which includes canoes fishing at night without the use of snorkel gear, spears or spearguns (Joby Siba, VFD, pers comm). This is in line with the original intent of the traditional take permit but had not been rigorously enforced by the VFD prior to 2022. The catch in 2022 was all green turtles. Nine turtles were harvested in Pescarus (two males, seven females), six at Pelong (all female) and eight in Lutas (six females, two males).

These figures were lower than the number approved by VFD for harvesting in 2022. The reasons being a passing cyclone, which made it difficult to locate turtles due to rough seas, and the rigours of jumping from a canoe at night to catch turtles foraging over seagrass meadows by hand and wrestling them into a canoe. This is a significant step towards reviving the highly specialised traditional skills of turtle hunting, while at the same time reducing the harvest to more sustainable levels. It also brings the traditional take of turtles under the Fisheries Act back in line with the original intent; to only use traditional methods to catch turtles. This outcome also reinforces the assertion that traditional harvesting methods of foraging turtles is more sustainable than using introduced modern methods (Hickey and Petro 2005).

One of the most significant drivers for harvesting turtles in the Maskelynes takes the form of a challenge to other male relatives by a fisher presenting the heart of the turtle he caught to his maternal cousin (Hickey and Petro 2005). The cousin must then catch and give back the heart of another turtle of equal or greater size to satisfy the challenge. If he takes too long to do this, he will be reminded of his obligation, and it will not be forgotten. This system would appear to not only contribute to turtle hunting excellence in the Maskelynes, but also to the high number of turtles caught there. The elders feel very strongly about this cultural practice, as they grew up with it and they do not want this customary practice to die out. Other drivers specific to the Maskelynes in the era prior to legislation banning turtle harvests, were for raising money for school fees by selling prepared turtle cuisine, payment for community labour, and because it was one of their traditional foods (Hickey and Petro 2005).

The key environmental cue signalling the annual New Yam timing in Vanuatu (and many other countries in Oceania) is when the asterism Pleiades sets in the west at sunset (Hickey 2006, 2007b). This astronomical pattern occurs in late March or early April, which also marks the end of the turtle nesting season. Some elders from the Maskelynes concurred in 2004 that the traditional time for New Yam formerly aligned with the setting of Pleiades in early April (Hickey and Petro 2005; for a traditional seasonal calendar in Vanuatu, see Chambers et al. 2021).

Preliminary discussions are now under way to consider shifting the New Yam Festival back to its traditional time of the setting of the Pleiades, in early April, for all villages in the Maskelynes. This would reduce the likelihood of consuming females already laden with eggs. It would also make the monitoring of New Yam turtle take by VFD personnel significantly easier and more cost effective while training the CBAO's and Vanua-tai on how to collect turtle data, including tissue samples for genetic analysis. There may be some initial resistance to moving the dates for the New Yam Festival, and it will require extensive consultations with the Maskelynes Council of Chiefs for it to be a positive move to improve management of the turtles in this area. Surveying other villages in south Malekula that may still recall the tradition of celebrating New Yam in April, may assist in making this change.

VFD maintains records of approved permitted turtle take. There is only limited data collection of traditional turtle take regarding numbers consumed (versus permitted) and species consumed (see '4.3 Traditional Take Permits and Harvest Data'). Permits do not consistently require records of the species type, size measurements, or collection of genetic samples. There are no substantiated estimates of illegal take.

The criteria for allowing traditional take of turtles currently only requires that there is the existence of some turtle customs, such as New Yam celebrations. It does not require an assessment as to whether the turtle population is sufficient to allow for the traditional take of a modest number of turtles. The goal should be

sustainable use[9], as with any fishery, and in line with IUCN guidelines, ensuring that the take allowed does not impact the viability of sea turtle populations. The emphasis for permitting needs to be strengthened to consider how sustainable the proposed traditional take is likely to be, using latest data available to assess the population in the area. The NPOA for Turtles acknowledges that turtles are a traditional food in Vanuatu. For the Maskelynes, given the cultural significance, there is a need to assess the turtle population before allocating a quota of turtles under a traditional take request going forward. Nesting surveys are required in the Maskelynes to determine what the current level of nesting is, compared to estimates provided by earlier SPREP surveys.

It may be necessary to revise the legislation to include a requirement for ensuring a viable turtle population in that area before harvesting is permitted.

People's desire to maintain their turtle-related traditions such as New Yam celebrations may increase their motivation to manage and conserve turtles. Their improved understanding of turtle biology and life-history through ongoing awareness, as well as of the multiple factors affecting turtle populations in Vanuatu and throughout their range, may support enforcement of existing turtle protection measures and reduce the incidence of non-sanctioned take of turtles.

4.3 Traditional Take Permits and Harvest Data

The Fisheries Regulations of 2009 outline a process for permitted turtle harvest:

"(2) Despite subclause (1), a person may apply in writing to the Director for an exemption from all or any of the provisions under subclause (1) for the purposes of carrying out customary practices, educational and/or research purposes."

Several communities occasionally apply to harvest a small number of turtles for traditional purposes, often for Chiefs' Day or New Yam festivities. The exception is the Maskelyne Islands, where residents annually request a larger number of turtles. The reasons for the traditional take requests represent the drivers for people to consume turtles (Table 4).

Given the lack of turtle population estimates for the Maskelynes, there is no scientific criteria on which to base the allowed number of turtles to be caught. The exemptions appear to be granted for any sea turtle species. For instance, Critically Endangered hawksbill sea turtles have been captured under permit during 2018 to 2020 (Table 5 and Table 6). The species taken does not appear to be consistently recorded or reported.

In 2012, 17 sea turtles were recorded to have been killed and consumed as part of traditional practices, increasing to 24 in 2013 (VFD 2015).

More or fewer turtles may be harvested than permitted. However, follow-up data are lacking. In the Maskelyne Islands, the actual take in 2020 exceeded the permitted take by 15 turtles (Table 5).

[9] According to the UN Convention on Biological Diversity (CBD) sustainable use "entails the introduction and application of methods and processes for the utilization of biodiversity to prevent its long-term decline, thereby maintaining its potential to meet current and future human needs and aspirations." Sustainable use is supported by sound knowledge of species and the broader ecosystem, and benefits from governance conditions that incentivise conservation. One of the fundamental characteristics of supportive governance is clear tenure and secure legal rights for local people to manage and benefit from wild resources. This is critical to counter overexploitation, illegal use, and degradation or clearing of natural habitats. (IUCN Sustainable Use and Livelihoods Specialist Group Brochure https://iucnsuli.org/wp-content/uploads/2020/03/webSULIbrochure.pdf.

Table 4: Turtle consumption requests made to the Office of the Director of Fisheries, 2018–2021. Approvals were granted for the harvest of 27 turtles in 2018, 8 turtles in 2020, and 5 turtles in 2021. Note that VFD indicated separately that traditional take of 19 turtles was approved for the Maskelynes communities in 2020 (see Table 5). Source: VFD.

Date of request (mo/dd/year)	Title / role of Applicant	Village / Island	Reason for request	Number of turtles requested	Decision	Total Approved
03/30/2021	Chief	Takara/Efate	Celebration of digging of New Yam at Easter	5	Approved**	5
02/03/2021		Buluwai Area/Epi	Celebration of New Yam and Chiefs' Day	4	Declined*	
02/03/2021	Chief	Mabfilau/Epi	Celebration of Chiefs' Day	No figure	Declined*	
03/24/2021	Chief	Paunagisu/ Efate	Celebration of digging of new Yam at Easter	6	Declined*	
03/03/2021	Chief	Takara/Efate	Celebration of Chiefs' Day	2	Declined*	
03/25/2021	Chief	Unakap/ Nguna	Celebration of New Yam festival and Opening of New Farea	4 male	Declined*	
02/26/2021	Chief	Laman Bay/Epi	Celebration of Chiefs' Day	2	Declined*	
07/05/2021	Chief	Piliura/Pele Island	Celebrate an Outreach from Piliura Village	1	Declined*	
01/03/2021	Elder	Laman Bay/Epi	Celebration of New Yam festival	No figure	Declined*	
02/02/2021	Secretary	Takara/Efate	Celebrations of Chiefs' Day	No figure	Declined*	
03/02/2021	Chief	Pele Island	Celebrations of Chiefs' Day	2	Declined*	
04/28/2020	Chief	South Malekula	New Yam Feast Harvest	4	Approved**	4
03/03/2020	Secretary	Anelcauhat/ Aneityum	Celebrations of Chiefs' Day	4	Approved**	4
11/09/2020	Chairman of Chiefs	Tongamea/ Emae	Closing of Presbyterian Church Emae/Makira Session	3	Declined*	
05/02/2018	Chiefs	Peskarus/ Pellonk/Lutes/ Avock Isl/ Neraniem Village/ Haiumb Isl/ Okai Village	New Yam Feast Harvest	27	Approved**	27
TOTAL				**64**		**40**

*Declined because there is no evidence of customary or traditional practice in the turtle harvesting within the community

**Approved under conditions of: monitoring of activities by an officer authorised by the VFD; use of authorised traditional methods for the harvesting of turtles but prohibiting the use of motorised boats and canoes as well as tools such as metal hooks and spear guns; monitoring support by the Vanuatu Cultural Centre for recording and verification purposes.

Table 5: Vanuatu Cultural Centre turtle consumption on Uliveo, Maskelyne Islands, Vanuatu, under a traditional take permit, on 4 February 2020. Source: F. Hickey, Field Report 2020 (unpublished)

Village	Turtles requested	Turtles permitted	Turtles harvested	Species breakdown	Difference
Peskarus	25	9	10	8 green; 2 hawksbill	+1
Pellonk	15	5	12*	11 green; 1 hawksbill	+7
Lutes	15	5	12**	12 green	+7
Total	55	19	34		15 more than permitted

In the Maskelyne Islands, green turtles are slightly preferred because green turtles do not have a distasteful odour as hawksbills do (J. Laggat pers. comm.) and because green turtles do not bite as hard as hawksbills (F. Hickey pers. comm.). There may also be perceived risks of chelonitoxism as three people (a woman and two children) in the Maskelynes died after consuming a hawksbill turtle in 2003 (F. Hickey pers. obs.).

Geermans (1992) indicated that the Maskelynes community reported that chelonitoxism had never happened prior to the 1992 study; in February 2020, Francis Hickey was told that the 2003 event was the first known event and none has happened since. People in Papua New Guinea rarely consume hawksbills due to the prevalence of chelonitoxism (Vagi Rei, PNG Environment Department, pers. comm.). In Micronesia, three children died, and 20 other people sickened from chelonitoxism after eating a hawksbill turtle in Yap state in 2010 (Pavlin et al. 2015).

In discussions with fishers in the Maskelynes in 2020, most turtles were harvested from boats, diving at night while the turtles slept and using gaff hooks to impale them (Francis Hickey pers obs.). This method is not in line with what VFD requires as part of the traditional take, which is to catch turtles from canoes at night when they forage in shallow water and dive in to hold them, as was done traditionally prior to the introduction of spearguns and gaff hooks (Hickey and Petro 2005).

Between 2018 and 2021, 125 turtles were documented as permitted for take or illegally killed and reported (Table 6), with an average of 31 turtles consumed per year. Based on the penalties issued in early 2021, 44 turtles were documented as killed illegally in the Maskelynes (12 in Lutes, 15 in Pellonk, and 17 in Peskarus). Undocumented, unsanctioned take may be higher. Given the small size of villages. Estimating undocumented and unsanctioned take of 4 turtles per village in Okai, Avok, Haiumb Island and Nerenium would bring the total to 60 turtles. See Table 7 for the penalties issued.

The relevant management issue regarding take requests is the status of the turtle population in that area, but this is not considered. If turtles are abundant and nesting beaches are healthy and accessible to nesting turtles, then an allocation that is sustainable for traditional take could be set to ensure it does not endanger the population. The ‘stock level’ should be the priority factor when deciding traditional take. Given the poorly known threat status of the sea turtles present in Vanuatu, the reproductive capacity of each adult turtle may be essential to maintain, arguing against permitted take. Additional data are needed to define and monitor turtle populations in Vanuatu to responsibly respond to traditional take requests from communities. It may be as simple as training the CBAO’s and Vanua-tai in an area to conduct the surveys of foraging and nesting turtles.

Consent to occasional traditional takes under the Fisheries Act may increase compliance with regulations and strengthen conservation measures; for instance, communities may agree not to consume turtles at other times during the year, given that the VFD grants their traditional take request for a single, time-bound occasion for cultural purposes.

Table 6: Summary of the 125 turtles consumed over 2018–2021 under a traditional take permit through VFD or known unsanctioned take (for a breakdown of unsanctioned take, see Table 7). Take averaged 45 turtles per year. The actual unsanctioned take may be much higher. Source: VFD

Year	Location	Turtles consumed	Data source	Notes
2021	Lamen Bay, Epi Islands	1	Unapproved take VFD data	No species breakdown
2021	All of Maskelyne Islands*	44	Unapproved take VFD data	No species breakdown
2021	Torres, Paama, Efate, Anietyum	6	Unapproved take VFD data	No species breakdown
2021	Takara, North Efate	5	Traditional Take Permit VFD	No species breakdown
2020	Aneityum	4	Traditional Take Permit VFD	No species breakdown
2020	Farun, South Malekula	4	Traditional Take Permit VFD	No species breakdown
2020	Peskarus, Pellonk, Lutes of Maskelynes	34	VKS data; Traditional Take Permit VFD	31 green; 3 hawksbill
2018	All of Maskelyne Islands	27	Traditional Take Permit VFD	No species breakdown
Total		125		

*There were communication problems between the remote Maskelyne Islands and VFD in Port Vila that contributed to this unsanctioned take of turtles.

Sign board used by Vanua-tai to promote not harvesting female turtles in 2004. © F. Hickey

Table 7: Vanuatu Fisheries Department turtle enforcement and compliance record for 2021. In each case, the investigation team was the VFD and Police Maritime Wing Operation by RVS Tukoro. It is not clear if these fines have been paid. Source: VFD pers. Comm.

Date	Village / Island	Penalty issued	Penalty	Fine (Vatu)	Number of turtles killed
9/3/2021	Laman Bay, Epi Island	1	Penalty Notice issued to offenders	200,000	1
10/3/2021	Pellonk, Maskelynes, Malekula	2	Penalty issued to Community	1,000,000	15 (Female)
10/3/2021	Peskarus Nasara Pimon, Maskelynes, Malekula	3	Penalty issued to Community	1,000,000	4 (sex unidentified)
10/3/2021	Peskarus Nasara Amalulu, Maskelynes		Penalty issued to Community		7 (4 Male, 3 Female)
10/3/2021	Peskarus Nasara PPL, Maskelynes		Penalty issued to Community		2 Female
10/3/2021	Peskarus Nasara Imeren, Maskelynes, Malekula		Penalty issued to Community		4 Male
10/3/2021	Lutes, Maskelynes, Malekula	4	Penalty issued to Community	1,000,000	12 (1 Male, 11 Female)
10/3/2021	Okai, Malekula	5	Penalty issued to Community	1,000,000	Unidentified
10/3/2021	Avock, Malekula	6	Penalty issued to Community	1,000,000	Unidentified
14/3/2021	Toga Island/Torres	1	Penalty issued	50,000	1
9/7/2021	Luli Village, Paama	1	Penalty issued	50,000	1
19/7/2021	Pele Island, Efate	1	Penalty issued	50,000	1
1/11/2021	Anelcauhat, Anietyum	1	Penalty issued	50,000	3
TOTAL		**25**		**7,200,000**	**51**

4.4 Tourism impacts

Access to sea turtles is used in marketing campaigns by some tourism operators in Vanuatu (see 'Annex E: Turtle tourism'). Some tourist facilities allow and/or encourage people to physically interact with captive turtles. These interactions range from wading among hatchlings in a shallow pool at the Vanuatu Zoo to swimming with, holding and 'riding' the adult turtles in foreshore pools on south Efate. The health impacts of these practices on the turtles and people are unknown, and data are not systematically collected or reported to facilitate future assessments. Some facilities have been observed to have high mortality of hatchlings, often related to poor water quality.

Vanuatu's existing turtle-related legislation could be interpreted as covering tourism operations that keep turtles in captivity as tourist attractions as well as part of head-start programmes, under the auspices of a Fisheries research permit for educational purposes. Most of these facilities do not have recognised permits under the Fisheries regulations to operate and, despite reporting these operations, no action has been taken to enforce compliance (C. Shaw pers. comm.). There is a shortfall in the oversight provided through permits to tourism operations that capture turtles for captive rearing and head-start programmes.[10]

Concerns over perceived impacts on employment of ni-Vanuatu who work at these ventures has been noted as a potential reason for this lack of enforcement. One operator refused to comply, claiming they were under a grandfather clause as they had been operating for so long. However, with the investment these operators have made, it is unlikely they would lay people off or close the facility. VFD may need to resort to legal means to ensure compliance with the Fisheries Act.

There are ethical and turtle health issues with people holding, riding and feeding (usually with pawpaw/papaya or incomplete fish) turtles (taken from the wild) in enclosures. The potential impacts on long-term turtle health and the wild turtle population are unknown. These issues and open questions exist in a context of strong interest in turtles. In a global survey of 133,344 wildlife 'selfies' (photographs of a person with a wild animal) on three social media platforms over 2014–2017, sea turtles ranked third in representation in the images, following elephants and sloths (World Animal Protection 2017). The number of wildlife selfies uploaded to Instagram grew by 292% between 2014 and 2017, and over 40% of these were 'bad selfies' picturing someone hugging, holding, or inappropriately interacting with a wild animal (World Animal Protection 2017).

Human contact with turtles may bring a range of other risks, largely unquantified. For instance, there are issues of water contamination from sunscreens and other cosmetics and personal-care products used by people who may place their hands/arms on or enter the water with the turtles.

There are four[11] head-start programmes around Efate that purchase hatchlings from communities to exhibit in tanks for tourists, even though the sale of hatchlings or eggs is prohibited under existing legislation in Vanuatu (see '5.1.2 Conservation through national regulations'). These tend to be mainly hawksbill hatchlings and collected locally, although one facility occasionally sources them from other islands. When hatchlings are purchased, a market is created for hatchlings, which may spur further extraneous capture of hatchlings and nest disturbance. This is a significant problem given that hatchlings have a limited time to reach the sea before using up their energy reserves (Putnam et al. 2010, Trullas et al. 2006). Hatchlings do not eat immediately; rather, they rely on their egg yolk reserve for their early stage of digging out from the

[10] Tourism operators are required to have a permit issued by the Department of Tourism in order to obtain their business licence. For the conditions of the tourism permit, they are required to meet minimum standards, one of which is to be compliant with the laws of Vanuatu which includes any permits required. Any tourism operator that interacts with wildlife is supposed to comply with the wildlife activities minimum standard. All operators are required to fill in a self-assessment form. The Department of Tourism is tasked with conducting compliance checks. Completion of these forms and compliance is limited or non-existent to date. See: https://tourism.gov.vu/index.php/en/accreditation-resources

[11] One operator that keeps both hatchlings and adults was closed for renovations as at mid-2022.

Figure 8: Fishing line attached to the caudal portion of the carapace of an injured hawksbill turtle, 2016. Source: Shaw 2016, VESS.

nest, crawling to the water, and swimming, with a suggested maximum range of 40 kilometres swimming range to reach a suitable habitat (Trullas et al. 2006). Interrupted hatchlings are far more likely to die before reaching the next stage of development. Some facilities have hundreds of hatchlings held in captivity. The conservation value of head-start programmes is limited, at best (Burke 2015).

Adult turtles, both hawksbill and green turtles, are also caught or purchased for display in larger pools at some of these facilities. People also catch and display turtles in large dishes for the tourists from cruise ships to observe in captivity. This practice was observed by DEPC personnel at Champagne Beach on Santo and at the main wharf where the cruise ships berth on Santo Island, for example.

In some instances, turtles are caught, brought to shore, and kept for hours to days for the purposes of shared viewing by residents or tourists. These turtles are kept in an inland pond, or even a bucket with seawater or freshwater. During their captivity, turtles may reduce their food consumption or be fed inappropriate or insufficient foods, and temperature stress is likely to occur on top of the stresses of capture and captivity. There is evidence of tethering by piercing the shell and attaching fishing line to retain the turtle as a pet (Figure 8, Shaw 2015), or for unknown purposes that may be related to tourism or for later consumption (Shaw 2016).

The poor conditions and unsafe practices are visible to tourists, with some tourists publishing negative reviews of captivity centres in Vanuatu based on the treatment of the sea turtles (see 'Annex E: Turtle tourism').

Evidence exists of 'tagging for tourism' practices where a captive turtle is presented to tourists and payment results in the tagging and release of the turtle (Annex E: Turtle tourism Photo D.2). The extent of these practices in Vanuatu is unquantified. Such a practice brings with it the hazard of exploitation or creating perverse incentives. For example, a tagged turtle may be caught, the tags removed, and a new payment obtained. This risky practice may be spread among the islands, increasing the risk if it is adopted by those with little or no knowledge of safe and optimal tagging and turtle handling practice.

In some cases, turtles are raised in captivity for up to one year before their release (Photo D.3, 'Annex E: Turtle tourism'). The quality of care is unknown, with anecdotal evidence that carers may be untrained in basic animal care or turtle management. Post-release mortality of hand-reared turtles by comparison to fully wild turtles is unknown. Tagging reports are intended to specify the encounter context of the tagging team and the turtle as well as the turtle's approximate age. When complete, these reports can be used to identify whether the tagged turtle was wild-caught as an adult, tagged and released immediately as a hatchling, tagged as a hatchling and released within hours or days, or tagged and released after weeks to a year in captivity.

In some locations, such as on Nguna-Pele, there is established practice of income from capturing foraging turtles for tourists to observe, and sometimes to tag and release, for a fee. The amount of income from such activities as a lump sum or as a percentage of household income is unknown. There is a hypothesis that this model could assist in providing funds for turtle research activities. Consideration of this hypothesis must incorporate information on the present fate of the funds raised and whether these practices are governed to avoid re-tagging of tagged turtles, stress or harm to captured turtles, or interruption of turtle life-history (such as through capture and retention of a turtle on its way to nest) – all of which are illegal under the Fisheries Regulations 2009.

In the past, a version of eco-tourism was conducted on Moso Island that included bungalows for eco-tourists to stay for longer periods and to assist with beach surveys. The funds generated by this programme helped support turtle research activities. Difficulties in managing the funds led to the eventual breakdown of these activities. The multiple social, cultural, ecological and economic factors associated with such a programme are beyond the scope of the present document, but any consideration of such a programme should rely on transparent discussions of those factors with local communities as well as the latest information about the effectiveness of similar programmes elsewhere.

Alternatives, including 'safe turtle tourism' if and where possible, may be necessary to transition (or increase the pace of transitioning) away from tourism that places turtles at risk. This would be in line with the Sustainable Tourism Policy 2019 to 2030 and accompanying Strategy.[12]

Tourism may also be a driver of coastal and nearshore land-use change, threatening nesting sites.

[12] See: https://tourism.gov.vu/index.php/en/policies. VESS is undertaking the preparation of turtle-related guidelines.

4.5 Turtle by-catch: coastal and nearshore fisheries

Artisanal and subsistence monofilament gillnet fisheries often occur in areas identified as important foraging areas for green and hawksbill turtles and result in the un-intentional capture of sea turtles (Hickey and Petro 2005). In a 2016–2017 survey of 537 people from all six provinces in Vanuatu, approximately 30% of respondents used gillnets at least some of the time while fishing (VESS 2017). Of those using gillnets, 56% left nets unattended, including nets set at night (VESS 2017). Turtles are air-breathing reptiles, requiring regular visits to the surface to breathe, and capture or entanglement within fishing gear or debris often results in the turtle drowning.

There is no systematic turtle by-catch monitoring for coastal and nearshore fisheries in Vanuatu. Turtle mortality because of fishing activities or lost or discarded fishing gear is both a fisheries problem and a general conservation or environmental problem, potentially complicating the jurisdiction over monitoring and managing this issue. DEPC personnel noted that the public tends to report any turtle infractions observed (such as incidental by-catch in villages where the turtle may be consumed) to the VFD, not to DEPC, so DEPC has no record of turtle by-catch/incidental catch. VFD CBAOs[13], supported through the BIEM Initiative for 2022–2023, are likely to be the recipient of infraction reports, and building communication channels for these CBAOs with both VFD and DEPC could address this barrier (see 'Annex D: Active and upcoming projects supporting sea turtle management in Vanuatu').

In other regions, turtle by-catch in small-scale fisheries may be comparable to that of industrial fisheries, as found in the south-eastern Pacific (Alfaro-Shigueto et al. 2018).

There is no monitoring of by-catch in open-water (which may be considered either nearshore or offshore) of recreational fisheries in Vanuatu. However, the Vanuatu Sports Fishing Association reported they have had no reported turtle interactions.

Since 2018, a community-based catch monitoring approach has been piloted under the Pathways Project (2018–2021) with VFD as a project partner (Sami et al. 2020, Andrew et al. 2020).[14] This monitoring has not included by-catch, but successful use of this monitoring system may lend itself to the addition of by-catch reporting.

[13] Clarification that VFD Community Based Authorised Officers (CBAO's) are volunteer positions within the community to assist the Chief of the village following the Chief's traditional mandate of managing resources. If some community members do not follow the Chief's rulings, for example fishing within a tabu area, or diving at night when it is prohibited, then the CBAO's may intervene to issue a spot fine (determined by the Chief) or report it to Fisheries for further legal action.

[14] For information about the Pathways Project in Vanuatu, see: https://fisheries.gov.vu/index.php/what-we-do/projects/pathways-project.html

4.6 Turtle by-catch: offshore commercial fisheries

The impact of offshore interactions with fisheries activities on sea turtle populations in the Pacific region is unclear. We do know that by-catch is regularly reported by observers in longline fleets, but due to the very low level of observer coverage achieved, the level of interactions is likely to be an underestimate and impacts this may have on populations is unknown. Given the basic characteristics of sea turtle biology and life history, with long-lived individuals and high hatchling and juvenile mortality, the loss of a small number of adult sea turtles may have disproportionately large impacts on the abundance and diversity of the total population (Wallace et al. 2013b). By-catch rates vary in accordance with many factors, including fishing depth, gear types, and bait used, and the impact related to turtle populations and the strength of other drivers of sea turtle population trends (Wallace et al. 2013b).

Existing requirements for offshore commercial fisheries

Because Vanuatu is a party to the WCPFC, it is obligated to implement the provisions of the WCPFC Conservation and Management Measure on sea turtles (CMM2018-04) and any subsequent changes. Accordingly, Vanuatu advises that it requires its flag vessels to use the required mitigation measures and report all observed turtle interactions, incidents and by-catch during offshore fishing operations. This information is provided in Vanuatu's annual report to the WCPFC. Monitoring mechanisms such as observer and catch logs are meant to be implemented on all licensed foreign and Vanuatu flagged vessels (VFD 2015). See Table 8 for an overview of the fleet.

The existing WCPFC Conservation and Management Measure outlines gear and method requirements for purse seine and shallow-set longline fisheries. Deep-set longline fisheries are not required to use mitigation although this provision was meant to be reviewed by the Commission in 2021. A modelling study identified greater reductions in sea turtle mortality with the application of mitigation measures for deep-set gear, reaching further than present practice under existing WCPFC Conservation and Management Measures (WCPFC 2017). The analysis found that expanding mitigation to deep-set longlines would deliver stronger reductions (compared to other mitigation scenarios) in interaction rates due to the four-times greater effort in deep-set longline fisheries. Essentially, just 1% of existing longline effort was subject to mitigation under the existing CMM at the time of the analysis (CMM2008-03). The CMM2018-04 does not substantially change this status because deep-set longline fisheries are still not required to apply turtle by-catch mitigation measures.

The Regional Marine Species Programme 2022–2026 (SPREP 2022) Marine Turtle Action Plan includes an action to improve mitigation requirements for turtles in WCPFC: "Action 4.2.3 Work to improve the WCPFC sea turtle conservation and management measure (CMM) to include use of circle hooks, fin fish bait, and removal of 2 hooks near buoy. Apply to both shallow and deep-set fisheries."

Vanuatu could require additional use of mitigation measures against by-catch of sea turtles over and beyond the current requirements in the CMM and application of such measures to both shallow and deep-set fisheries. Reporting has improved substantially since 2017 and further strengthening of reporting requirements for turtle interactions can boost understanding of by-catch trends as well as related implications for sea turtle populations. By-catch mitigation requirements could be included in licence conditions for all fisheries vessels.

Sea turtle by-catch in purse seine fisheries in the WCPFC region averaged 285 turtles per year over 2003 to 2020, peaking in 2013 with 482 reported individuals '(Supplement 1: Sea turtle data relevant for Vanuatu', Tables S.A.2 and Figure S.A.1). For global context, see Wallace et al. (2013b).

Trends in turtle interactions for Vanuatu's offshore fisheries fleet

In 2010, there were 171 foreign, local, and local-based fishing licences granted for use in Vanuatu's EEZ (VFD 2015). By 2014, this number was down to 78 licences, with the majority (over 84%) granted to foreign applicants (VFD 2015), and as of 2020 was at 92 licences within the EEZ (Table 8). In 2014 there were 134 international authorisations to fish certificates issued to Vanuatu flagged vessels to allow fishing in other Regional Fisheries Management Organisation regions globally (VFD 2015), which has since dropped to 84 (Table 8). Most of the licences and certificates granted were for longline fishing operations, with this method known to be of concern regarding turtle by-catch (VFD 2015).

The observer coverage rate in Vanuatu's national offshore fleet ranged from 0.8% to 5% from 2010 to 2016, which was considered low. Observer coverage peaked in 2018 with 6.6% of the longline fleet and 100% of the purse seine fleet carrying observers (VFD 2019), followed by 6.2% and 90.7%, respectively, in 2019 (VFD 2021). In 2020 observer coverage dropped to 1.1% for longliners and 51% for purse seiners (VFD 2021). The data on turtle interactions preceding 2010 may be low due to a lack of observer coverage and interaction reporting, rather than a lack of interactions with turtles (Supplement 1: Sea turtle data relevant for Vanuatu Table S.A.1).

In total, 75 turtles across five species were reported as by-catch during Vanuatu's national offshore fisheries operations between 2010 and 2020; the actual number of by-caught turtles may be higher across the entire fleet (Table 9). In most years, the number of turtles observed to be caught was small: ranging from 1 to 13. The most striking exception is the catch of 28 olive ridley turtles in 2015 (Table 9 and Table 11).

Although the flatback turtle (*Nattator depressus)* distribution is normally considered limited to Australia and southern Papua New Guinea, flatback turtles may be found within Vanuatu's EEZ. According to an SPC report on Vanuatu's by-catch within its EEZ, "five specimens of turtle were caught between 1996 and 2012: two flatback turtles, one leatherback turtle, one loggerhead turtle and one unidentified turtle" **(**Allain 2014). An additional flatback turtle was reported as by-catch in 2018 by the Vanuatu national offshore fleet within the WCPFC area (Table 9).

Table 8: Vanuatu's offshore fishing fleet, observer coverage, and turtle by-catch mitigation strategies for 2020. Source: VFD

Vessel classification	Number of vessels	Observers and coverage	Logbook data provided
Foreign vessels fishing Vanuatu's EEZ	85 Total (74 Chinese and 11 Fijian)	Observer coverage required as part of regional agreement: targets of 5% for longline and 100% for purse seine vessels. Actual 2020/2021 coverage not yet available.	Yes, for sharks only
Locally based foreign vessels	6 Sino Van longline vessels	100%, to be reduced to 20% due to costs; 20% is considered sufficient to extrapolate by-catch.	Yes, for sharks only
Purse seine	1 US vessel under the US Treaty fished skipjack for less than two weeks in 2020	100% coverage	Yes, for sharks only
Vanuatu-flagged vessels fishing in International Waters[15]	2 Categories: 78 longline and 6 purse seine vessels	5% longliner coverage in WCPFC region Target for purse seine coverage is 100%	Yes, for sharks only

[15] Under COVID-19 related travel restrictions after the closing of Vanuatu's borders in March 2020, observers were no longer deployed on Vanuatu-flagged vessels for the remainder of 2020 and 2021 (observers were not able to freely travel to board fishing vessels in other EEZs). The observer programme is expected to resume once these travel restrictions are lifted.

Table 9: Observed annual estimated catch of sea turtle by gear for the Vanuatu national (Vanuatu flagged) offshore fishing fleet operating in the WCPFC area, 2010–2020. Observers are required to report the fate of each turtle encountered: 'alive' indicates alive and moving at the time of release. The observed interactions here represent only a portion of the potential total turtle interactions across the fleet, particularly prior to 2016 when 5% or less of the fleet carried observers. Source: Vanuatu's Annual Reports to WCPFC Regular Session of the Scientific Committee: see https://meetings.wcpfc.int/meetings/type/11

Year	Gear	Species common name	Total number	Alive	Dead
2020			0	0	0
2019	Longline	Leatherback	1	1	0
2018	Longline	Flatback	1	1	0
	Longline	Green	1	0	1
	Longline	Leatherback	1	1	0
	Longline	Loggerhead	1	0	1
	Longline	Olive ridley	2	1	1
2017			0	0	0
2016	Longline	Green	1	0	1
	Longline	Hawksbill	1	0	1
	Longline	Olive ridley	1	0	1
2015	Longline	Green	2	1	1
	Longline	Hawksbill	1	0	1
	Longline	Leatherback	1	0	1
	Longline	Olive ridley	28	10	18
2014	Purse seine	Loggerhead	1	Fate unknown	
	Longline	Olive ridley	3	1	2
2013	Purse seine	Hawksbill	3	Fate unknown	
2012	Purse seine	Olive ridley	2	Fate unknown	
	Purse seine	Hawksbill	1	Fate unknown	
	Purse seine	Hawksbill	6	Fate unknown	
	Purse seine	Loggerhead	3	Fate unknown	
	Longline	Leatherback	1	1	0
2011	Longline	Leatherback	1	1	0
	Purse seine	Green	1	Fate unknown	
	Purse seine	Hawksbill	6	Fate unknown	
	Purse seine	Loggerhead	3	Fate unknown	
2010	Longline	Loggerhead	1	1	0
TOTALS			76a	20	29

[a] Of the 76 turtles, the fate of 27 was unknown.

Note: In the case of discrepancies, values were taken from the most recent report. Reports dating back to the 2014 session (WCPFC-SC10-AR/CCM-28) were used. In the 2021 report to WCPFC, Table 3 correctly reports no turtle interactions in 2020 (VFD pers. comm.).

Table 10: By-catch reported under Species of Special Interest (SSI) Interaction monitoring of local-based foreign fishing vessels in Vanuatu's waters, 2016–2017 and 2020–2021. Source: Vanuatu Fisheries Department pers. comm.

Turtle species and fate	2016	2017	2020	2021	Grand Total
All turtles		3	8		11
GREEN TURTLE		2	3		5
Discarded, other reason		2			2
Discarded, SSI handling guidelines followed			3		3
HAWKSBILL TURTLE			1		1
Unknown condition			1		1
LOGGERHEAD TURTLE			2		2
Discarded protected species, dead			1		1
Discarded, SSI handling guidelines followed			1		1
OLIVE RIDLEY TURTLE		1	2		3
Discarded, other reason		1			1
Discarded protected species, dead			2		2

Note: Among six Sino-Van longline vessels Data unavailable for 2018 and 2019.

4.7 Threats to nests and nesting beaches (excluding direct take)

Vanuatu has a limited number of sandy beaches suitable for turtle nesting. Nesting beaches in Vanuatu are typically small in both width and length, by comparison to other common turtle nesting sites in other countries. The longest known nesting beach is roughly 12 kilometres (at Maranata) with lengths less than five kilometres much more common (C. Shaw pers. comm.). With land in Vanuatu under traditional land tenure, a given nesting beach may be divided into several land parcels, typically one to five (C. Shaw pers. comm.). Negotiations among the multiple landowners can be a barrier to spatial management, unless carefully and respectfully undertaken, with assistance from the Vanua-tai networks.

At present, Vanuatu turtle legislation and relevant policies do not specify a target share of nesting beaches to be maintained (that is, without development or land-use change that would hinder turtle nesting) for a defined time.

Threats to nests include tsunamis, storm surges, cyclones, and floods, humans (harvest or disruption), as well as crabs, birds, invasive ants, and feral animals, such as horses, cows, pigs and dogs (Petro et. al. 2007, Pilcher 2021). These hazards cover a spectrum from purely natural to directly human-caused. Some efforts have been undertaken by communities to protect nests from predators by covering them with bamboo grids (D.J. Aromalo pers. comm.). Steel mesh has also been used but quickly rusts.

The entire turtle nesting season throughout the archipelago extends from August to early March, with green turtles peaking in late October to December and hawksbills and leatherbacks peaking in November to January. This season also coincides with an average of two to three tropical cyclones passing through Vanuatu (VMGD and CSIRO 2011) often accompanied by coastal flooding associated with high rainfall and storm surges that may erode turtle nests.

Coastal ecosystems are dynamic environments. The 'normal' baseline rate of turtle nest wash-out in Vanuatu due to wave action or storms is unknown. Given the low number and density of turtle nests in Vanuatu, the loss of a single nest due to storm impacts may have a significant impact. Some people link such nest loss to sea-level rise, although data are absent to support or negate this hypothesis. What has

been clearly observed however, is that storm surges from passing low pressure storms and cyclones often wash out turtle nests, including at Bamboo Bay in the 2021/2022 season (Donald James Aromalo, pers. obs). Leatherback turtles are observed to generally make their nests lower on the beach, so are more vulnerable to be washed out (Aromalo, pers. obs.).

Some communities under the direction of their Vanua-tai network members move eggs to higher beach areas in an attempt to avoid nest washouts (F. Hickey pers. comm., C. Shaw pers. comm.); it is not clear if all of those who move nests are trained in best practice for nest/egg relocation. This relocation is primarily done at Bamboo Bay on Malekula, where they have a good survival rate according to anecdotal evidence (D.J. Aromalo pers. comm.). The narrow beaches at Votlo and Maranata may be perceived as priority sites for nest relocation due to space limitations. When images and stories of nest relocation are shared, such as on social media, there is an increased risk of untrained relocations with an accompanying risk to the eggs and hatchlings. This same process of unintended sharing resulting in untrained mimicry may extend to other behaviours for turtle interaction, potentially increasing risks to turtles.

Land-use change is a threat to nesting sites, complicated by the span of 20 to 50 years between the hatching of a turtle and her return to lay her eggs. Nearshore habitats in Vanuatu have suffered considerable coastal development pressure over the last 20 years during a coastal housing boom. Coastal forest clearance and foreshore dredging, including the destruction of mangroves and seagrass meadows, were part of these developments, accompanied by increased turbidity impacting nearshore coral reef and seagrass habitats (Hickey 2014). These coastal development impacts continue today given the limited capacity of the central government to monitor coastal developments and implement the Foreshore Development Act and Environmental Impact Assessment legislation, the primary pieces of legislation used to control coastal developments. Vanuatu does not have an overall land-use plan or marine spatial plan at present. In the absence of a holistic national land-use plan, management may be reactionary to development applications rather than pro-actively directing development away from important turtle habitat. Efforts are underway to create a marine spatial plan, building on identified priority marine areas (see ‘5.1.2 Conservation through national regulations’).

Coastal development is likely to continue to increase, including through the support of a decentralisation policy that extends infrastructure development beyond the main population centres.

Challenges exist regarding effective implementation of, and response to Environmental Impact Assessments (EIA) in Vanuatu, such as EIA for road construction. These challenges exist despite community concern. For example, in 2021, landowners from Tavie village in Paama wrote to the government to demand a halt to the government-proposed road works unless a thorough EIA was conducted prior to construction, due to concerns about the environmental impacts of coastal roads (Roberts 2021). Even within the current legislative framework, with established requirements for foreshore development permits and EIA, coastal development of nesting beach areas continues for resort and tourism usage as well as coastal housing developments. At developed sites, human disturbance, light and noise pollution, seawalls, fences, and domestic dogs may adversely affect turtle nesting activities. Areas of particular concern include Havannah Harbour on north Efate, as well as the east coast of Santo.

Light and noise pollution has reached many turtle nesting beaches, particularly on the islands of Santo and Efate that have the two large urban centres and where coastal areas have experienced a significant boom in tourism and coastal housing development over the last 20 years. Understanding of the potential impacts of anthropogenic light on turtle hatchlings is extremely limited in the Pacific Islands region (Pilcher 2021). At present, control of light and noise near nesting beaches is likely a lower priority than control of predation and direct take (for consumption or captivity). However, if coastal development continues without addressing habitat alienation, including light and noise pollution of nesting sites, this could change.

4.8 Threats to turtle habitat (excluding direct take)

At sea and in the marine environment, manageable threats to sea turtles include interactions through fishing activities, interactions through other human traffic in marine areas, and pollution (VFD 2015). Climate change affects sea turtle habitat, prey, and turtles themselves; examples of the scope of impact include increasing nesting site disruption during more frequent extreme weather events, sea level change, changes in hatchling sex ratios due to the relationship between nesting temperature and sex development, and other changes (Patrício et al. 2021, Pilcher 2021, VFD 2015, Work et al. 2020).

For information about diseases, see '4.1. Natural mortality'.

Boat strikes are a risk factor for recreational and commercial vessels, both nearshore and offshore, although the extent of this hazard is understudied for sea turtles in the Pacific islands (Work et al. 2015, Pilcher 2021). The number of small, motorised craft for transport, pleasure and fishing has increased in Vanuatu in the past decade, potentially leading to increased boat strikes and/or disruptions to turtle foraging areas; for instance, the import value of boat propellers grew by 314% over 2014 to 2019, ranking second in machine-related imports.[16]

Plastic waste is of concern for the conservation of sea turtles, with a range of impacts including through ingestion or entanglement (UNEP 2021). Although rates of plastic entanglement are largely unquantified for global sea turtle populations, 84% of expert respondents from 43 countries reported encountering a sea turtle entangled in plastic, with entanglement affecting all turtle life stages (Duncan et al. 2017). Single-use plastic packaging has become widespread in Vanuatu. Effective waste management in Vanuatu to safely dispose of plastics is an ongoing challenge (SPREP 2021, Wander et al. 2019). Very little plastic is collected for recycling in Vanuatu (SPREP 2021). Plastics can be discarded on land or at sea, including during commercial fishing activities in the Pacific Islands region (Richardson et al. 2016). Regardless of its source, much of this plastic waste finds its way into coastal waters where it may be ingested by turtles, seabirds, and other marine life. The Vanuatu government implemented a ban[17] on the use of single-use plastic shopping bags, plastic straws, and polystyrene take-away boxes as of 1 July 2018 and plastic cutlery, plastic cups, plastic drink stirrers, plastic mesh food netting, egg cartons and artificial flowers as of December 2019.

Pollution other than plastic is also of concern for water quality and the health of turtles and the ecosystems and species on which turtles rely. The risks and hazards are largely unquantified for sea turtles in Vanuatu.

Lost or discarded fishing gear, including nets and ropes found drifting in coastal areas, may entangle turtles and other marine life (UNEP 2021). These wastes are a problem in Vanuatu as in other marine regions, although the scale of the problem in turtle habitats of Vanuatu is unquantified (Richardson et al. 2019). For an analysis of the rate and types of gear loss in Vanuatu fisheries, see Giskes (2019).

General ecosystem health in nearshore and marine environments would support sea turtles in Vanuatu. Signs of ecosystem imbalance should be considered a potential cause for concern for turtle management. As one example, crown of thorns starfish (COTS; *Acanthaster planci*) occasionally have outbreaks that degrade coral cover. Outbreaks have particularly affected west and north Efate in the last two decades (Dumas et al. 2014). As of mid-2022, COTS has become a significant problem on Efate in Pango, Erakor, Eratap and Shark Bay (Francis Hickey pers. obs.) Although there is no direct link between COTS and sea turtles, the degradation of coral reef systems may reduce food and habitat availability, likely most relevant for hawksbill turtles.

[16] Observatory of Economic Complexity. Vanuatu. (4 January 2022) Retrieved from: https://oec.world/en/profile/country/vut. Note that many small crafts are manufactured within Vanuatu rather than imported as a completed craft.

[17] Waste Management Regulations Order No. 15 of 2018 and the Waste Management (Penalty Notice) Regulation Order No. 17 of 2018, available in the Official Gazette No. 10 of 2018.

A hawksbill nester with Telonics Argos satellite tag on Moso Island. © F. Hickey

5. Management of sea turtles in Vanuatu

5.1 Policies, legislation, and traditional customs

5.1.1 Conservation through international conventions and agreements

Vanuatu is a party to several international conventions of relevance for sea turtle conservation (see 'Annex B: International conventions and agreements of relevance for sea turtles').

Among these, Vanuatu is party to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) 1973. CITES seeks to block cross-border trade in listed species, particularly relevant for the hawksbill as its carapace has historically been a valuable international trade item to produce jewellery and ornaments. All sea turtle species are listed under CITES Appendix I, prohibiting international trade in sea turtles whether live or dead, their products, or derivatives. CITES reports are not publicly available, but Vanuatu's reporting[18] is up to date for 2020; the last instance of a turtle-related CITES infraction linked to Vanuatu is not available.

Vanuatu is not party to the Bonn or CMS Convention (Convention on the Conservation of Migratory Species of Wild Animals) 1979, which defines basic obligations of the parties towards leatherback, hawksbill, loggerhead, green and olive ridley turtles as listed on Appendix I of the Convention.

The WCPFC Conservation and Management Measure on sea turtles (CMM2018-04) provides mitigation measures for improving management and reducing the mortality of sea turtles associated with commercial offshore fisheries.

5.1.2 Conservation through national regulations

Vanuatu's progression of legislated turtle management and conservation has evolved incrementally since the first Fisheries Act of 1983 that protected only eggs and nests through to the current legislation that more comprehensively protects sea turtles while allowing for research, education or traditional take under permit. The current Fisheries regulations of 2009 prohibits harming, capturing, or killing of any species of turtle or the taking of turtle eggs.

The Fisheries Regulations Order No. 49 of 1983 states:

> *No person shall*
>
> *i) disturb, take, have in his possession, sell or purchase any turtle eggs;*
>
> *ii) interfere with any turtle nest;*
>
> *iii) or sell, purchase or export any turtle or the shell thereof of the species* Eretmochelys Imbricata*, known as the hawksbill turtle.*

During the 1980s and 1990s, turtles were actively and opportunistically harvested, including for traditional purposes and for subsistence. The increased availability of snorkelling gear and spearguns in rural areas during the 1990s led to increased opportunistic catches of turtles by night divers targeting fish, who would come across sleeping turtles (Hickey and Petro 2005). Nesting turtles were also routinely harvested during this period as the 1983 legislation did not specifically protect the adult turtles, only the nests and eggs. However, even this level of protection was very difficult to enforce in remote, rural areas, and eggs and nesters were also routinely harvested during this period (Hickey and Petro 2005).

[18] See: https://cites.org/eng/parties/country-profiles/vu/reports

In response to declining turtle populations throughout many areas of the Pacific, SPREP sponsored the Year of the Turtle in 1995 and the local NGO Wan Smolbag (WSB) was commissioned by SPREP to create a drama performance (for details, see Hickey and Petro 2005). This led to considerable awareness regarding threats to turtles, and the creation of a Turtle Monitor network initially on north Efate that eventually evolved into the Vanua-tai network to champion the community-based monitoring and conservation of turtles along with other natural resources. As access to turtles found along the nearshore reefs, along with nests and eggs are essentially controlled through customary marine and land tenure access rights, traditional leaders, clans, and families have the traditional right to ban or control their harvests (Johannes and Hickey 2004, Hickey and Johannes 2002, Hickey and Petro 2005). A significant number of communities have enacted this right since the mid-1990s as the awareness programme took effect. There are also efforts to formalise some marine protected areas, and key ones established to date are listed in 'Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu'.

To further support this work, and in response to the recognition of a declining turtle population and increasing international pressure to stem global declines, the Fisheries Act No. 55 of 2005 pertaining to marine turtles was passed and gazetted in October 2005, while the regulations of 1983 were repealed:

> ***38. Marine Turtles***
> *(1) A person must not:*
>
> *(a) take, kill, have in his or her possession, export, sell or purchase any turtles of the species* Dermochelys coriacea *known as leatherback turtle; or*
>
> *(b) take, have in his or her possession, sell, purchase or export any shell of the species referred to in paragraph (a); or*
>
> *(c) interfere with or disturb in any way a turtle nest or any turtle that is in the process of laying eggs; or*
>
> *(d) take, have in his or her possession, export, sell or purchase any turtle egg; or*
>
> *(e) use any weapon to harm, capture, kill or destroy any turtle species.*
>
> *(2) Despite subclause (1), a person may apply to the Director for an exemption from all or any of the provisions under subclause (1) for the purposes of carrying out a customary practice.*

The amendment of 2005 addressed the critically endangered leatherback concerns and closed the loophole of consuming nesting turtles. It also restricted the catching of turtles to doing so by hand by prohibiting the use of 'weapons', such as spearguns, spears, gaff hooks, and so on. However, these new regulations were still not easily enforced in remote, rural areas.

Take of sea turtles for food is regulated under Sec. 59(2) of the Fisheries Regulation Order No. 28 of 2009. In 2009, a further Fisheries Regulation amendment was introduced to prohibit the killing of the three main species of turtles (green, hawksbill and leatherback turtles):

> ***59. Marine Turtles***
>
> *(1) A person must not:*
>
> *(a) take, kill, have in his or her possession, export, sell or purchase any or all of the following turtle of the species:*
>
> *(i)* Dermochelys coriacea *known as leatherback turtle, illustrated in Schedule 26;*
>
> *(ii)* Eretmochelys imbricata*, known as the hawksbill turtle, illustrated in Schedule 26;*
>
> *(iii)* Chelonia mydas*, known as the green turtle, illustrated in Schedule 26; or*
>
> *(b) take, have in his or her possession, sell, purchase or export any shell of the turtle species referred to in paragraph (a); or*
>
> *(c) interfere with or disturb in any way a turtle nest or any turtle that is in the process of preparing to nest or laying eggs; or*

(f) take, have in his or her possession, consume, export, sell or purchase any turtle egg; or

(g) harm, capture, kill, consume, sell, purchase, export or destroy any turtle species (hatchlings, juveniles or adults) including by use of any weapon; or

(h) have in his or her possession any marine turtles that is held in captivity in any way.

(2) Despite subclause (1), a person may apply in writing to the Director for an exemption from all or any of the provisions under subclause (1) for the purposes of carrying out customary practices, educational and/or research purposes.

This amendment effectively made the killing of the three main turtle species (green, hawksbill and leatherback) illegal for the first time in Vanuatu's history. It also prohibited the use of any weapon, such as spearguns or gaff hooks, to capture turtles. The legislation also expanded the exemption to include catch not only for traditional purposes but also for educational and research purposes. With this provision, operators who capture and rear turtles for educational purposes or researchers who capture turtles for tagging or other research purposes would be able to act within the law upon obtaining a valid permit.

The exemption permits do not automatically specify the species for which the permit is granted. In practice, this means that upon obtaining an exemption for traditional take, harvesters take any turtle encountered, including hawksbills which are Critically Endangered (see Table 1). It would be useful to develop a standardised application form that specifies the needs of the community as clearly as possible, including number of turtles requested for what traditional purpose, and if they have any CBAO's or Vanua-tai Network members to assist with the monitoring of the traditional take. VFD can also specify any relevant conditions such as species of turtle, size and sex restrictions as well when and how the collection of turtles may commence prior to the cultural event in addition to what data should be collected including size, species, sex, tissue samples, etc. Communities also need to be made aware that they must submit their application one month prior to the date of their cultural event, to give the VFD time to process the request.

The primary legal instrument for the management, development, protection and conservation of fisheries resources in Vanuatu is the Fisheries Act No. 10 of 2014. This Act includes turtles, and the Fisheries Regulation Order No. 28 of 2009 (quoted above regarding turtles) provides the regulatory framework. The Act includes the development of a National Plan of Action for Turtles, which is also a condition of the WCPFC.

Pro-active spatial planning for both land and sea areas of Vanuatu could be used to preserve turtle habitat and mitigate anthropogenic harm to sea turtles and turtle populations. The turtle-specific legislation at present does not have a spatial component; rather, the legislation focuses on species and covers the country. There was an effort to identify special and unique marine areas under the Marine and Coastal Biodiversity Management in Pacific Island Countries (MACBIO) project, with known presence of sea turtles or important turtle habitat resources indicated for given areas when possible (Ceccarelli et al. 2018).[19] Vanuatu's National Ocean Policy (2016)[20] and associated processes set out the goal of a national marine spatial plan, with a process for creating this plan underway grounded in the MACBIO project results (C. Shaw pers. comm.). Vanuatu has an existing set of defined marine protected areas, with varying degrees and modes of protection (see 'Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu').

[19] See: http://macbio-pacific.info/Resources/biophysically-special-unique-marine-areas-of-vanuatu/

[20] See: http://www.nab.vu/vanuatu-ocean-policy

5.1.3 Additional compliance and management measures relevant for sea turtles in Vanuatu

In compliance with the Fisheries Act No. 10 of 2014, the Vanuatu National Action Plan for Sea Turtles 2016–2020 (NPOA Turtles) was completed in 2015 (VFD 2015). The NPOA is being reviewed and an updated NPOA Turtles will be available in 2023.

The NPOA Turtles "is a policy that seeks to protect, conserve and manage sea turtle populations in all Vanuatu waters, other jurisdictions as well as in areas beyond national jurisdiction where its flag fishing vessels are actively operating" (VFD 2015). It has also been prepared in accordance with the FAO Technical Guidelines to Reduce Sea Turtle Mortality in Fishing Operations and assist with the implementation of the WCPFC CMM 2018–2004 and related measures in other conventions to which Vanuatu is party. It aligns with other national policies such as the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB) Corporate Plan, the National Sustainable Development Plan to 2030 (the People's Plan), and the Vanuatu National Roadmap for Coastal Fisheries: 2019–2030.

Reducing by-catch of turtles in offshore fisheries is one of the key goals identified in the NPOA Turtles. However, to date, observer coverage of turtle interactions is limited to only the 6 locally based longline vessels, and excludes all foreign based, which currently has 85 longline vessels. This is a significant shortfall for assessing turtle interactions within Vanuatu's EEZ.

The NPOA not only covers all Vanuatu-flagged fishing vessels and all Vanuatu waters but also the "utilization of sea turtles for customary practices and food security, education, research and tourism purposes." The NPOA addresses key aspects of turtle conservation, including the protection of nest sites and nesting females and light pollution.

Neither the legislation nor the NPOA set a target percentage of Vanuatu's beaches, or known turtle nesting beaches, to be left intact for nesting. The majority of the enacted policies and legislation cover turtle take or by-catch during fishing/harvest; none however, address disturbance of nesting turtles, eggs, or nests by domestic animals or their feral counterparts, such as pigs or dogs, other than the general protection supported by the NPOA in Policy goal 5: Cooperation in sea turtle conservation**: "**Coastal communities to continue active participation in protection of sea turtles in marine protected areas, feeding grounds and special protection of nesting sites and nesting females."

The FAO Technical Guidelines to Reduce Sea Turtle Mortality in Fishing Operations provide potential mitigating actions and best practices for the safe release of sea turtles, which Vanuatu uses.

The Environmental Protection and Conservation Act CAP 283 contains a range of general provisions relating to the protection and conservation of the environment. It provides for the establishment of community conservation areas (see 'Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu') as well as a need for Environmental Impact Assessment. Sea turtles are listed as a significant species to be protected under conservation and tabu area management plans. Section 45(1)(f) allows the minister responsible to make regulations on the control and taking of specified species and 2 (b) provides for regulating the harvesting of natural resources. Such provisions could contribute indirectly to the protection and conservation of sea turtles (VFD 2015).

In 2012, Vanuatu was issued a Yellow Card by the European Union for failing to put in place effective control measures for the management of its Vanuatu flagged fishing fleet (VFD 2015). This issue was resolved in 2013, but challenges remain to comply with all regional fisheries management measures, including for turtle management. Vanuatu's Revised Tuna Fishery Management Plan (20I4) states that the level of fishing effort that maximises economic rent allows for 70 fishing licences per year within Vanuatu's EEZ. The Plan also prioritises the licensing of local vessels (domestic), then locally based vessels followed by foreign-based vessels. In part, this prioritisation is to facilitate greater observer coverage so that target catch reports are

more accurate and better reflect the value of the catch, allowing licence values to be better assessed and adjusted to maximise revenue. Greater observer coverage would also allow for more accurate by-catch data estimates collected on Species of Special Interest, including turtles. Better estimation and response to by-catch not only follows the precautionary principle but also embraces the ecosystem-based approach to fisheries management, both of which are incorporated into Vanuatu's Revised Tuna Fishery Management Plan (VFD and FFA 2014).

Vanuatu has also taken steps to mitigate plastic pollution. The government implemented a ban on the use of single-use plastic shopping bags, plastic straws, and polystyrene take-away boxes as of 1 July 2018, and plastic cutlery, plastic cups, plastic drink stirrers, plastic mesh food netting, egg cartons and artificial flowers as of December 2019. The plan is to eventually also include a ban on the import of disposable children's diapers.

Vanuatu has taken a leading role in marine pollution management through the International Maritime Organisation. In 2018, the IMO Marine Environment Protection Committee adopted the IMO Action Plan to address marine plastic litter from ships, which aims to enhance existing regulations and introduce new supporting measures to reduce marine plastic litter from ships. The Committee agreed actions to be completed by 2025, which relate to all ships, including fishing vessels.

5.1.4 Traditional management measures

Figure 9: A traditional tabu indicator on Rah Island, Banks Group, used to prohibit all fishing in that area. © F. Hickey

Limited capacity of the central government to enforce existing legislation protecting turtles, nests and eggs throughout the archipelago with numerous rural villages remains a significant challenge. The advantage of traditional and community-led management measures is the local level of monitoring and social pressure available to enforce the measures under traditional governance systems. The combination of traditional tenure and governance systems, along with traditional knowledge and the tradition of taboo have allowed for an ideal socio-cultural framework to enable traditional resource management (TRM) at the community level (Hickey 2006, 2007a). However, TRM systems in general have been eroded over the last 25 years in Vanuatu. This is due to a combination of development pressure and the monetisation of resources, introduction of modern fishing methods, western education impacting the way traditional knowledge is passed to future generations, and the introduction of western science-based conservation programmes introduced by NGO's and government agencies (Hickey 2006, 2007a). Strengthening TRM systems along with traditional governance and tenure systems that underpin TRM is important, as explicitly expressed by the Convention of Biodiversity as well as the National Sustainable Development Plan to 2030 (People's Plan) and the Nagoya Protocol. If the issues eroding TRM are not addressed effectively within this generation, it is likely that TRM will be further eroded and largely lost, including traditional knowledge associated with environmental management, gained through an intimate association with Vanuatu's island environments, including climate change issues over thousands

of years. Addressing these issues is also important to reduce the potential significant cost burden on the central government to manage resources throughout communities from Torres to Aneityum.

Traditional taboos (tabu) provide some protection to sea turtles. The turtle nesting season coincides with the traditional season to plant yams, an important staple throughout Vanuatu. A traditional management measure present on most islands of Vanuatu directs that a person who eats turtle or turtle eggs may not attend to their yam, taro, or other gardens for a period of 5 to 14 days, or risk ruining their crops (Hickey 2006, 2007a). The widespread existence of this turtle management taboo may lend evidence to the widespread historical consumption of turtles throughout Vanuatu. There are several islands that traditionally place a taboo on nearshore reefs once yams are planted in October, until six months later, when New Yam is celebrated in early April (Hickey 2006, 2007a). This practice assists to reduce fishing pressure on turtles during their most vulnerable period of nesting, as the yam growing season is during the same months that turtles come ashore to nest. Older people may be more likely to still follow this traditional rule (Hickey 2006, 2007a; Hickey and Petro 2005). The loss of these traditional beliefs and practices poses additional threats to turtles and their nests. Other turtle related traditional taboos included children not eating turtles as it leads to them developing sores (Hickey and Petro 2005) and people afflicted with asthma not eating them as it aggravates their condition (Hickey and Petro 2005). These two prohibitions serve to reduce fishing pressure on turtles.

In the Maskelyne Islands, there is a related taboo for expectant couples: a pregnant woman must stay away from turtles, and her partner is not permitted to hunt turtles during her pregnancy (J. Laggat pers. comm.). This taboo is also found in numerous other cultural groups throughout Vanuatu, and often applies to fishing in general, not just for turtles (Hickey 2006, 2007a).

To reduce people harvesting eggs in some areas, some Vanua-tai members place traditional taboo markers at the nest (Johannes and Hickey 2004). This practice is still observed on Pentecost and Malekula, and likely other areas (Donald James Aromalo, pers obs).

Traditional closures of fishing grounds for a defined period also govern turtle harvests, as defined by the taboo in place. There was considerable support from traditional leaders and communities to introduce a ten-year taboo on turtles and egg consumption by many communities throughout Vanuatu, initiated in 1995 starting on north Efate. In fact, throughout Vanuatu, the introduction of turtle related taboos were the most common management measures amongst villages surveyed between 1993 and 2001 (Johannes and Hickey 2004, Hickey and Johannes 2002).

The use of cooperative management that includes scientific knowledge blended with traditional knowledge such as growth rates, size at sexual maturity, modes and timing of reproduction of highly valued or commercial resources such as trochus, green snail and sea cucumbers has had significant success in enhancing community-based management (Johannes 1998, Amos 1993, Johannes and Hickey 2004). In fact, the early work done by the WSB Turtle Monitor Network since 1995 had great success within communities by providing information to communities regarding their complex lifecycle and the various threats turtles face.

These management measures may include seasonal or other spatial temporal closures in community managed areas, as well as gear restrictions and other spatially defined marine areas (‘Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu’).

Traditional land and marine tenure rights remain in place throughout Vanuatu, including tenure over nesting beaches and nearshore reefs. Traditional land and marine tenure may vary amongst the different cultural-linguistic groups of Vanuatu. Tenures typically extend beyond the nearshore reef into bays and lagoons (Hickey 2006, 2007a), covering the areas where sea turtles would be nesting or prone to human use.

5.2 Current government turtle management arrangements in Vanuatu

At present, turtle management is under the purview of the Vanuatu Fisheries Department (VFD). The VFD has been the main government department responsible for the management of turtles since the first Fisheries Act of 1983 after Independence in 1980. Previously, turtles were managed through traditional management systems (Hickey 2006, 2007a).

The primary legal instrument for the management, development, protection and conservation of fisheries resources in Vanuatu is the Fisheries Act No. 10 of 2014 (see above). This Act includes turtles, and the Fisheries Regulation Order No. 28 of 2009 provides the regulatory framework for turtle related management and conservation, including managing the traditional take of turtles.

In implementing the Act and Order, the VFD seeks guidance on managing the traditional take of turtles from the Vanuatu Cultural Centre to screen community traditional take requests. To assist with enforcement within communities, in 2014, the VFD initiated a programme to train community members to act as Fisheries Authorised Officers (FAOs[21]) to monitor and report fisheries infractions at the village level, including turtle-related infractions.[22]

For offshore commercial fisheries, VFD as the Vanuatu member of the WCPFC is responsible for monitoring and enforcing regulations for offshore by-catch of turtles through their Fisheries Observer Program for the industrial fishing fleet within Vanuatu's EEZ as well as internationally on Vanuatu-flagged vessels. Vanuatu is also a member of the South Pacific Regional Fisheries Management Organisation (SPRFMO) without vessels presently active in the SPRFMO area; and the Inter-American Tropical Tuna Commission where there are Vanuatu-flagged vessels active in the eastern Pacific Ocean. Reporting is either not active or not publicly available.

Sea turtles use both land and sea and have a range of uses or values that extend beyond the traditional definition of 'fisheries'. Jurisdiction and effective management of turtle-related activities on land, such as for head-start programmes, is not as clear-cut as the management of turtles as a fisheries by-catch species.

The DEPC is the institution in Vanuatu responsible for protecting internationally endangered species, alongside other environmental and conservation duties of relevance for sea turtles and the habitats and species on which turtles depend. DEPC manages Environmental Impact Assessment processes in Vanuatu.

The VFD are considering DEPC's involvement in conserving turtles through legislation and regulations. The DEPC envisages the creation of new species-specific regulations to better conserve endemic, rare, threatened, and vulnerable species, as well as those covered under CITES. This list also includes species harvested, exported, or kept in captivity. Under these criteria, this list would include numerous species that VFD would typically and currently regulates under their existing legislation, including sea cucumber, trochus, green snail, and many aquarium trade products (such as small colourful fish, coral, and a range of small invertebrates including sea urchins, nudibranchs and anemones).

DEPC, however, faces significant capacity challenges, potentially restricting their involvement, particularly for enforcement. The VFD has greater capacity than DEPC with a range of marine biologists on staff and have now trained 20 Vanua-tai as CBAOs to work in their communities. The VFD also has an ongoing relationship with the Police Maritime Wing that makes routine cruises through the archipelago as part of

[21] These Officers are now called Community Based Authorised Officers (CBAO).

[22] Community-based coastal fisheries management, including by-catch monitoring, was supported under the Pathways Project over 2014–2021. See: https://fisheries.gov.vu/index.php/what-we-do/projects/pathways-project.html

compliance and monitoring measures. Fisheries enforcement staff often accompany the Maritime Wing on these cruises, which are an opportunity to liaise with communities on turtle-related issues and infractions.

The Department of Tourism also has a role to play by ensuring tourism operators are compliant with the DEPC and VFD legislation and regulations before issuing permits. This requires that tourism officers work together and are well-versed on the turtle-related regulations.

There is a sense of urgency because Vanuatu's environment is changing at a rapid pace, due in part to the continuing development pressure Vanuatu is experiencing, coupled with the limited human and financial capacity of the government and NGO environmental sectors. During consultations for the present report, DEPC raised the need for improved collaboration and cooperation among government agencies and NGOs working on environmental management in Vanuatu. Trust within the sector is essential to share information and collaborate to protect Vanuatu's environment and therefore, sea turtles.

Memoranda of Understanding (MOUs) between partners are one option that may assist in establishing this trust. Cooperation would enable the long-term protection of and accessibility to shared data, while addressing intellectual property rights.

5.3 Non-governmental turtle management arrangements

The VFD has signed an MOU with WSB to promote community-based turtle management through the Vanua-tai network (VFD 2015). WSB has a countrywide network of monitors (termed Vanua-tai Resource Monitors). The MOU sets out the duties and responsibilities of both parties in relation to the protection, conservation and management of sea turtles. This management collaboration has been in place since 2008.

The DEPC has had an MOU since 2011 with the WSB Vanua-tai to capture and tag foraging and nesting turtles, along with collecting genetic samples.

5.4 Priorities for training, research and spatial management

Support for turtle monitoring and research aligns with Policy Goal 3 in the NPOA Turtles: “Strengthen monitoring and data collection within coastal waters”. The most basic question is: How many sea turtles by species are present in Vanuatu?

VFD Director Naviti recommended turtle tagging and a country-wide census to get a snapshot of the turtle population nationally. Alternatively, rather than coordinating and funding a country-wide census in one go, it may be more prudent to start providing training in turtle abundance assessment to Vanua-tai members and increase monitoring of turtle foraging grounds over the next two years.

5.4.1 Research priorities

1) Conduct basic population assessments of sea turtles throughout Vanuatu.
2) Continue monitoring and tagging of previously untagged turtles at key nesting sites to determine trends for the five species of marine turtles found in Vanuatu.
    a. Because leatherbacks and hawksbill turtles remain critically endangered, sampling effort should increase for these species by targeting new locations.
    b. Annual sampling of all nesting beaches may not be realistic. Sampling on a rotational basis with the goal of covering all nesting beaches in Vanuatu every five years may be more realistic, ensuring that sampling effort is recorded to permit the detection of trends.
    c. The number of monitors required to meet that survey intensity will depend on the extent of support provided, such as for travel between islands.
3) Identify and monitor the health impacts of turtle handling and captivity practices, to provide evidence for the permit or refusal of practices such as captive rearing, turtle handling or feeding, and other practices by researchers and visitors.
4) Collect further information and data on other potential key and small nesting sites (with 5 to 10 nests) in new areas to confirm species, numbers, and nesting survival rates.
5) Conduct further satellite tagging of nesting turtles of various species to identify their foraging grounds and migratory corridors.
6) Conduct genetic sampling (see ‘3.2 Genetic diversity of Vanuatu turtles’ for estimated sample size requirements):
    a. Further genetic sampling from various rookeries to determine if Vanuatu's green turtles are one single Management Unit.
    b. Commence genetic sampling of hawksbill turtles to determine if they may also be a distinct Management Unit.
    c. Collect leatherback tissue samples for genetic analysis.

Recommendations for turtle research in Vanuatu are provided in Chapter 6. Priority Recommendations’.

5.4.2 Training priorities

Local capacity to monitor turtles and to conduct research is central to having adequate understanding of sea turtles in Vanuatu. Local capacity for sea turtle management is also key. Training is part of sustainable research and management capacity in the country. Specific recommendations are provided in Chapter 6. Priority Recommendations’. Sustainable turtle-related research and conservation in Vanuatu relies on long-

term support. Particularly given the international nature of sea turtle populations, ni-Vanuatu experts need to work alongside other experienced turtle biologists and ecologists, either by establishing long-term relationships with legitimate, skilled scientists or travelling overseas on exchange programmes, internships, or similar, with sufficient time for ni-Vanuatu scientists and experts to gain useful experience.

Building local capacity requires both initial training as well as long-term sustainable career prospects for those with the relevant capacity. For example, a master's scholarship may be funded to enable a ni-Vanuatu student to undertake a thesis on Vanuatu sea turtles. This step aligns with and expands the scope of Policy Goal 7 in the NPOA Turtles: 'Encourage postgraduate scholarships on the science and management of by-catch in tuna fisheries including sea turtles.' However, a scholarship associated with a funded project has a short lifetime, and there is a risk that the scholar will have to seek other employment (potentially outside of Vanuatu) if a local career is not practicable.

Vanua-tai members who collect nesting, foraging, and flipper tag data in the field require training in best practices for these activities and for the use of the new TREDS system. SPREP has already conducted two initial training sessions (2021) for key WSB personnel for the new TREDS database. The training of Vanua-tai members could be introduced at the next Annual General Meeting or provincial sub-group meetings. A significant practical component to the training would be welcome, focusing on areas like the index sites of Bamboo Bay, Wiawi, and Moso as well as Votlo and Maranata.

To permit effective analysis of trends in turtle populations, the CBAO, in addition to Vanua-tai, also need to strengthen their turtle-related data collection methods, record keeping, and timely submission of data for analysis.

In addition, CBAO's and Vanua-tai members need to work closely together and support each other on turtle management and environmental issues in general. VFD recommended that this could be initiated through a provincial level meeting to formally assist with removing any current barriers to cooperation. Also useful for the Vanua-tai sub-networks is the need to liaise with the Provincial Government and their respective Area Councils to keep them informed of Vanua-tai activities, as well as advise them about critical habitat areas for turtle nesting and foraging of turtles. This is in line with the move towards decentralisation of governance to the local level and will help ensure that upcoming infrastructure developments will not interfere with key turtle habitats.

Training and best practices also relate to knowledge custodianship. Knowledge custodianship includes the practicalities of data management, but also the appropriate sharing – or restriction – of knowledge and representations of turtle management. Photographs of turtles and of interactions with turtles are attractive elements of social media posts, for example. However, widespread sharing of images and stories of turtle interactions, such as nest relocation, bring a risk of untrained mimicry that may cause harm to turtles; this sharing may also encourage wildlife harassment (World Animal Protection 2017). Examples of supportive frameworks for preventing harmful image-sharing practices include the IUCN Primates Best Practice Guidelines for Responsible Images of Non-Human Primates[23] and Costa Rica's national legislation regulating human-wildlife interactions with an accompanying eight-point code for ethical animal selfies.[24] Given existing turtle tourism in Vanuatu and the extensive network of volunteers conducting turtle surveys, training to prevent wildlife harassment may be a training priority.

[23] See: https://human-primate-interactions.org/resources/

[24] See: https://stopanimalselfies.org/en/home/

5.4.3 Priority locations for turtle research and monitoring

The length of nesting beaches at Votlo on Epi and Maranata on Ambrym (12 kilometres) makes monitoring time-consuming and labour-intensive. Very little nest monitoring has been done on these beaches over the last few years. Prioritisation of these sites is warranted given the critically endangered status of leatherbacks in the western Pacific. Addressing this data gap will require further training and encouragement for communities and Vanua-tai members residing near these leatherback index sites. The expenses associated with accessing and monitoring these beaches may be a barrier, recognising that any compensation and distribution of funds to support surveys needs to be egalitarian so there is no resentment by other communities, which may be expected to monitor for free.

Wiawi village (Malekula) is an important index site for hawksbill turtles but has only minimal monitoring of nesting activity. The bay also has seagrass meadows that support foraging by green turtles. Training and encouraging Wiawi community members could support future nesting surveys. It would also be a good location to survey the foraging green turtles to get an estimate of the resident population.

Moso Island (north Efate) is an important hawksbill index site that has not had regular nesting surveys for many years. Monitoring the trend in nesting on Moso is of value, given the amount of resort and coastal housing development the island has experienced in the last ten years. The Tassiriki community has expressed interest in building bungalows to accommodate eco-tourists who would assist with the nesting surveys, as was done in the past. The intent is to use revenue from the bungalows to support the nesting surveys; this initiative would have to be assessed in accordance with the best information available about tourism impacts and similar programmes elsewhere.

Lelepa Island (next to Moso Island) has good nesting beaches, and this island is likely to be developed as a cruise ship destination, potentially for thousands of visitors per day. It would be useful to obtain baseline data on Lelepa nesting beaches to support environmental impact assessments and mitigation strategies to increase sea turtle resilience to this upcoming development.

There are other potentially significant nesting and foraging sites that have never been surveyed properly to assess their status, despite many of these sites being highlighted as important in 2009/2010. These sites include:

- Malokilikili (Sanma Province);
- Naone area of Maevo Island (Penama Province);
- Tuktuk Bay on Efate (Shefa Province);
- in the Banks Islands (Torba Province): Pakea Island, Reef Islands, various areas of Gaua Island, Ambek area on east Vanua Lava, Uraparapara Island and Ravenga Island; and
- for leatherback nesting, Devils Rock on Ambae (Penama), Point Cross on South Pentecost (Penama), and Big Bay Beach on Santo (Sanma).

5.4.4 Priority locations for turtle protection and land-use management

In addition to the above locations, known nesting sites and foraging habitat are candidates for priority management.

Existing initiatives for marine spatial protection in Vanuatu include at least 56 sites where turtles or their primary foods, such as seagrass, are known to be present (Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu). These initiatives take the form of traditional tabu areas, community managed areas, and ‘formal’ marine protected areas, with a range of enforcement and monitoring

mechanisms and levels. Supporting and strengthening existing initiatives is likely to be a lower-cost, effective intervention.

The Vanua-tai Annual General Meeting provides an opportunity to record, by location, which species have been observed by communities in those areas to be plentiful. These observations may be useful in informing responses to requests for traditional take to the VFD. Community reports can provide information or direct future research efforts to follow up on reported trends. For instance, some community members report perceived increased turtle abundance over the past 25 years of community conservation efforts, and at least one community member believed that turtles were harvested because of their impacts on seagrass meadows through over-grazing, a sign of green turtle abundance (VESS unpublished).

The Vanua-tai network is largely centralised on Efate, but would benefit from decentralising to the provinces, in line with the Vanuatu government's national decentralisation policy. This would reduce travel expenses to annual general meetings and allow for a greater number of Vanua-tai members to attend sub-group meetings at the provincial level and to concentrate on addressing local issues and constraints. Some provinces are now in the process of consolidating sub-Vanua-tai groups.

Maps (Figures 10 – 16) of reported turtle observations, based on 2016–2017 survey of fishers throughout Vanuatu (see '3.6 Vanuatu fishers survey'), indicate potential priority areas where fishing activity overlaps with turtle presence. The maps contain areas as drawn by the fishers, generally aligning with their traditional fishing areas; an absence of turtle observations in an area may simply indicate that fishers did not use that area, although turtles might be present. The survey was conducted in 2016–2017, but the time period of the observations may be broader than that period and the times of observation may not have been specified by each participating fisher. The reported sightings largely represent foraging turtles. The development of maps to illustrate important nesting areas was beyond the scope of the present report.

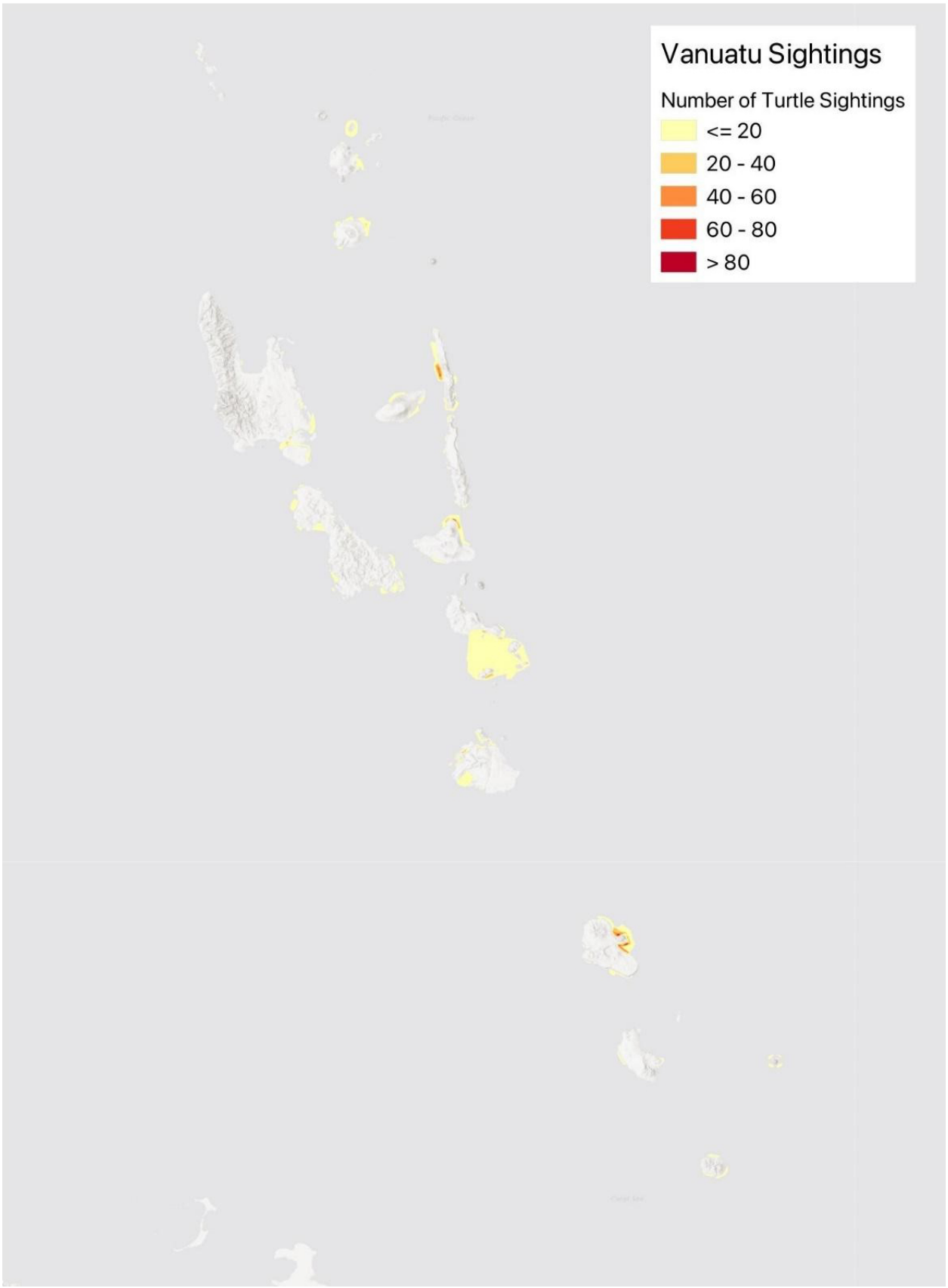


Figure 10: Indicative heat maps of reported sea turtle sightings by fishers in Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

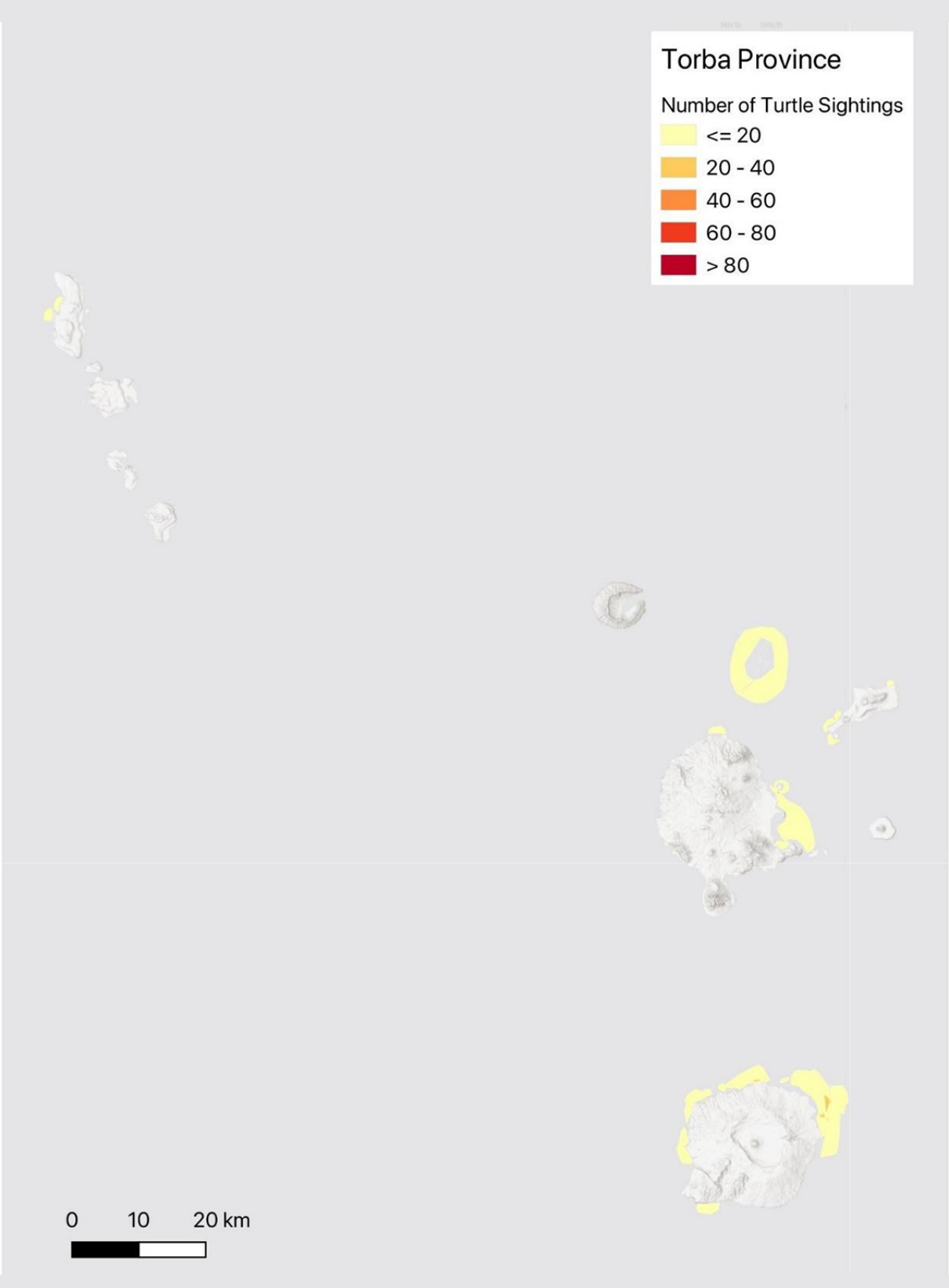


Figure 11: Indicative heat maps of reported sea turtle sightings by fishers in Torba Province, Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

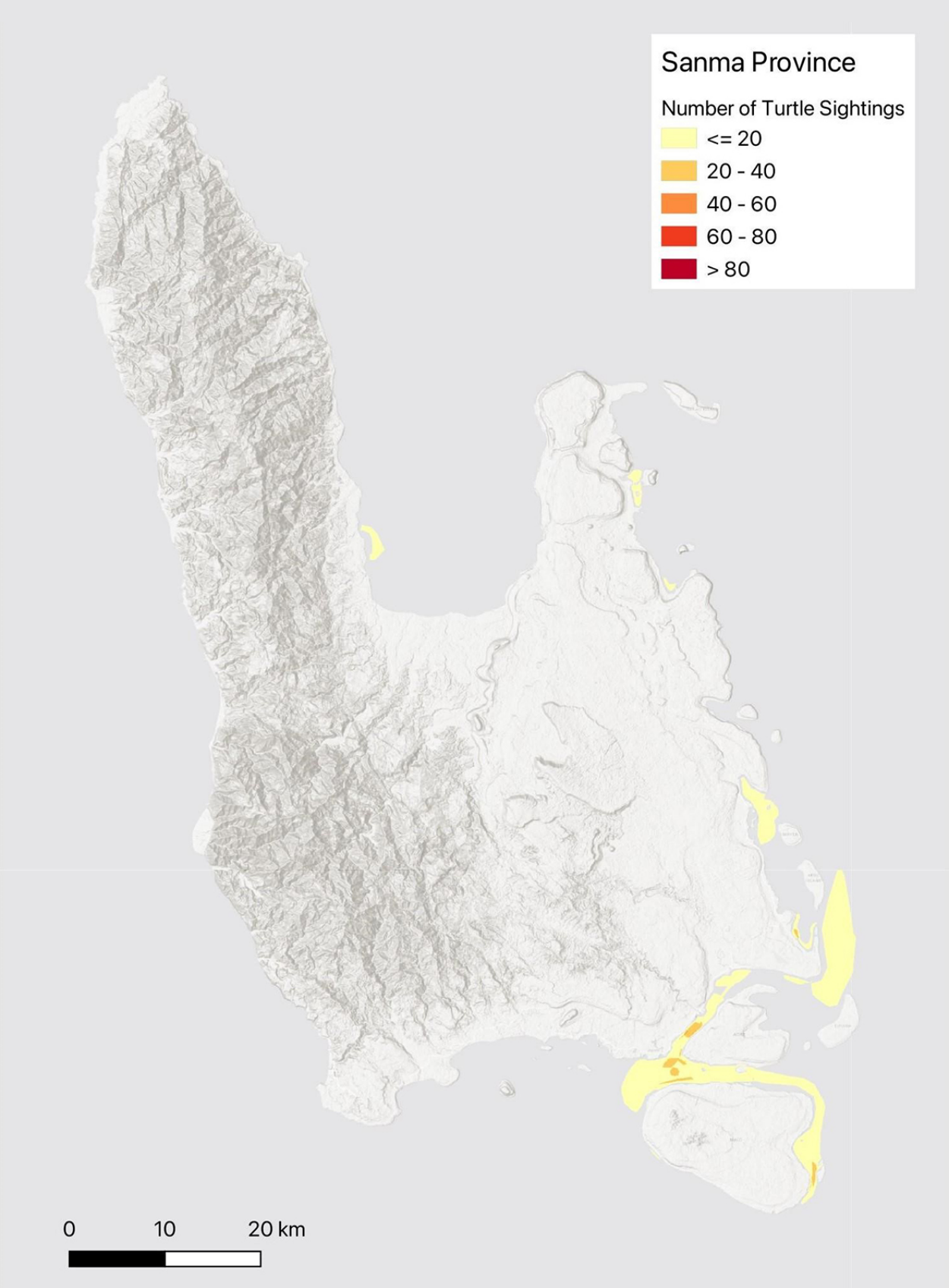


Figure 12: Indicative heat maps of reported sea turtle sightings by fishers in Sanma Province, Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

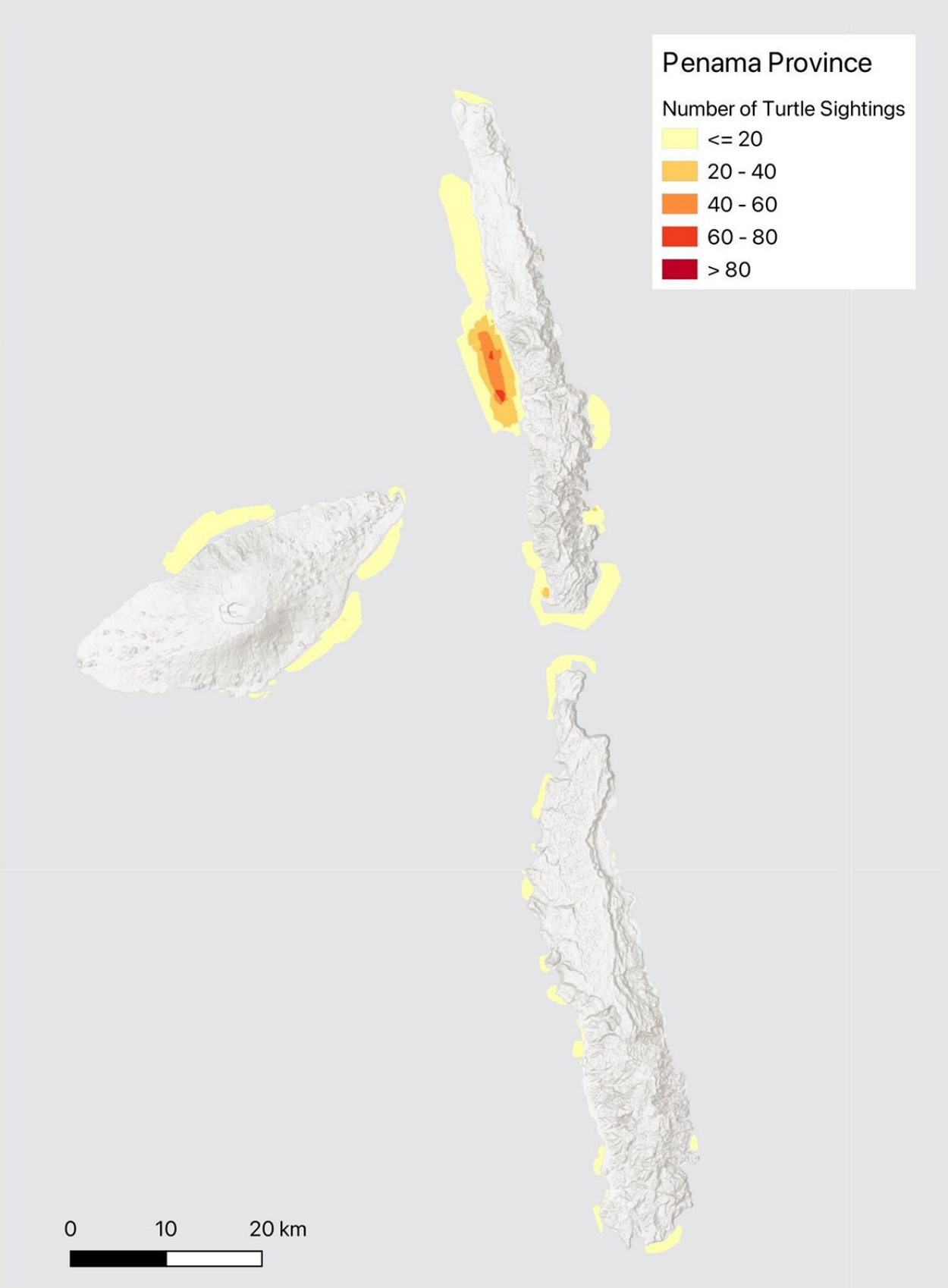


Figure 13: Indicative heat maps of reported sea turtle sightings by fishers in Penama Province, Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

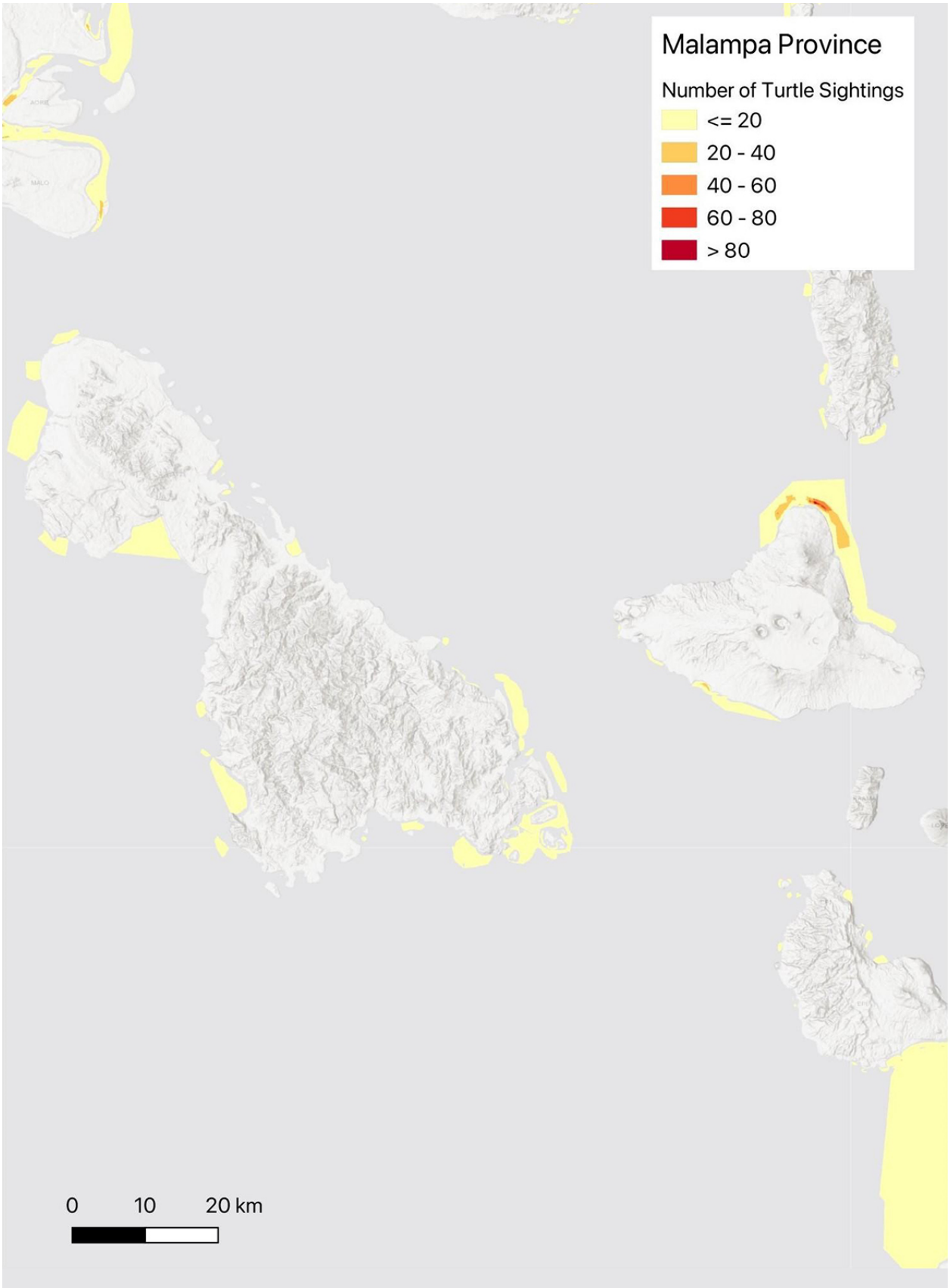


Figure 14: Indicative heat maps of reported sea turtle sightings by fishers in Malampa Province, Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

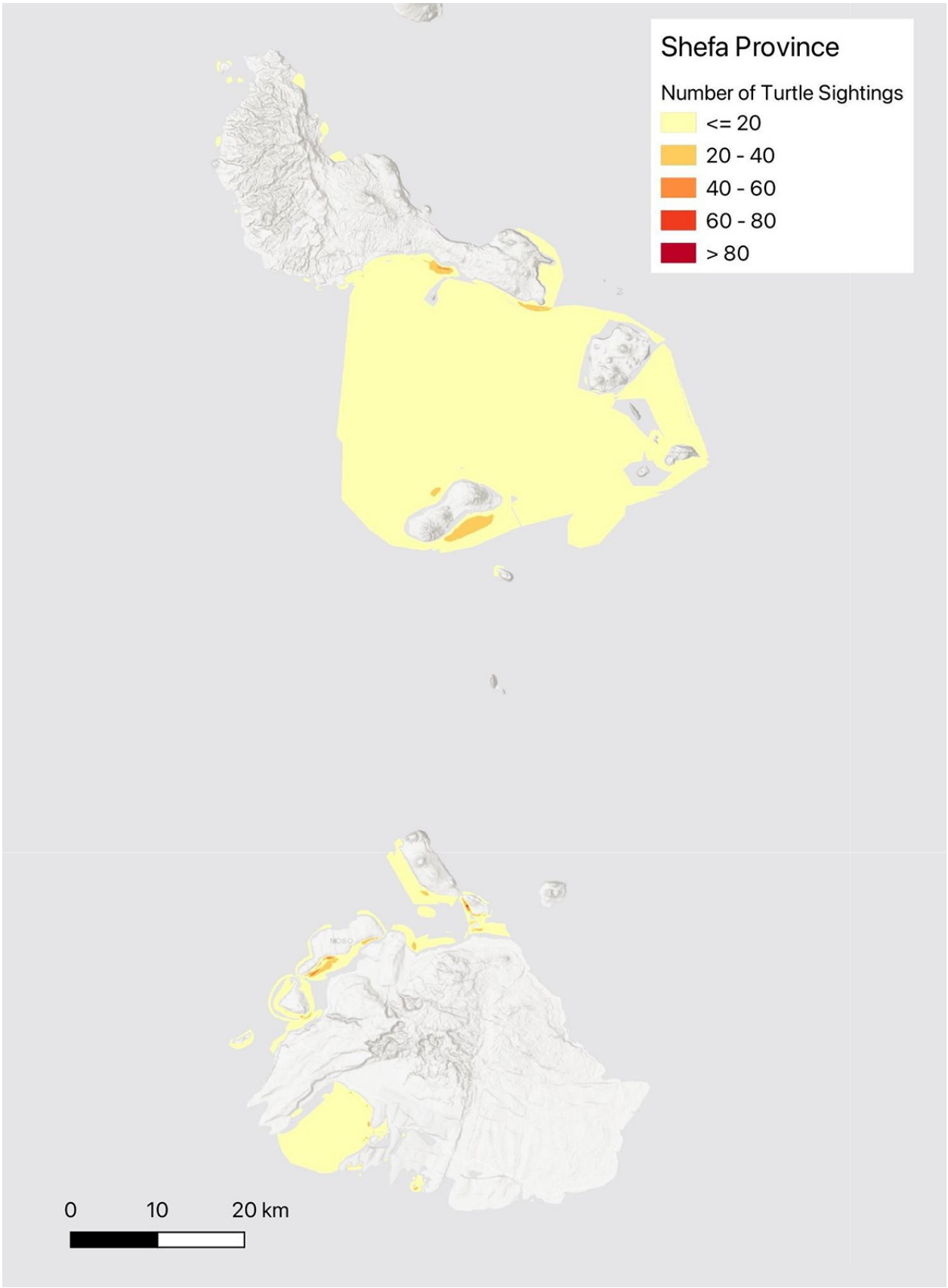


Figure 15: Indicative heat maps of reported sea turtle sightings by fishers in Shefa Province, Vanuatu, 2016–2017. Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar

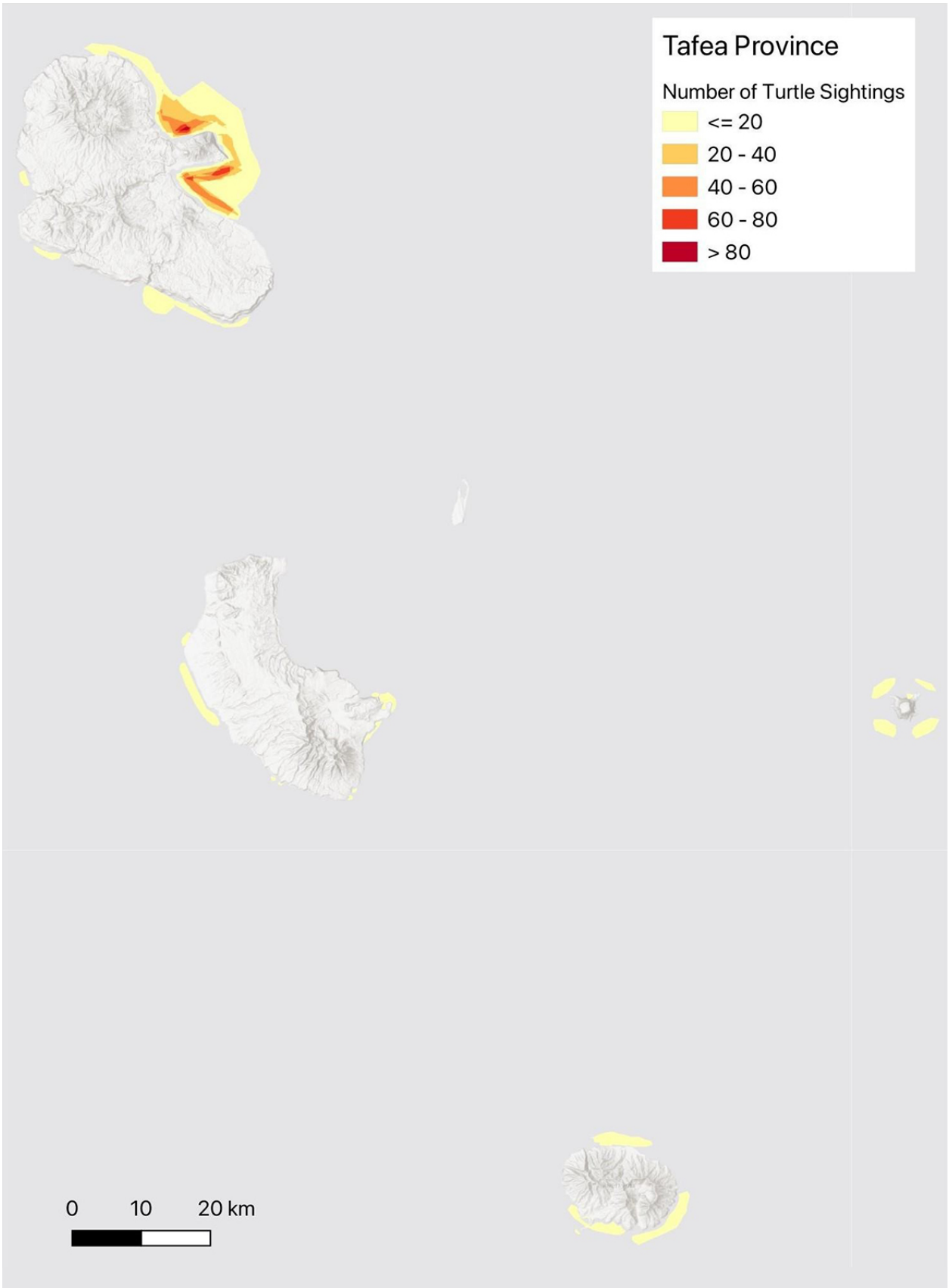
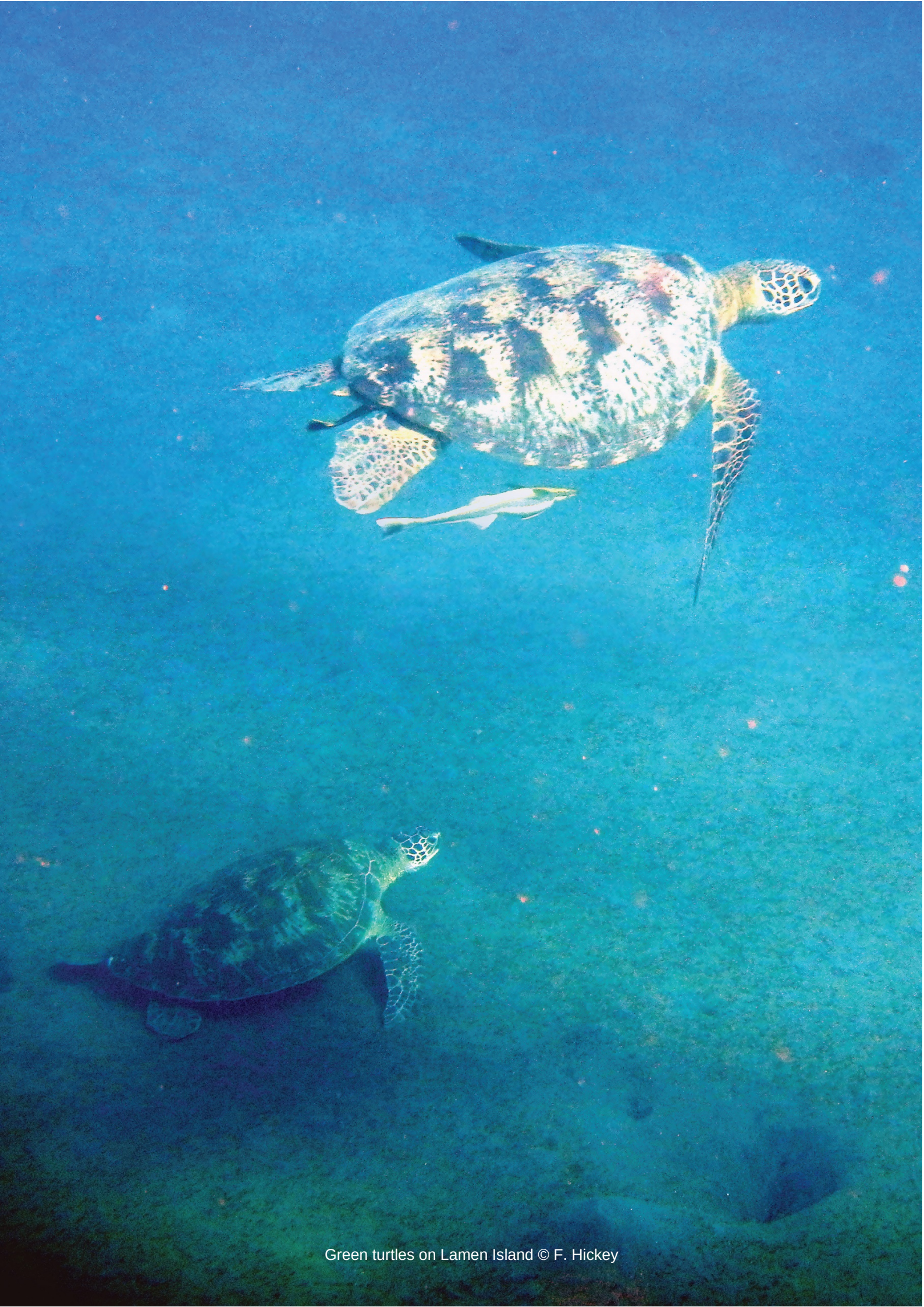


Figure 16: Indicative heat maps of reported sea turtle sightings by fishers in Tafea Province, Vanuatu, 2016–2017
Source: data: VESS 2017 unpublished survey, supported under the GEF Dugong and Seagrass Conservation Project; visualisation: TierraMar



Green turtles on Lamen Island © F. Hickey

6. Priority High-level Recommendations

From this review, seven high-level recommendations are provided to the Government of Vanuatu and other sea turtle stakeholders in Vanuatu to assist in strengthening sea turtle conservation and management. For each, example actions are included, along with information about present and upcoming project activities of relevance. In some cases, current and upcoming project activities may address part of a recommendation. The order of recommendations presented here is not intended as a ranking of priority.

Recommendation 1:

Strengthen the policy and legislative framework in Vanuatu for effective sea turtle management.

Potential actions for consideration to strengthen sea turtle management include:

- **Harvest and traditional take.** Revise policies governing traditional take permits to grant permission for only green turtles of a defined size and prohibit take of hawksbill and leatherback turtles as Critically Endangered species. It may be necessary to revise the legislation to clarify that exemptions will be limited to defined species.
- **Harvest and traditional take:** Revise the policy requirements for a special take permit to require monitoring of take activities that includes the collection of data documenting location collected, species, size (curved carapace length/width – CCL/CCW), genetic samples, tag returns, diseases, and general health status. These data should be provided to the VFD in a timely manner as part of the conditions of a take permit. Ensure greater transparency of follow-up actions in cases where actual take exceeds permitted take.
    - *Project actions underway:* Within the BIEM funded initiative[25] to support the VFD Community-based Authorised Officers (CBAO) for the next several years, CBAO are tasked with monitoring nearshore fisheries. The CBAO or another designated VFD representative could take the role of data collector during traditional turtle harvest. They could also be required to collect necessary data on turtles brought in by fishers.
- **Tagging or other handling:** Develop a policy to require licences/permits for turtle tagging or other handling/capture for those performing these activities under an approved research or education permit.
- **Strengthen capacity within government to create and enforce sustainable land-use and marine spatial plans and related legislation** at provincial and national levels as well as to monitor and enforce environmental requirements for land-use and development, to prevent further degradation of turtle foraging, nesting and other habitats.
- **Strengthen coordination among national partners with jurisdiction for sea turtles and their habitats and the ecosystems and other species on which sea turtles rely**. Meaningful coordination may include, among others, shared prioritisation of key sites for conservation or management action.
- **Strengthen capacity for management, monitoring, and enforcement of policy, legislation, and practices affecting sea turtle habitat**, such as waste management and pollution control, coastal development, and so on.

[25] 'Strengthening inshore fisheries by-catch data collection and community-based fisheries enforcement in Vanuatu' Partnership Agreement with VFD

Recommendation 2:

Strengthen wildlife health and welfare in Vanuatu using best practices for animal encounters and wildlife tourism.

Potential actions for consideration to support sea turtle health and welfare in Vanuatu include:

- **Turtle-related knowledge.** Build awareness of sea turtle biology, risk assessment, turtle protection, and other turtle-related knowledge, building on and embedding awareness programmes in local languages and culture.
- **Turtle encounters.** Build awareness and training, including at the village level, of best practices for encountering a turtle in the wild.
    - *Project actions underway:* Best-practice guidelines/code of conduct for tourism interaction with turtles in Vanuatu will be prepared with the support of the European Union through the Pacific Biodiversity and Sustainable Land-Seascapes (Pacific BioScapes) Programme, executed by SPREP. The development of the guidelines will begin in 2023 and will include extensive consultation with operators and other interested parties. The development of guidelines/code of conduct can be grounded in existing examples from other regions and/or for other species, such as the *Scottish Marine Wildlife Watching Code* (2017) and *Guide to Best Practice for Watching Marine Wildlife* (2017), the *Guide to Good Practice in Animal Interactions: Wildlife Tourism* (2004), and *Responsible Shark and Ray Tourism – A Guide to Best Practice* (2017), as well as Vanuatu's own minimum standard for Wildlife Activities.
- **Tagging.** Tagging and monitoring teams should carry their tagging equipment with them on every visit, with sufficient tag kits provided to allow a kit per active survey (see also 'Physical resources and financing' in Recommendation 5). The practice of flipping a nesting turtle over, leaving the turtle, and returning hours or days later to tag the turtle is not best practice and should be avoided (see also: 'Training and Spatial Coverage' in Recommendation 5).
    - *Project actions underway:* A regional Turtle Monitoring and Tagging Manual is planned to be produced and distributed through SPREP with the support of the Pacific BioScapes programme funded by the European Union. The manual is intended for publication in 2023.
- **Permitted research and education uses.** Minimise contact with sea turtles. When contact is required, ensure safe turtle handling. Provide training in proper turtle handling methods to minimise stress, injury, and mortality to turtles. It may be necessary to license individuals so that only trained individuals are allowed to handle or capture turtles, including for tagging. This is likely to be a recommendation within the proposed Turtle Monitoring and Tagging Manual developed for the region.

Recommendation 3:

Strengthen management and mitigation of sea turtle by-catch in nearshore and offshore fisheries.

Potential actions for consideration to mitigate, monitor and manage turtle by-catch include:

- **Build resilience into by-catch monitoring of offshore fisheries** for record-keeping even when observers are not able to serve on board, as has been the case during the COVID-19 pandemic response.
- **Consider the installation of e-monitoring systems on Vanuatu-flagged vessels or increase observer coverage**, including to support observations of protected species and/or Species of Special Interest interactions and to improve compliance with logbook-based reporting systems.
- **Require the presence of observers or e-monitoring** as part of any fishing licence granted.
- **Strengthen reporting of by-catch** to provide robust estimates of by-catch based on observed by-catch, with a sufficient proportion of vessels carrying onboard observers or using electronic monitoring.
- **Strengthen mitigation measures to reduce turtle by-catch on any Vanuatu-flagged fishing vessel and/or any vessel fishing in Vanuatu's waters,** including through the adoption of best practice and by-catch-mitigation measures and gear, for both nearshore and offshore fisheries. Consider requiring two or three mitigation measures for sea turtles on longline vessels rather than just one, such as use of large circle hooks, use of fin fish bait, or removal of the first two hook positions closest to each float. In addition, expanding the conservation measure to include deep-set longlines would deliver strong reductions in by-catch due to the greater effort in this fishery.
    - *Project actions underway:* A port-based extension officer, funded through the BIEM Initiative, will be working with VFD for the extension of mitigation measures against by-catch of Species of Special Interest in the offshore longline fleet until December 2023. This provides an opportunity for additional training for skippers and crews and potentially the provision of mitigation devices, such as dehookers, line cutters and hookpods, for vessels to reduce turtle by-catch and mortality.
- **Establish and strengthen by-catch monitoring and reporting for nearshore and artisanal or subsistence fisheries**.
    - *Project actions underway:* Within the BIEM funded initiative to support Community-based Authorised Officers (CBAO) for the next several years, CBAOs are tasked with monitoring nearshore fisheries and reporting infractions, including relating to turtles. They could also be tasked with collecting necessary data on turtles brought in by fishers from by-catch, or stranded or entangled turtles.
- **Strengthen the knowledge base and monitoring of the drivers of by-catch mitigation and retention**, including in nearshore and artisanal fisheries.
    - *Project actions underway:* A port-based extension officer, funded through the BIEM Initiative, will be working with VFD for the extension of mitigation measures against by-catch of Species of Special Interest in the offshore longline fleet until December 2023. This provides an opportunity for additional training for skippers and crews and potentially the provision of mitigation devices, such as dehookers, line cutters and hookpods, for vessels to reduce turtle by-catch and mortality.

Recommendation 4:

Strengthen knowledge and information collection about traditional turtle use in Vanuatu, including data collection in the Maskelynes around the New Yam Festival.

The limited data regarding sea turtle populations prevents accurate population assessments. As a result, the impact of traditional take on locally harvested populations is also unknown.

Potential actions for consideration to strengthen management of permitted sea turtle harvest and/or use include:

- **Expand data collection regarding traditional turtle take** to include the numbers harvested and consumed versus the number permitted to be taken, which species are consumed, the sex and size of harvested turtles, location(s) caught and consumed, health status of the turtle(s), and the drivers/motivation to take the harvested turtle(s). Where possible, collect genetic samples. Ensure tags are returned if a tagged turtle is harvested.
    - *Project actions underway:* Within the BIEM funded initiative to support CBAO for the next several years, CBAOs are tasked with monitoring nearshore fisheries. The CBAO or another designated VFD representative could take the role of data collector during traditional turtle harvests. They could also be required to collect necessary data on turtles brought in by fishers.
- **Support the traditional communities of the Maskelyne Islands in their decisions surrounding the New Yam Festival when 30 (mostly green) turtles are consumed by restricting the take to:** (1) foraging turtles, avoiding nesting females; (2) permitted species (see policy recommendations wherein permits could be revised to avoid Critically Endangered species); and (3) require the use of traditional practices, that is, capture of adult foraging turtles from a canoe without modern weapons or gear.
- E**ncourage the Maskelynes Council of Chief's to consider moving the New Yam Festival to 4 April, in line with their traditional environmental cue of Pleiades setting in the west at dusk**. This would reduce threats of consuming egg laden turtles. In addition, it is recommended that all villages on southeast Malekula should celebrate their New Yam festival on 4 April for the same reason, as well as to simplify and reduce costs of monitoring of these events by VFD.
    - *Project actions underway:* The CBAO for the Maskelyne Islands could support and oversee data collection during the traditional turtle harvest. The BIEM-funded initiative described above will support CBAOs for the next several years.
- **Acknowledging the traditional take of turtles and the customary importance of sea turtles, undertake open review (at least every five years) and community consultation to justify the granting or denial of take permits.** The goal is to ensure the turtle population is sufficient to allow for the traditional take of a modest number of turtles for a cultural celebration. A key challenge for this assessment is the availability of data to set a sustainable quota (see Recommendation 6).

Recommendation 5:

Strengthen the capacity for sea turtle monitoring, management, and enforcement in Vanuatu.

Management and enforcement

- **Build awareness and enforcement capacity to provide sufficient coverage of priority turtle locations and key communities**. The need for enforcement officers in place can be minimised through effective public awareness, training and community engagement.
- **Build capacity of enforcement officials to make decisions based on best practice and turtle biology**. Equip enforcement officials with up-to-date knowledge about key coastal foraging and nesting habitats. Enforcement decisions should also consider coastline dynamics under climate change and extreme events, as well as impacts of land-use change, such as roads and wharf construction.
- **Strengthen enforcement of the legislation even when granting special permits for traditional take or research.** For instance, the capture of nesting female turtles is to be avoided even under special permit.
- **Halt or bring into compliance with the Fisheries Act any turtle capture/handling activities as soon as possible, as per current legislation for a research permit for educational purposes provided for under the Act.** Ensure adequate capacity for random inspections of turtle-related tourism operations. Costs associated with the monitoring could be covered by the tourism operator. If data are not provided[26] in accordance with the permit, the permit may be suspended or cancelled; this would assist in ensuring data is provided on a timely basis.

Physical resources and financing for long-term monitoring

Resources required for monitoring include considerable time demands for promoting the conservation and sustainable use of sea turtles (and a range of other environmental issues) in a developing economy that is increasingly monetised. Night-time nesting surveys of remote beaches have expenses associated with truck or boat transport as well as food and shelter for monitors. Other expenses include torches and batteries as well as a camera to document turtle nesting activities, threats, or assist with turtle identification.

Potential actions for consideration to reduce and meet monitoring resource needs include:

- **Monitoring, fieldwork gear:** Supply Monitoring Kits consisting of a waterproof torch, waterproof clipboard, a measuring tape for measuring turtles, a genetic sampling kit, and a waterproof bag to carry this gear. A smartphone[27] or tablet could be used to enter the field data from the field data sheet, using standard offline TREDS forms. In addition to the standard tagging equipment, it is also important to have an extra supply of tag applicators available to replace those damaged or lost.
    - *Project actions underway:* Within a BIEM-funded initiative to support CBAO[21] for the next several years, CBAO are tasked with monitoring nearshore fisheries and reporting infractions, including relating to turtles. They will be provided with some equipment (excluding a

[26] If a research or educational captivity activity is permitted, the VFD could assist the licensed facilities to set up a data collection system that records mortalities, species used, geographical source, size, etc, to be regularly submitted to VFD for analysis. The CBAO of the area should be present to oversee the collection of data regarding turtles and turtle facilities. The CBAO will require training in these aspects of hatcheries; the Research Section of the VFD has these skills to transfer to the CBAOs.

[27] One option is to use smart phones/tablets which have a torch, camera, video, and a sound recorder to record field activities. For example, a photo can be used to later confirm the species identification of unusual looking turtles. Offline data forms and photos of field data sheets could be uploaded to head office in Port Vila so that data could be backed up and stored, as well as rapidly entered into TREDS. This would provide more data security than the present process of recording field data manually on data sheets that are stored in the field for about six months and then hand-delivered at the Vanua-tai AGM. The smart phones would also require a waterproof container/bag for use in the field to protect them from the elements.

smartphone) and could also be tasked with collecting necessary data on turtles brought in by fishers.

- **Tag inventory**: Regularly (or at least annually), request all those (such as Vanua-tai resource monitors) holding flipper tags to report all unused tags and update tag inventory records to make sure that tag distribution to resource monitors and any lost or damaged tags are reported back to SPREP. Build a consistent chain of information flow, such as one person collating information from the Vanua-tai to enhance the flow of information to SPREP.
- **Sustainable financing**: Investigate sustainable financing options for turtle monitoring, including support for the voluntary Vanua-tai network. Consider support of monitoring programmes through funds to assist with the expenses, including labour.

Training and spatial coverage

All training and awareness should consider the potential risks associated with untrained or poorly trained activities and the risk of unsolicited copying, as when people act based on what they see on social media.

Potential actions for consideration for training and enhanced spatial coverage of priority areas include:

- **Continue to build the capacity of resource monitors, including Vanua-tai members, in monitoring, identifying, and tagging turtles, especially for new members**; and in refining data collection of turtle measurements, recording of tag numbers, nesting data, and foraging population estimates, along with genetic sampling techniques. Strengthen reporting to include monitoring effort (see research recommendation).
    - *Project actions underway:* a regional 'Turtle Monitoring and Tagging Manual' is in preparation, to be produced and distributed with the support of the Pacific BioScapes programme. The manual is intended for publication in 2023.
- **Support the expansion of the Vanua-tai monitors network** throughout the provinces of Vanuatu to monitor priority sites for sea turtles.
    - *Project actions underway:* National marine turtle monitoring coordinators for Pacific Island countries and territories will be trained in 2023, as part of the Pacific BioScapes programme. In Vanuatu, this effort will be undertaken in partnership with WSB.
    - *Project actions underway:* The same Pacific BioScapes project has the target of implementing network(s) of long-term marine turtle nesting beach surveys, with support from 2023–2025.
- **Support training of Vanua-tai, staff at WSB, and other Vanuatu institutions involved in turtle management in the use of the new online version of the TREDS**, coordinated by SPREP.
    - *Project actions underway:* SPREP has conducted two initial training sessions for WSB members on the use of the new TREDS system. SPREP staff are available for additional (virtual) training sessions upon request.
- **Guide peer-to-peer learning, with transparent standards for best practices and grounded in expert evaluation of training materials and techniques prior to learning dissemination**.
    - *Project actions underway:* Through the BIEM Initiative, SPREP plans to run a regional learning exchange for turtle monitors from across Melanesia. This activity will be run in 2023.
- **Pending literature review and expert analysis to identify best practice, provide training for Vanua-tai resource monitors**:

- in nest translocation decision-making processes, which includes when not to relocate nests, and techniques. Given the observations of leatherback turtles nesting lower on the beaches, discussion and training in relocation best practice may be important for the Vanuatai living near the leatherback nesting beaches of Votlo and Maranata; and
- in nest cooling decision-making processes, which includes when not to act, and techniques for nest cooling.

- **Ensure appropriate turtle recovery training to be provided to vessel crews and fishers** who may encounter turtles entangled or caught in debris or fishing gear.
  - *Project actions underway:* A port-based extension officer, funded through the BIEM Initiative, will be working with VFD for the extension of mitigation measures against by-catch of Species of Special Interest in the offshore longline fleet until December 2023. This provides an opportunity for additional training for skippers and crews and potentially the provision of mitigation devices, such as dehookers, line cutters and hookpods, for vessels to reduce turtle by-catch and mortality.

Recommendation 6:

Strengthen the capacity for scientific research on sea turtles in Vanuatu and support targeted scientific research on sea turtles to underpin turtle management.

Potential actions for consideration to strengthen scientific research and research capacity on sea turtles in Vanuatu include:

- **Build local capacity in researching and managing marine turtles**, including expertise in science-based monitoring and management. Building this capacity requires not only initial training but also long-term viability of related careers.
- **Strengthen scientific research on sea turtles in Vanuatu**. A first step may be a research needs analysis, collaboratively created by researchers and managers.
- **Strengthen social science research into the cultural values and traditions associated with sea turtles in Vanuatu**. The Vanuatu Cultural Centre has already collected cultural values and traditions over many islands in the last 20 years. This work should be further supported. An analysis of the 2016/2017 turtle related data from the Vanuatu Fishers Survey may be of value, but there were some doubts expressed by the VFD personnel that participated in the survey of its accuracy.
- **Strengthen research permits and permitting processes to ensure compliance with best practice standards** as well as knowledge custodianship and exchange, for any proposed research project with potential interaction with sea turtles or application to sea turtle research and management. Permitting processes may also be used to strengthen local capacity through requirements for engagement and knowledge exchange.
- **Strengthen collaboration among partners**, such as local government, non-governmental organisations, regional agencies, communities, and other interest groups, for the assessment and information flow of turtle-related information.
- **Acknowledge and strengthen Traditional Resource Management (TRM) systems,** as well as traditional governance, tenure, and knowledge systems that underpin TRM in Vanuatu at the policy level as well as at the community level.
- **Ensure that all conditions of formally registered community conservation areas (CCA) under the Environmental Protection and Conservation Act [CAP 283] are clearly explained to communities** including the requirements for written permission to alter the original management plan and formal land surveys, and that DEPC reserves the right to not deregister formally registered CCA's even if the community requests deregistration as stated in the DEPC CCA Handbook.
- **Acknowledge that turtles have been a traditional food in Vanuatu since the arrival of the Lapita people some 3,000 years ago.** This is acknowledged in the NPOA Turtles by the VFD. The priority criteria in assessing traditional take permits should be whether there are sufficient turtles in the area where the request for traditional harvest is being made for it to be sustainable. Hence, the need for an assessment of the turtle stock in that area.
- The impact of ongoing turtle interactions in Vanuatu, such as by-catch or captive rearing, on wild resident and nesting turtle populations is largely unknown due to data limitations. **In the absence of data, the precautionary principle supports management action to protect wild populations** given that the present interactions and interventions can cause harm.

Potential actions for consideration research and information collection include:

- **Support a national census (population assessment) of sea turtle abundance and status**.
- **Prioritise sites for new or extended monitoring** and research activities on sea turtles (see '5.4.3 Priority locations for turtle research and monitoring').
- **Measure and report sampling effort**. Modify the data forms used for turtle monitoring to report sampling effort.[28]
- **Harvest and traditional take.** Increase monitoring of or research on, traditional take activities and include the collection of data documenting factors such as the location collected, species, size, genetic samples, tag returns, diseases, and general health status. These data should be provided to the VFD in a timely manner as part of the conditions of a take permit.
- **By-catch management.** Introduce regular monitoring and reporting of turtle by-catch in coastal and nearshore fisheries, encompassing all fisheries from traditional, recreational, and artisanal to nearshore commercial.
- **Support genetic sampling,** particularly in green turtle rookeries, to confirm whether the assigned (Regional) Management Units for populations of turtles found in Vanuatu are correct and adequate (see '3.2 Genetic diversity of Vanuatu turtles').

[28] Effort encompasses the number of people working, the space covered (such as the length of a nesting beach surveyed), the frequency of monitoring (such as the number of times the same beach was surveyed in a month or year), and the time spent monitoring relative to the space. For example, how many times a given nesting beach was surveyed per night, or the time it took to observe a specific number of foraging turtles in the ocean. There has not been any record of sampling effort recorded in past nesting or foraging surveys. This data gap prohibits comparison between years to interpret a trend.

Recommendation 7:

Strengthen knowledge custodianship and sharing of turtle-related data, information, and practices in Vanuatu.

Potential actions for consideration to strengthen knowledge custodianship include:

- **Transition to centralised data records, preferably digital records**. This transition may require training, mandates and protocols for consistent and timely use. There may also be equipment requirements: resource monitors with smartphones can enter field data and send these data via the Internet for backing up and entering data into TREDS.
- **Data sharing.** Where possible, share turtle-related data and information among relevant national authorities, such as VFD and DEPC.
- **Open access**. Where possible, make data publicly available in line with national and regional guidelines for data sharing, in recognition of data protection requirements where (1) data and knowledge may place species and/or habitats at risk and (2) knowledge holders, including traditional and Indigenous leaders, mandate protection of their sacred and secret data and knowledge.
    - Vanuatu endorsed the UNESCO Recommendation on Open Science in 2021, a legal instrument providing an international framework for open science policy and practice.
- **Open access to TREDS Annual Reports.** Mandate access for Vanua-tai members to Vanuatu's TREDS Annual Reports, so that the data provided by network members are returned and explained to them clearly. This practice will help to clarify the use and value of the data collected by Vanua-tai members in managing sea turtle populations and their importance and relevance to management.
- **Increase capacity for data management** to consolidate tagging and nesting data and enter it into the TREDs database for analysis on a timely basis.
    - *Project actions underway:* SPREP has conducted two initial training sessions for WSB members on the use of the new TREDS system. SPREP staff are available for additional (virtual) training sessions upon request.
- **Incorporate data from all valid sources, including permitted activities and known violations**. These may include captivity programmes and permit requests as well as illegal take and fined actions. Data to collect includes species and sources of hatchlings and adults purchased (in violation of legislation) as well as mortalities, diseases, and other issues.

Green Sea Turtle Hatchling making its way down the beach to the ocean. Bamboo Bay, Malekula © SPREP/Bartlett

7. Species summaries

Loggerhead sea turtle

(*Caretta caretta*)

Regional Management Unit[29] for Vanuatu population: South Pacific

Red List status: Vulnerable

Primary food sources:

Carnivores, loggerheads often dig in benthic habitats for prey such as bivalves. Loggerheads will scavenge fisheries discards and bait from fishing gear (Wyneken et al. 2013).

Nesting sites in Vanuatu:

As of 2009, there was only one record in TREDS of a nesting loggerhead turtle: in 2006/2007 at Linua on the island of Loh in the Torres Group of northern Vanuatu (Trevor 2009). However, at that time many of the Vanua-tai monitors from the more remote islands were not proficient at identifying loggerhead turtles. For this reason, there is some doubt about this identification.

With the data provided from the Vanuatu Environment Unit's (now DEPC) first turtle nesting survey conducted with SPREP from 1992 to 1994 (see Table 3), at least two islands now have records of loggerhead nesting: Wiawi, Malekula and Votlo, Epi. Given that these were early surveys, these loggerhead nesting sites still need to be confirmed through follow-up surveys.

A number of islands have vernacular terms for four to five different kinds of sea turtles, and some of these likely include loggerheads.

Marine areas for loggerhead turtles in Vanuatu:

Unknown. Loggerhead turtles are known to transit throughout the southern Pacific Ocean (Boyle et al. 2009).

Several islands have vernacular terms for four to five different kinds of sea turtles, and some of these likely include loggerheads. Recent data from a WWF-France satellite tagging study confirms this observation, as per the tracking map below that shows a loggerhead originating in New Caledonia spending time around Aneityum on its way to Fiji (Figure 17).

Threats to loggerhead turtles in Vanuatu:

Fishery interactions with longline and purse seine vessels appear to be the greatest threat to loggerhead turtles in Vanuatu. Threats to nesting sites, nesting turtles and nests, eggs, and hatchlings are relevant for all species.

[29] See Pilcher (2021) for a description of turtle Regional Management Units.

Drivers of loggerhead take in Vanuatu:

Unknown; take is unlikely due to low abundance of loggerheads in Vanuatu.

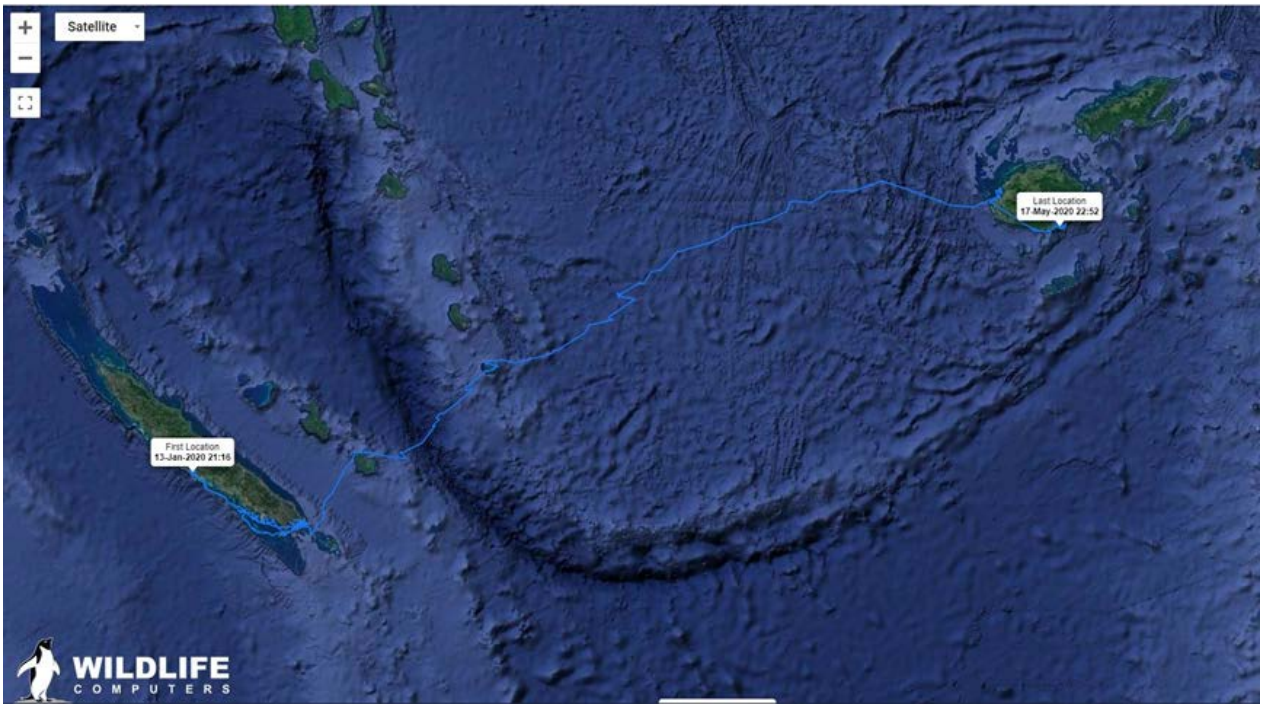


Figure 17: Tracking map of a satellite tagged loggerhead originating in New Caledonia transiting Aneityum in southern Vanuatu on its way to Fiji. (Tracking Map courtesy of Marc Oremus, WWF France; unpublished)

Research and tagging in Vanuatu:

Of the 3,004 turtle encounters in Vanuatu reported into TREDS since 1991, seven represent loggerhead turtles (TREDS, accessed January 2022).

Size frequency of loggerhead turtles in Vanuatu:

CCL range: 40.0–59.9 centimetres for juveniles (n = 4) and 100.0–104.9 centimetres for adult (n = 1), based on TREDS records of five loggerhead turtles.

Olive ridley sea turtle

(*Lepidochelys olivacea*)

Regional Management Unit for Vanuatu population: West Pacific

Red List Status: Vulnerable

Primary food sources:

Near omnivores, olive ridleys have a varied diet such as algae, tunicates and jellyfish, crustaceans, fish and fish eggs, and other prey.

Nesting sites in Vanuatu:

None reported. Information on olive ridley (and loggerhead) nesting sites are the most data deficient nationally.

Marine areas for olive ridley turtles in Vanuatu:

The olive ridley is considered an intermittent visitor within Vanuatu's waters and is known to interact with the international fishing fleets registered with Vanuatu (see '4.6 Turtle by-catch: offshore commercial fisheries').

Threats to olive ridley turtles in Vanuatu:

Fishery interactions with longline and purse seine vessels appear to be the greatest threat to olive ridley turtles in Vanuatu. Threats to nesting sites, nesting turtles, and nests, eggs, and hatchlings are relevant for all species; see nesting threats for green and hawksbill turtles.

Drivers of olive ridley take in Vanuatu:

No documented take, likely due to low abundance of this species in Vanuatu.

Research and tagging in Vanuatu:

Of the 3,004 turtle encounters in Vanuatu reported into TREDS since 1991, five represent olive ridley turtles (TREDS, accessed January 2022). These five turtles were foraging when caught and tagged (Ward 2019).

Size frequency of olive ridley sea turtles in Vanuatu:

CCL range: 45.0–59.9 centimetres, based on TREDS records of three olive ridley turtles.

Little to no data is recorded for this species except from longline by-catch (see '4.6 Turtle by-catch: offshore commercial fisheries').

Leatherback turtle

(*Dermochelys coriacea*)

Regional Management Unit for Vanuatu population: West Pacific

Red List status: Critically Endangered (West Pacific RMU)

Primary food sources:

Jellyfish (Wyneken et al. 2013)

Nesting sites in Vanuatu:

TREDS tagging records show leatherback turtles nesting on the islands of Epi, Efate, Espiritu Santo, and Malekula, with Votlo beach on Epi showing the most numbers (Figure 18; Trevor 2009, Siota 2015).

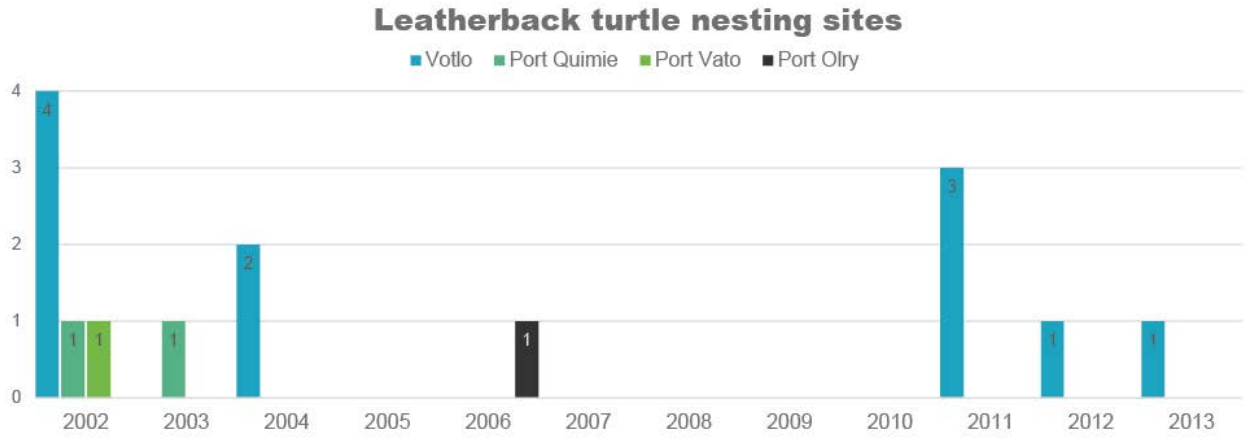


Figure 18: Nesting leatherback turtles recorded in TREDS for Vanuatu, 2002–2013. Port Olry is on Espiritu Santo; the remaining sites are on Epi Island. Source: Siota 2015.

Votlo on Epi is recognised as the main leatherback nesting beach in Vanuatu, accounting for an estimated 70% of the recorded leatherback nesting in Vanuatu (Siota 2015, Petro et al. 2007). In the 2018/2019 nesting season, five leatherbacks were counted nesting at Votlo. However, by February, most of these nests had been washed out by storm waves (D. Aromalo pers. comm.), likely from Tropical Cyclone Oma that passed to the west of Malekula in February 2019. In the 2020/2021 season, three kilometres of the beach at Votlo was surveyed: 16 turtle nests were found, five of which were leatherback nests (Hickey 2020; Figure 1).

The second most important nesting beach in Vanuatu is at Maranata on South Ambrym Island where an estimated 20% of the leatherbacks in Vanuatu nest (Siota 2015). The remaining 10% of leatherback nesting is found on Malekula and, prior to coastal development in the last 20 years, on Efate.

A small amount of nesting may occur at other sites. Petro et al. (2007) reported “Residents of several different islands, from Gaua and Espiritu Santo in the north through Ambae, Efate to Tanna and Aneityum in the south, indicated that there were formerly at least small nesting populations of leatherbacks on the black beaches of these islands. Nesting events on these islands were reported to have significantly declined since the 1980s.” This report also lists leatherbacks formerly found nesting on Efate at Teouma Bay (circa 2005, consumed) and Mele Bay (two in 1997–1998, three in 1999–2000, and one in 2003) south Pentecost Island (Point Cross) in 2000 (consumed), Ambae (Devils Rock and Lolowai), Ranon area of north Ambrym, and at various locations around Malekula Island, including one that was consumed circa 1996 at Sarmette (Hickey 2007b). There was also a leatherback nesting at the black beach of Matantas in Big Bay, Santo

Island (D.J. Aromelo pers. comm.). Malekula residents indicated that a leatherback came ashore to nest on 11 December 2004 at the black beach of Aulua village, 20 kilometres south of Crab Bay. This leatherback was observed by many people, not harmed, and safely returned to sea. It is not clear, however, whether it successfully nested or whether hatchlings emerged (Hickey 2007b).

Early WSB leatherback nesting surveys were performed annually as part of training to new Vanua-tai members (Table 11; see also WSB 2010). These surveys included areas that were known to be key sites for other turtle species, including Moso, Bamboo Bay, and Wiawi, and showed that leatherbacks did not use these three areas for nesting. However, these early surveys confirmed Votlo and Maranata as the two main known sites used for leatherback nesting in Vanuatu.

The beach at Maranata is over 12 kilometres long. In the 2007 surveys, community members at Maranata reported that they had observed numerous leatherback nesting there in the 1980s, but the leatherbacks were routinely targeted for consumption. By the 1990s, the numbers of leatherbacks fluctuated year to year in gradual decline. Severn leatherbacks were recorded during the 2005/2006 survey and only one in the 2006/2007 survey. In 2007/2008, no leatherbacks nested at Maranata; that was the first year in living memory without leatherbacks nesting there.

Numerous leatherback nests were washed out (Table 11), likely because the leatherback nests were found lower on the beach and closer to rivers than the nests of green and hawksbill turtles. These two beaches are on exposed, high-energy coasts that are vulnerable to not only storms and cyclones but also flooding of the rivers entering the bay.

The nesting of a leatherback turtle at Port Narvin on Erromango Island in southern Vanuatu on 15 February 2019 was the first incidence of leatherback nesting known for this area. The nest was cordoned off by the Vanua-tai member so it would not be disturbed. The nest was made very low on the beach (see Figure 19). This nest was washed out (D.J. Aromalo pers. comm.).

Table 11: Leatherback nesting survey summary, 2008–2011. Source: Compiled from Fletcher and Petro 2009 unpublished, Wan Smolbag 2007–2008, WSB 2008–2009, WSB-NOAA Vanuatu Leatherback Monitoring and Outreach Activities 2009–2010 Annual Report and 2010–2011 Annual Report

Nesting Site	Maranata	Votlo
Survey start–end date	Nov 2008 – Mar 2009	Oct 2008 – Apr 2009
Number tagged	0	0
Number nests laid	12	11
Number nests hatched	0	6
Survey start–end date	Nov 2009 – Feb 2010	Oct 2009 – Mar 2010
Number tagged	0	0
Number nests laid	1	2
Number nests hatched	1	0
Survey start–end date	Nov 2010 – Feb 2011	Sep 2010 – Feb 2011
Number tagged	0	2
Number nests laid	4	41
Number nests hatched	1	8

Figure 19: (left) Leatherback turtle at Port Narvin returning to sea after nesting; (right) the nesting site. It can be seen how low on the beach the leatherback laid its eggs. Credit: Charlie Novlu (Vanua-tai member at Port Narvin).

Marine areas for leatherback turtles in Vanuatu

Leatherbacks migrate through the waters of Vanuatu to nest, so the leatherback is considered a vagrant (incidental traveller) in the marine waters around Vanuatu. This is reflected in the Bislama name (translated into English) often given to the leatherback of 'Turtle from Overseas'. There are no foraging sites known for leatherback around Vanuatu (Petro et al. 2007); however, leatherbacks are occasionally captured in the longline fishery (see '4.6 Turtle by-catch: offshore commercial fisheries').

Leatherbacks nesting in Vanuatu (and other areas of Melanesia) are believed to migrate to foraging grounds north of New Zealand and southeast of Australia, primarily feeding on jellyfish and pyrosomes (Figure 20).

Threats to leatherback turtles in Vanuatu:

There is a record of avoidance of leatherbacks on south Malekula but no other islands to date; therefore, it is reasonable to assume that leatherbacks may be taken during a hunt if encountered. Based on present abundance and trends described above, the vulnerability of nests and nesting sites is a greater threat. Like the other species, leatherbacks are subject to by-catch.

Drivers of leatherback take in Vanuatu:

Unknown; likely opportunistic following the same drivers as the take of other turtle species.

Research and tagging of leatherbacks in Vanuatu:

Of the 3,004 turtle encounters in Vanuatu reported into TREDS since 1991, 19 represent leatherback turtles (TREDS, accessed January 2022). Only 17 leatherbacks have been tagged in Vanuatu (Ward 2019).

Size frequency of leatherback turtles in Vanuatu:

CCL range: 74.0–198 centimetres, based on TREDS records for 15 adult leatherback turtles (12 of which had CCL measures).

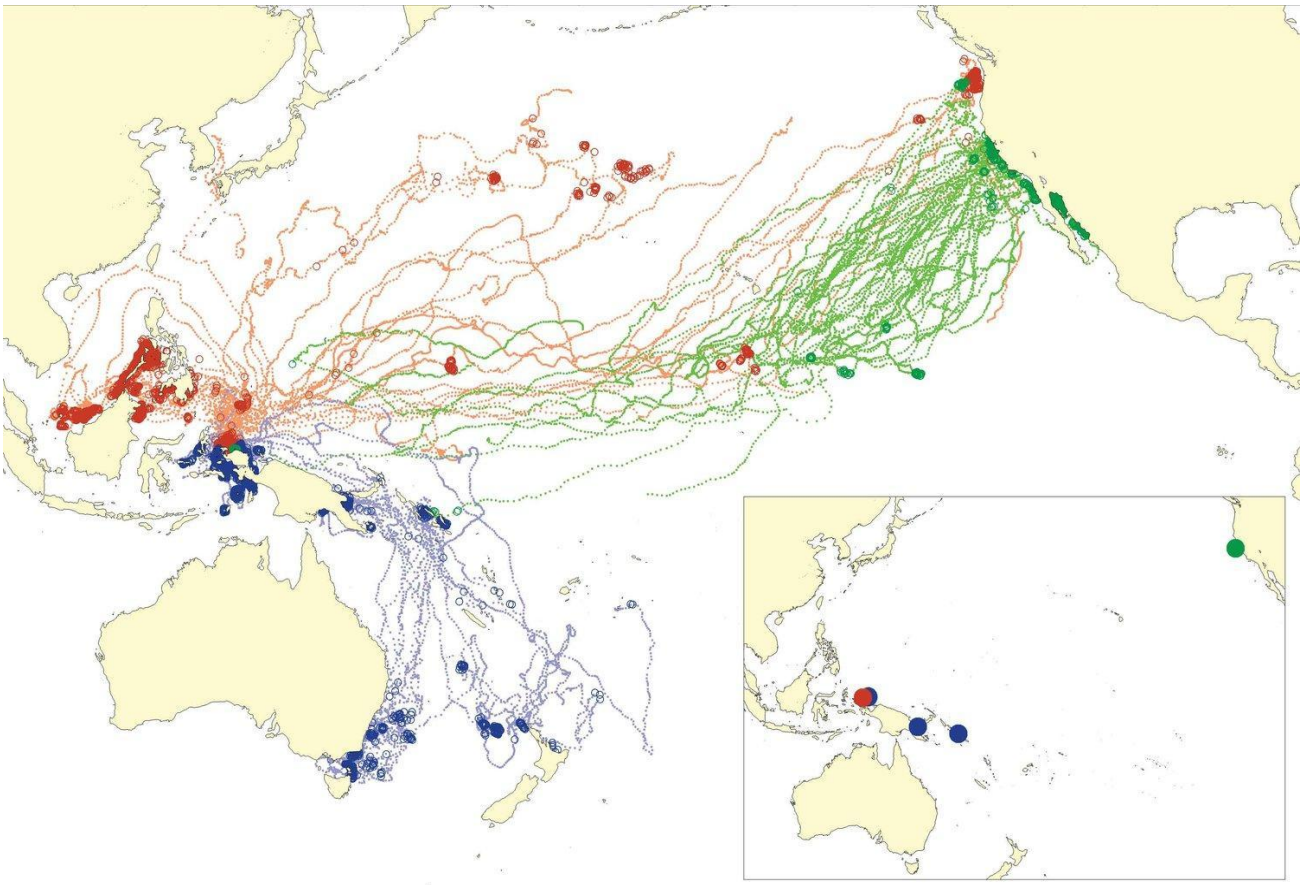
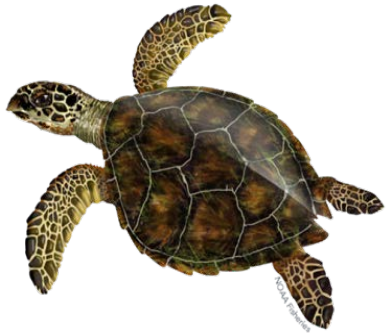


Figure 20: Migratory corridor of western Pacific leatherback turtles from nesting rookeries in southern Melanesia, including Vanuatu, to east Australia and north New Zealand. Map credit: Benson 2012.

Hawksbill turtle

(Eretmochelys imbricata)



Regional Management Unit for Vanuatu population: Southwest Pacific

Red List Status: Critically Endangered

Primary food sources:

Sponges and other invertebrates, as well as algae, often associated with coral reefs.

Hawksbills are the most reef-associated of the sea turtle species but still spend a significant portion of their lives in the open ocean (Wyneken et a. 2013).

Nesting sites in Vanuatu:

Vanuatu is estimated to have approximately 300 female hawksbills nesting annually (Mortimer and Donnelly 2008). The hawksbill turtle nesting sites recorded in TREDS are on the islands of Ambrym, Efate, Epi, Espiritu Santo, Malekula, Moso (off north Efate), and Tegua, Torres Island. The largest numbers of nest sites, likely due to more intensive surveying, were recorded on north Moso, and Bamboo Bay (Malekula) during the 2006–2007, 2007–2008, 2009–2010, and 2011–2012 nesting seasons (Siota 2015, Figure 21). See also Supplement 1 Tables S.B.1–S.B.3 for additional data.

By 2009, it became apparent that Wiawi and Bamboo Bay, on the west coast of Malekula, were key nesting areas for hawksbill turtles. Surveys began to be carried out more regularly there, usually with assistance from personnel from WSB, Port Vila, to train community members in survey techniques. Votlo may also be an important nest site. A growing number of hawksbill nests have been observed at Wiawi between 2008 (seven nests) and 2019 (244 nests) (Supplement Table S.B.1). The Vanua-tai member at Wiawi reported a total of 70 hawksbill nests for Wiawi for the 2020/2021 season (D.J. Aromalo pers. comm.). However, this survey did not cover all the beach sectors.

Moso Island has numerous uninhabited white beaches along its north shore, which are key hawksbill nesting areas. However, nesting surveys are no longer conducted there, resulting in a significant knowledge gap. Much smaller rookeries are found along the beaches of north Efate, including at Tuktuk Point, Kakula and Pele islands, with very limited nesting on Nguna Island. However, in 2019, three hawksbills came ashore to nest at Unakap village on Nguna island (pers comm, John Ronneth, Vanua-tai member), and this was seen as the beginning of hawksbills returning to nest on this island after the commencement of community-based conservation of turtles on north Efate in 1995.

The beaches of Crab Bay on east Malekula are known to have hawksbill nesting, along with the areas just north of there around Uripiv Island and Port Stanley (Hickey 2007b).

The Maskelynes on south Malekula have mangroves along much of their coast, which limits turtle access to upslope beaches. However, there are hawksbill nesting beaches on various islets, many of which are uninhabited, such as Vulai Island, as well as on the main islands of Uliveo and Sakao and on the mainland west of Hokai village and nearby Lemenmang Islet (Hickey and Petro 2005). Local residents report that hawksbill turtles are the main turtles found to nest in the Maskelynes.

Aneityum Island has hawksbill nesting areas at various locations around the island (D.J. Aromalo pers. comm).

Reef Islands in the Banks Islands have hawksbill nesting beaches. Extensive white sand beaches are found within the atoll but are regularly visited by fishers from surrounding islands, and eggs and turtles are often

targeted for consumption (Hickey Field Trip Report 2012). In early 2022, these islands were declared a conservation zone by the Torba Provincial Government Council with the intent of restricting or prohibiting fishing activities (Bule 2022).

Uraparapara Island in northern Vanuatu has four different main nesting sites located around the island and hawksbill turtles are reported to nest at these sites (Chief David Rueben pers. comm.).

More recently, it has been confirmed that the white beaches along south Efate ranging from Tamanu/Whitesands to Rentapau have hawksbill nesting activities. During the 2020–2021 nesting season, seven nests were found and protected with netting from predators within the Jacobe plantation beach known as Bucephale. The nets also collected the hatchlings upon emergence so they could be counted and released under controlled conditions, including high tides and protection from predators such as dogs, birds and crabs. Mr. Christiane Jacobe, who resides nearby and is the leaseholder of Bucephale Beach where the nests were found, reported 414 hatchlings were released between February and April 2021. Mr. Jacobe is working with the local chief of the area to protect the turtles of the area as part of a tourist attraction for residents to come and picnic and snorkel. This is a welcome initiative because formerly the hatchlings from this area were collected by local residents and sold to one of the three turtle-raising facilities in the area, despite Fisheries legislation prohibiting this practice.

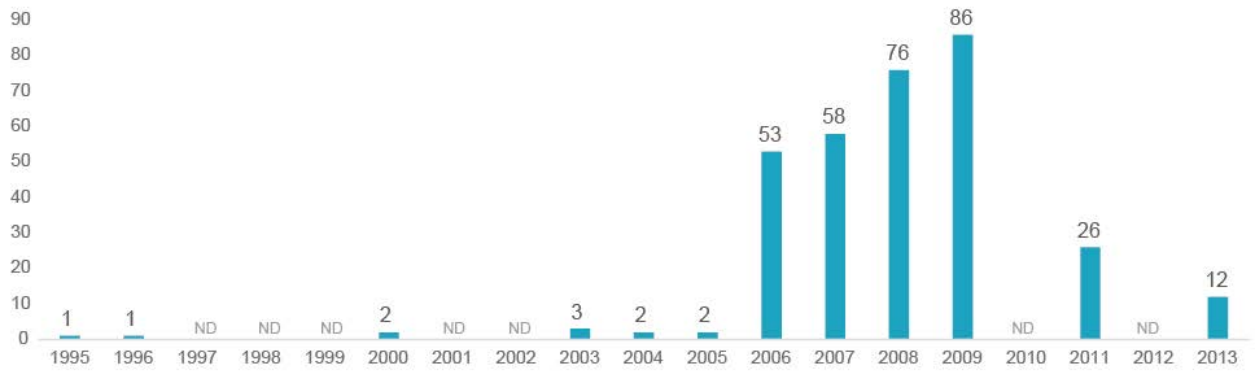


Figure 21: Hawksbill turtle nesting sites recorded in TREDS for Vanuatu, 1995–2015. The variability in nest site numbers will reflect both intensity of survey efforts (unquantified) as well as a change in nest site abundance; the relative weight of these factors is unquantified as survey effort was not monitored. For a breakdown of the total by location and island, see Supplement Table S.B.1. ND: no data available. Years refer to the starting year of the nesting season, that is, 1995 refers to the 1995–1996 nesting season. Source: Siota 2015

Marine areas for hawksbill in Vanuatu

General westward movement of the hawksbill turtle is observed in turtles tagged in Pacific island countries and territories (Siota 2015). Two turtles tagged in American Samoa were reported in neighbouring Samoa. Turtles tagged in Palau (n = 5) were shown to migrate westward to the Philippines (n = 2) with one migrating eastward to the Federated States of Micronesia. Turtles tagged in Samoa (n = 2) were reported as tag recoveries from Papua New Guinea (n = 1) and Vanuatu (n = 1), respectively. The eastward movement of turtles was shown by turtles tagged in Australia (n = 7) and reported as tag recoveries from Papua New Guinea (n = 3), Solomon Islands (n = 3) and Vanuatu (n = 1).

Hawksbills are found throughout all the islands of Vanuatu, particularly wherever coral reefs are healthy. These include all the main islands. Other sites known to host hawksbills or suitable hawksbill habitat include:

- Southeast Vanua-Lava in the Banks Group north from Port Patterson and Alget River north to Quanlap/Ravenga Island and seaward to the seagrass meadows and coral reefs are drop-offs inhabited by hawksbill turtles.

- Pakea Island reefs off southeast Vanua Lava support hawksbills.
- Reef Island (also known as Rowa), an uninhabited atoll in northern Vanuatu, has extensive reefs important for foraging by hawksbills. There is very little recent turtle data for Reef Islands, but it is likely fishers still occasionally harvest turtles and eggs from this area due to their remoteness.
- Malekula has numerous good coral reefs for foraging, including the Uripiv and Uri Island areas such as Port Stanley and south to Crab Bay (Hickey 2007b). Also, the Maskelyne Islands of southeast Malekula have extensive coral reefs for foraging, as well as the south coast of Malekula.
- North Efate has good turtle habitat in the form of coral reefs for hawksbill, including reefs at Lelepa, Kagula, Nguna, Pele, Emau, and Moso Islands.
- South Efate has good reefs for foraging hawksbills, including in Teouma Bay. However, since the establishment of a zoo in the bay in 2016 that captive rears turtles, they are no longer commonly observed in the wild (F. Hickey, pers obs.).
- Aneityum Island in southern Vanuatu around the offshore Mystery (Inyueg) Island has extensive coral cover for foraging. Port Patrick in the north also has extensive reefs for hawksbill foraging.
- Futuna Island also has hawksbill turtles present on its reefs, and with a recently placed Vanua-tai monitor, two turtles have been tagged.

Seven nesting hawksbills were satellite tagged on Moso between 2018 and 2020. Their migrations to their foraging grounds are summarised in Figure 22.

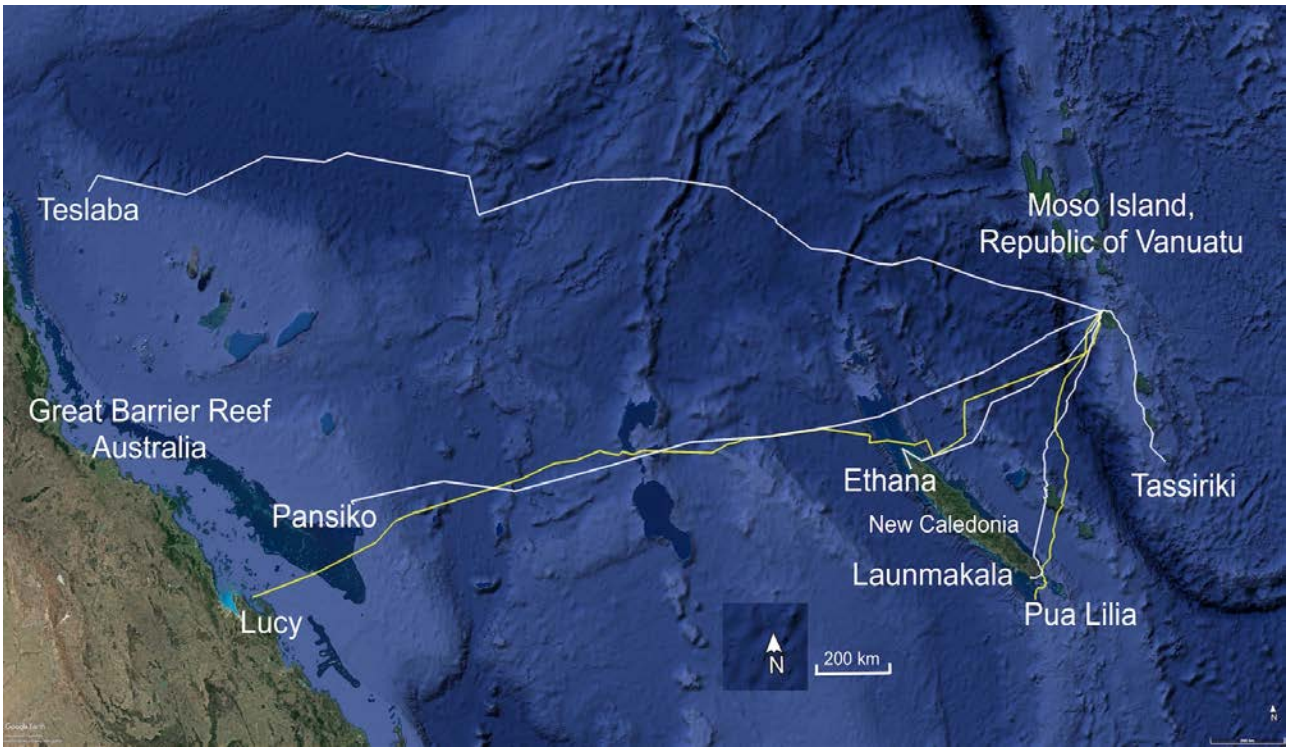


Figure 22: Migration patterns of 7 nesting hawksbill turtles with satellite tags on Moso between 2018 and 2020. Source: Tracking Map from Hickey 2020.

The nesting hawksbills from Moso migrated westward to New Caledonia, and to the Great Barrier Reef of Australia. It was interesting that one nester migrated to Aneityum in the south of Vanuatu. Details of this research are currently in press by Jim et al. Destination Revealed: Post Nesting Migrations of Hawksbill Turtles (*Eretmochelys imbricata*) from Moso Island, Republic of Vanuatu. (Tracking Map from Hickey 2020).

Threats to hawksbill turtles in Vanuatu:

The full range of threats to sea turtles apply to hawksbill in Vanuatu.

Drivers of hawksbill take in Vanuatu:

There may be lower preference for hawksbill turtles due to a disagreeable odour and their hard bite (see main text). However, hawksbills are opportunistically harvested during traditional hunts. Hawksbill shells are prized over other turtle shells for decorative purposes. Prior to the legislation prohibiting turtle hunting, hawksbill jewellery was made in the islands and sold in Port Vila. Hawksbills were also used historically to make traditional carved ornaments such as earrings and bracelets (F. Hickey, unpublished data).

Research and tagging of hawksbill in Vanuatu:

Of the 3,004 turtle encounters in Vanuatu reported into TREDS since 1991, 1,861 represent hawksbill turtles (TREDS, accessed January 2022). Hawksbill and green turtles are the most represented species in extant research in Vanuatu.

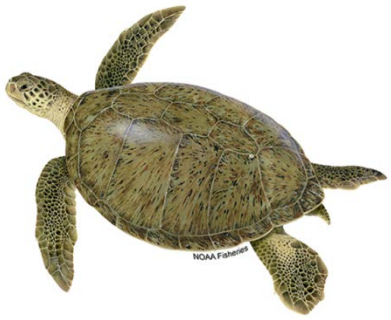
Size frequency of hawksbill turtles in Vanuatu

CCL range: 0.0–64.9 centimetres for juveniles (n = 1,086), 65.0–79.9 centimetres for sub-adults (n = 23) and 80.0–109.9.9 centimetres for adults (n = 345), based on TREDS records of 1,454 hawksbill turtles (Siota 2015).

These numbers reflect the prevalence of juveniles (especially those 25.0–29.9 centimetres), likely the tagged juveniles raised and released from the Tranquillity Resort head-start programme on Moso (Siota 2015).

Green turtle

(*Chelonia mydas*)



Regional Management Unit for Vanuatu population: Southwest Pacific

Red List Status: Endangered

Primary food sources:

At sea: predominantly carnivorous on zooplankton, pelagic crustaceans, and mollusks, with signs of omnivory; In coastal habitats: seagrasses and macroalgae (Wyneken et al. 2013).

Nesting sites in Vanuatu:

Over 80 green turtle nesting beaches have been reported for Vanuatu (Read et al. 2015, see also Maison et al. 2010). Nesting green turtles have been recorded in TREDS on the islands of Epi, Espiritu Santo, Malekula, and Moso, Pele and Nguna (all islands off north Efate), Motalava, Pentecost, Aniwa and Tegua, Torres. The highest numbers were recorded on Malekula Island due to surveys carried out at the key nesting site of Bamboo Bay in the Southwest Bay area, Malekula. See Supplement 1 Tables S.B.2–S.B.6.

Nesting activity at Bamboo Bay has increased over the years with a record high of 789 nests in 2019 (Supplement 1 Table S.B.6). The variability of green turtle nests recorded in Bamboo Bay and Wiawi is likely partially due to variable sampling effort. Unfortunately, there is no record of sampling effort. During nesting season, Bamboo Bay is still surveyed annually by Vanua-tai community members but not always with consistent effort due to the length of these turtle nesting beaches (approximately 11 kilometres). The Bamboo Bay village site is now accessible by road from Southwest Bay.

Moso Island (north Efate) is a green turtle nesting site. Most of the nesting occurs on the north side of the island which remains uninhabited. Green turtles are also known to nest nearby at Takara on north Efate, along with small numbers of nesters at most other villages along north Efate.

There is some green turtle nesting around the Maskelyne Islands, with one confirmed on Vulai Island (SPREP 1992) during one of the early SPREP/Vanuatu Environment Unit surveys of Maskelynes and supported by current observations of the Vanua-tai Monitors there (J. Laggat pers. comm.). Turtle nesting was estimated on Vulai by SPREP at 10 to 20 nests (of all species) in 1992 and less than five nests on Sakao Island. That survey indicated Maskelynes was not a key turtle nesting site for Vanuatu, in part because much of the coast is covered in dense mangroves, which make it difficult for turtles to access upslope beaches. Turtles are also known to nest on the beaches west of Hokai, on mainland Malekula, and in the Lutes village area (including Malaplap) on Uliveo, and at least formerly there was nesting on some of the uninhabited islands including Pakatel, Awei and Lamenmang (Hickey and Petro 2005). Uninhabited Vulai Island is currently the main nesting site for the Maskelynes, along with west of Hokai village.

Reef Island (also known as Rowa), an uninhabited atoll in northern Vanuatu is also used for nesting by green turtles. Extensive white sand beaches are found within the atoll but are regularly visited by fishers from surrounding islands and eggs and turtles often targeted for consumption (Hickey Field Trip Report 2012).

Tanna Island near Port Resolution has some nesting beaches and out of four nests: one green nester was observed by community members in October 2018; for the other three nests, the species was undetermined (F. Hickey Field Trip Report 2018). The year 2018 was the first time in many years nesting had occurred there.

Aneityum Island has green turtles nesting located at various sites around the island (D.J. Aromalo pers. comm).

Uraparapara Island in the Banks Islands of northern Vanuatu has had green turtle nests at four main nesting sites located around the island (Chief David Rueben pers. comm.).

Given the limitations of the data currently available and other factors discussed in the main text, it is difficult to indicate any clear trends on increases in nesting sites other than for Bamboo Bay, which is regularly monitored. Compounding this is that sampling effort of sites has not been very uniform for many nesting sites. With these caveats, the data for green turtle nesting at Bamboo Bay indicate an increase in nesting (see Supplement Table S.B.5); this increase is not reflected in the data for all tagged nesting green turtles reported in TREDS (Figure 23).

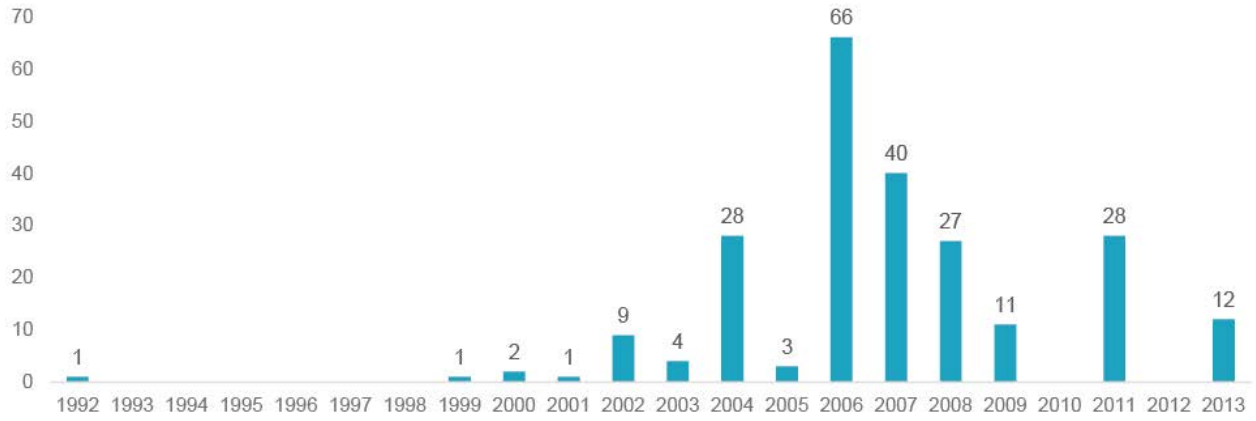


Figure 23: Nesting green turtles recorded in TREDS for Vanuatu, 1992–2014. Source: Siota 2015

Marine areas for green turtles in Vanuatu:

Australia, New Caledonia, and Fiji are the regional hotspots for foraging and nesting green turtles, based on migration data (Figure 24). There is a clear westward migration from Polynesian nesting sites to foraging grounds in Fiji, Vanuatu, and New Caledonia (Read et al. 2015). A westward migration from Melanesian rookeries to foraging grounds in the Great Barrier Reef and northern Australia is also apparent.

Southeast Vanua Lava in the Banks Group north from Port Patterson and Alget River north to Ravenga Island is an important green turtle foraging area over significant seagrass meadows bordered by mangals. Seaward to the meadows are coral reefs and drop offs inhabited by hawksbill turtles. This is the main area where saltwater crocodiles (*Crocodylus porosus*) are found in Vanuatu, and predation on turtles by this small population of resident crocodiles is unique to this area.

Mesina Bay on south Vanua Lava has seagrass meadows foraged by green turtles, as well as nesting beaches.

Reef Island (also known as Rowa) an uninhabited atoll in northern Vanuatu and the extensive reefs are important for foraging green turtles, although there is very limited seagrass in the lagoon (Chambers et al. 1990). There is limited recent turtle data for Reef Islands available, but it is likely fishers still occasionally harvest turtles and eggs from these islands due to their remoteness.

On Santo Island, the area between Palekula Bay north to Turtle Bay is a good turtle foraging area with seagrass meadows and coral reefs protected from ocean swells by offshore islands.

Malekula has numerous good coral reef and seagrass meadows for foraging including the Uripiv and Uri Island areas including Port Stanley and South to Crab Bay (Hickey 2007b).

The Maskelyne Islands of south Malekula have extensive seagrass meadows, mangroves, and coral reefs for foraging (Hickey and Petro 2005). Green turtles are common around the Maskelyne Islands, as evidenced by the number collected during the New Yam Festival of 2020. During the New Yam festival held in February 2020, a total of 34 turtles were caught and consumed by the three villages on Uliveo Island, Maskelynes. The majority were green turtles (31 consumed), with only 3 hawksbills consumed.

Epi Island on the west coast at Lamen Bay has extensive seagrass meadows (including extensive *Halophila ovalis* complex meadows), including around Lamen Island that support green turtles as well as dugongs. (Hickey Field Report 2015).

North Efate has good turtle habitat in the form of seagrass meadows and coral reefs for green turtles. Seagrasses are especially abundant in the Siviri area, Undine Bay, and the Paunganisu area. Seagrasses and reefs are found at Lelepa, Kagula, Emao, Nguna, Pele, and Moso Islands along with Takara on the mainland (Hickey and Petro 2005). At NW Efate, Tuktuk Bay is reported to have seagrass meadows and green turtle foraging there. On south Efate, Eratap Bay and Erueti Bay has mangals, seagrass meadows and supports green turtles. These areas are often targeted to supply adult green turtles to captive reared facilities on south Efate.

On Tanna Island in south Vanuatu, the main area with seagrass meadows is in Port Resolution and eastward around to Turtle Bay close to Captain Cook Rock. Both these areas are important green turtle foraging areas (Hickey Field Report 2011).

Aneityum Island in southern Vanuatu around the offshore Mystery (Inyueg) Island has both seagrass and coral cover for foraging; seagrasses extend into adjacent Anelguahat Bay. Port Patrick in the north of Aneityum also has extensive coral reef, seagrass, and mangrove habitat for foraging (Hickey Field Trip Report 2011).

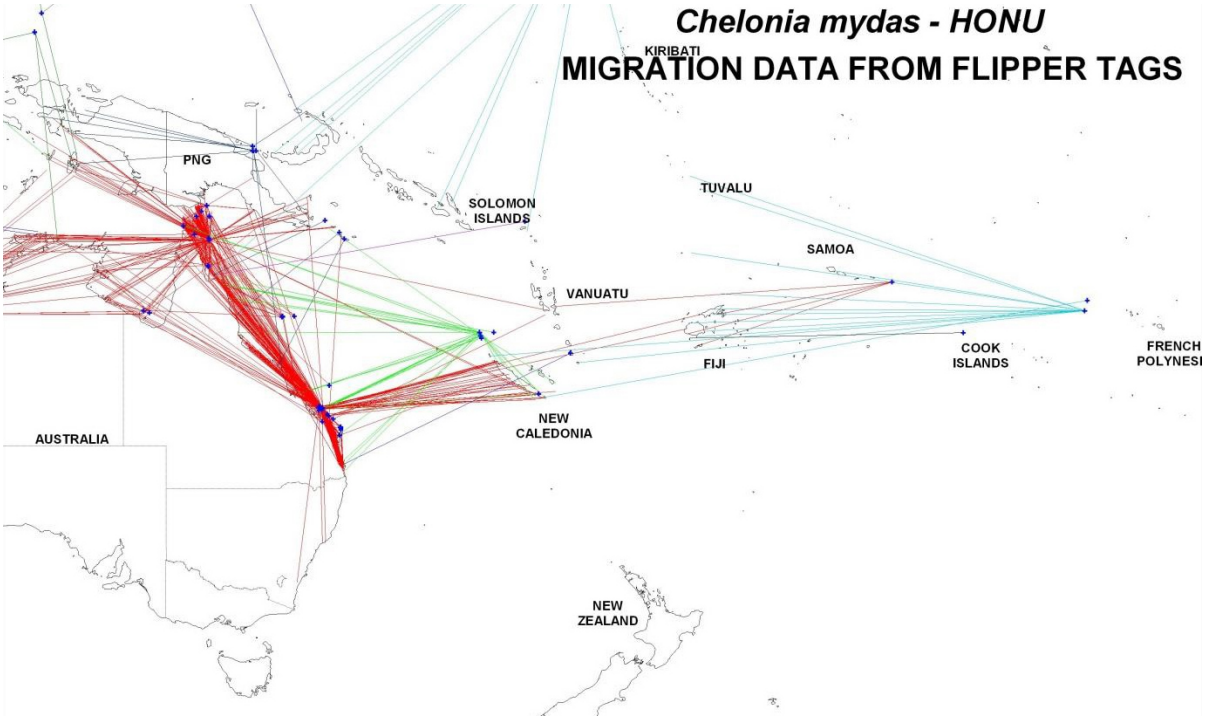


Figure 24: Breeding migrations of green turtle (*Chelonia mydas*) in the southwest Pacific based on flipper tag recoveries. Lines join non-nesting tag-recovery sites with the respective nesting sites. Line colours allow identification of tag recoveries from the respective nesting areas. Map credit: Read et al. 2015.

Threats to green turtles in Vanuatu:

The full range of threats to sea turtles apply to green turtles in Vanuatu.

Drivers of green turtle take in Vanuatu:

Green turtles are the most harvested sea turtles in Vanuatu. Although there are no recorded disincentives for green turtle take based on taste or bite strength (see main text), the high proportion of green turtle take is likely a result of the higher green turtle abundance in Vanuatu relative to other sea turtle species.

Research and tagging of green turtles in Vanuatu:

Of the 3,004 turtle encounters in Vanuatu reported into TREDS since 1991, 786 represent green turtles (TREDS, accessed January 2022). Hawksbill and green turtles are the most represented species in extant research in Vanuatu.

In 2021–2022, financial assistance has been provided to WSB to place temperature recorders within the nesting grounds to monitor nest temperatures at Bamboo Bay and Wiawi by the SPREP By-catch and Integrated Ecosystem Management (BIEM) Initiative, active in Vanuatu from 2019 to 2022. The BIEM Initiative is also funding Dr Christopher Bartlett to work with these communities to develop community-based turtle management plans to help strengthen the monitoring and conservation of turtles nesting at these sites. These measures apply not only to green turtles but to all turtle species nesting at these sites.

Size frequency of green turtles in Vanuatu

CCL range: 25.0–64.9 centimetres for juveniles (n = 398), 65.0–84.9 centimetres for sub-adults (n = 63), and 85.0–154.9 centimetres for adults (n = 181), based on measurements of 642 green turtles recorded in TREDS (Siota 2015).

Green Sea Turtle Hatchlings making their way down the beach to the ocean. Bamboo Bay, Malekula © SPREP/Bartlett

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Annexes and Supplements

Annex A: Map of Vanuatu

Map A.1: Islands, provinces, and major living centres of Vanuatu. Note that English transliterations of place names can vary. Credit: OnTheWorldMap 2022, see https://ontheworldmap.com/vanuatu

Annex B: International conventions and agreements of relevance for sea turtles

Table B.1: International agreements of relevance for sea turtle conservation to which the Republic of Vanuatu is a party.

International Convention	Binding	Compliance measured and reported via:	Conservation actions	Relevance to sea turtles
Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPF Convention)	yes	Annual reports, legislation updates	A binding measure prescribes measures to reduce sea turtle by-catch in purse seine and shallow-set pelagic longline fisheries. The measure also prescribes the use of handling and release methods to maximise the probability of post-release survival in purse seine and shallow-set pelagic longline fisheries (WCPFC, 2008)	This regional fisheries management organisation has the authority to adopt binding measures for offshore commercial fisheries (primarily tuna fisheries), including to manage by-catch of sea turtles. The Commission has adopted a binding measure applicable to sea turtle conservation resulting from fisheries by-catch (WCPFC, 2008).
Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean	yes	Regular reporting to the Commission; violation reporting	General principle: "fishing shall be commensurate with the sustainable use of fishery resources taking into account the impacts on non-target and associated or dependent species and the general obligation to protect and preserve the marine environment" (Article 3.1.a.ii)	Impacts on non-target species, such as turtles, are to be 'taken into account' by all parties, reporting to the South Pacific Regional Fisheries Management Organisation.
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	yes	Annual reports	Prohibits or issues permits for international trade of Appendix II and III species.	Trade or export of any turtle products prohibited; especially relevant for hawksbills, the main species used for turtle shell ornaments.
Convention on Biological Diversity (CBD)		National Biodiversity Strategy Action Plan (NBSAP)	General: conserve biological diversity including sustainable use of resources.	Overall conservation of biological diversity, with national prioritisation. Vanuatu is currently updating its NBSAP.
International Convention f or the Prevention of Pollution from Ships (MARPOL)	yes	Incident reporting; reporting on stocks and consumption of certain materials (such as oil or fuel); management plan reporting and approval for certain materials or systems (such as oil or rubbish)	Minimise pollution of the oceans and seas, including dumping, oil, and air pollution. The objective is to preserve the marine environment in an attempt to completely eliminate pollution by oil and other harmful substances and to minimise accidental spillage of such substances.	Reduces pollution impacts on turtles, their prey, and their habitat. For example, MARPOL prohibits the pumping of bilge water in coastal waters.
United Nations Convention on the Law of the Sea (UNCLOS)	yes		General 'protect and preserve the marine environment'; minimise by-catch and fisheries impacts on non-target species	States are obligated to protect and preserve the marine environment (Article 192) and consider the effects of fishing on species associated with or dependent upon commercially exploited species (Article 119). The 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, requires States to minimise by-catch and impacts on associated and dependent species (Article 5f).
United Nations Framework Convention on Climate Change (UNFCCC)		Annual reports, National legislation and policy updates	General: Mitigate greenhouse gas emissions; support climate resilience	Relative sea level rise and changes in air and sea temperatures pose a threat to sea turtles.

Annex C: Existing spatial marine protection of turtle-relevant sites in Vanuatu

Vanuatu's national, provincial, and traditional leadership has established spatial management, including types of spatial protection (Table C.1). Vanuatu's government participated to identify special and unique marine areas as part of the Marine and Coastal Biodiversity Management in Pacific Island Countries (MACBIO) project, with known presence of sea turtles or important turtle habitat resources indicated for given areas when possible (Ceccarelli et al. 2018).[30] The identified special and unique marine areas may overlap with some of the areas in Table C.1.

Table C.1: Main marine protected area initiatives in Vanuatu that overlap with known presence of seagrasses and turtles. CCA: Community conservation area; JICA: Japan International Cooperation Agency; LLV: Live and Learn Vanuatu, a non-governmental organisation. Source: Department of Environmental Conservation and Protection 2022

Conservation / Tabu area	Location	Type of area conserved / under Tabu	Status and presence of management plan (MP)	Turtles or turtle habitat
Vatthe Conservation Area	Matantas, Santo	Terrestrial and Marine	Registered CCA under EPA in 2004 (MP)	Leatherback, green and hawksbill turtles
Mere-Sauwia Conservation Area	Nguna Island	Terrestrial and Marine	(MP)	Turtles
Epau Conservation Area	East Efate	Terrestrial and Marine	(Draft MP)	Turtles
Amal-Crab Bay Tabu Eria	NE Malekula	Marine	Registered CCA	Rich seagrass, corals and mangroves; green and hawksbill turtles; Hawksbill nesting
Wiawi Conservation Area	NW Malekula	Terrestrial and Marine	Traditional tabu	Seagrass; corals; turtles (key hawksbill nesting area; green and loggerhead also present)
Mystery Island	Aneityum	Marine	(MP)	Seagrass; turtles (green and hawksbill present)
Anelcahaut Marine Conservation Area	Aneityum	Marine	Traditional tabu	Seagrass; green and hawksbill turtles
Uri Marine Reserve	Uri Island, Malekula	Marine	Traditional tabu	Seagrass and mangroves; green and hawksbill turtles
Dixon Reef Tabu Area	Malekula	Marine	Traditional tabu (Developing MP)	Turtles (important green turtle nesting area)
Million Dollar Point*	Banban, South Santo	Marine	Under Fisheries Act	Coral reef; some seagrass; possibly turtles

[30] See: http://macbio-pacific.info/Resources/biophysically-special-unique-marine-areas-of-vanuatu/

President Coolidge*	South Santo	Marine	Under Fisheries Act	Coral reef; some seagrass; turtles seen
Loru Protected Area	Kohle, East Santo	Terrestrial and Marine	Traditional tabu	Turtles
Mondoro Marine Conservation Area	South Gaua	Marine	Traditional tabu (Draft MP)	Turtles
Lemoga Marine Conservation Area	North Gaua	Marine	Traditional tabu	Turtles
7 Proposed Marine Conservation Areas	Around Epi Island	Marine	Traditional tabu	Turtles- green and hawksbill
Traditional	South Pentecost	Terrestrial and Marine	Traditional tabu	Seagrasses and turtles
Tasi Vanua Conservation Areas	From Pangpang to Moso Island	Terrestrial and Marine	Tasi Vanua Resource monitors	Turtles – Green and Hawksbill
Takara Tabu Area	North Efate	Marine	Traditional tabu (Draft MP developed)	Turtles– Green and Hawksbill
Marou Marine Conservation Area	Emau	Marine	Traditional Tabu	Turtles
Unakap Marine Conservation Area	Nguna	Marine	(MP)	Turtles
Hideaway Island Sanctuary	Mele	Marine	(MP)	Coral reef; Hawksbill
Pellongk Marine Reserve	Maskelyne Is	Marine	Under Fisheries MP	Green and hawksbill turtles
Apuma CCA	Lelepa Is	Marine	Registered DEPC CCA (MP)	Green and hawksbill turtles
Telvet	NE Mota Lava	Marine	CCA	Green turtle
Chief Natu CCA	Aore	Marine	Malopass MPA, LLV	Green turtle
Palau CCA	Efate	Marine	Tasi Vanua	Green turtle
Lelema	NW Efate	Marine	Tasi Vanua	Green turtle
Qeremangde CCA	Mota Lava	Marine	CCA	Green turtle
Nerenigman CCA	Mota Lava	Marine	CCA	Seagrass
Ifira Marine Managed Area	Efate	Marine	JICA, VPMU, CCA	Green turtle
Reef Island	Reef Island	Marine	Proposed CCA	Green and Hawksbill turtles
Sola Turtle Sanctuary	Vanua Lava	Marine	Locally Managed	Green turtle

Quanlap Turtle Sanctuary	Vanua Lava	Marine	Traditionally Managed	Green and Hawksbill turtles
Totoglag CCA	Motalava	Marine	CCA	Green turtle
Metoma CCA	Torres Group	Marine	Under Fisheries Regulation	Marine ecosystem
West Malo	Malo	Marine	Malopass MPA, LLV	Marine ecosystem
Barnabas Vuro	Aore Island	Marine	Malopass MPA, LLV	Green turtle
Chief Paul Sope	Aore Island	Marine	Malopass MPA, LLV	Green turtle
East Malo	Malo Island	Marine	Malopass MPA, LLV	Green turtle
Mele bay	Mele, Efate	Marine	Proposed CCA	Marine ecosystem
Emua	Efate	Marine	Tasi Vanua	Green turtle
Tanoliu	Efate	Marine	Tasi Vanua	Green turtle
Saama	Efate	Marine	Tasi Vanua	Green turtle
Launamoa	Pele	Marine	Nguna Pele Marine Network	Green turtle
Paunagisu	Efate	Marine	Tasi Vanua	Green turtle
Piliura	Pele	Marine	Nguna Pele Marine Network	Green turtle
Worasifiu	Pele	Marine	Nguna Pele Marine Network	Green turtle
Worearu	Pele	Marine	Nguna Pele Marine Network	Green turtle
Ringi te suh Conservation	Maskelynes, S Malekula	Marine	Under Fisheries MP	Green and hawksbill turtles
Unacap CCA	Nguna	Marine	Nguna Pele Marine Network	Green turtle
Lutes Tabu Area	Maskelynes, S Malekula	Marine	ACIAR / SPC	Green and hawksbill turtles
Woralapa CCA	Nguna	Marine	Nguna Pele Marine Network	Green turtle
Taloa CCA	Nguna	Marine	Nguna Pele Marine Network	Green turtle
Utanlangi CCA	Nguna	Marine	Nguna Pele Marine Network	Green turtle
Nekapa CCA	Nguna	Marine	Nguna Pele Network	Green turtle
Vet Tande	Torba Province	Marine	Marine spatial plan (No MP)	Green and hawksbill turtle

Annex D: Active and upcoming projects supporting sea turtle management in Vanuatu

Several projects and programmes have been approved or are in the advanced stages of proposal development, with relevance for sea turtle management in Vanuatu and/or throughout the Pacific islands region.

Pacific BioScapes Programme

A five-year programme of work (2022–2026) with dedicated funding for marine turtles to assist with implementing the new Pacific Regional Turtle Action Plan, slated for publication in 2023. Most of the activities have a regional focus, which will include Vanuatu, and there is one activity which is dedicated to Vanuatu on marine turtle tourism. The project holds six activities:

1. Development of a Regional Marine Tourism Guideline in partnership with the Pacific Tourism Organisation.
2. Regional workshops to develop specific activities to conserve turtles.
3. Development of a Pacific turtle monitoring and tagging manual.
4. Establishment of (or supporting existing) training of marine turtle monitoring coordinators, including provision of equipment.
5. Implementing a network of long-term marine turtle nesting surveys (at index beaches).
6. In Vanuatu, develop best practice guidelines/code of conduct for tourism interactions with turtles including consultation and training.

For more information about the Pacific BioScapes, contact sprep@sprep.org and/or karenb@sprep.org

By-catch and Integrated Ecosystem Management (BIEM) Initiative of the Pacific-European Union Marine Partnership (PEUMP) Programme

A six-year programme of work (2018–2024) with dedicated funding from the European Union and the Government of Sweden to halt the decline of protected marine species, strengthen the sustainable management of their coastal and marine ecosystems, and support poverty reduction. Activities in Vanuatu are approved and managed through the multi-partner BIEM Initiative Steering Committee, chaired by the Director of DEPC. Activities include:

(i) Project *addressing offshore by-catch mitigation measures.* The 'Improving uptake of by-catch mitigation measures for Species of Special Interest in the Pacific longline fleet through a port-based extension programme in Vanuatu' will be based at VFD for the extension of mitigation measures in the offshore longline fleet from 2022 to 2024.

(ii) *Project addressing nearshore by-catch mitigation measures and traditional harvesting.* Within the 'Strengthening inshore fisheries by-catch data collection and community-based fisheries enforcement in Vanuatu', Community-based Authorised Officers (CBAO)will be tasked with monitoring nearshore fisheries. The CBAO or another designated VFD representative could also take the role of data collector during traditional turtle harvests.

(iii) *Data collection and monitoring of turtle nesting habitat in Vanuatu*. Through BIEM, WSB has been responsible for programming and deploying data loggers and weather stations to key index beaches in Wiawi and Bamboo Bay in 2021 and 2022, with monitoring being undertaken every six months. The data are being uploaded to the WWF 'Cool Turtle' database and provided to DEPC. The research will help to collect temperature and other environmental data necessary to inform potential impacts of climate change on turtle hatchling sex ratios.

(iv) *Production and implementation of community turtle management plans for two turtle nesting sites on Malekula Island.* Work is underway with local communities, DEPC and VFD to develop and implement community management plans for turtles at Bamboo Bay and Wiawi on Malekula island, including turtle monitoring activities.

(v) *Review, update, and finalise the National Plan of Action for Turtles (NPOA Turtles) in Vanuatu.* VESS is reviewing the National Plans of Action (NPOA) for sharks, turtles, and seabirds in Vanuatu. For the NPOA Turtles, the focus is on reviewing and updating the plan in line with the United Nations Food and Agriculture Organization guidelines, with the outcomes from this review of sea turtles in Vanuatu informing the NPOA.

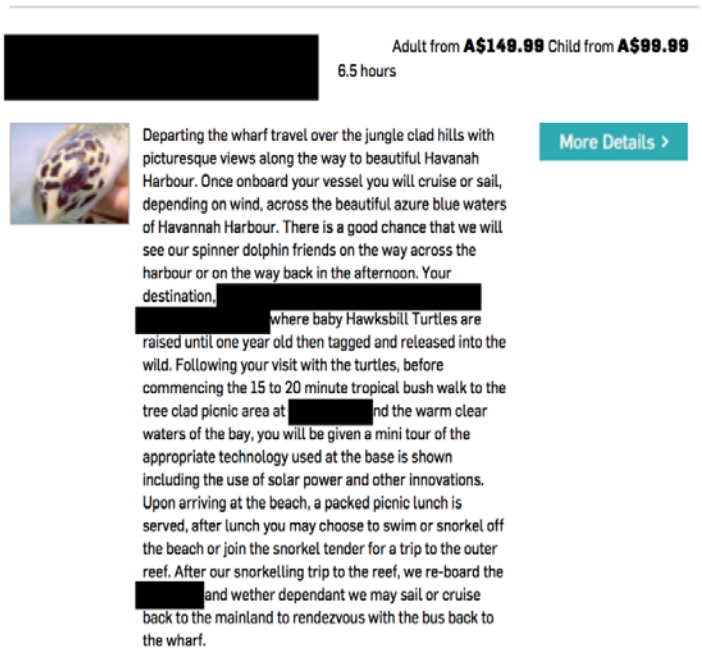
(vi) *Regional learning exchange for turtle monitors from across Melanesia.* This activity will be run in 2023 to promote peer-to-peer learning and best practices.

(vii) *Regional turtle extinction risk assessment.* An assessment of extinction risk for marine turtle species in the Pacific is underway with results due in 2023 to support the strengthening of marine turtle conservation and management by Pacific Island nations. The focus is on green, hawksbill, leatherback, olive ridley and loggerhead turtle species.

Annex E: Turtle tourism

Tourist operators in Vanuatu use turtles as an attraction. Income-generating activities include ‘tagging for tourism’.

Photo D.1: Screenshots of online advertisement for tourist operators in Vanuatu, (a) describing interactions with turtles in a head-start programme and (b) demonstrating touching an adult turtle. Source: Facebook advertisement, online advertisement



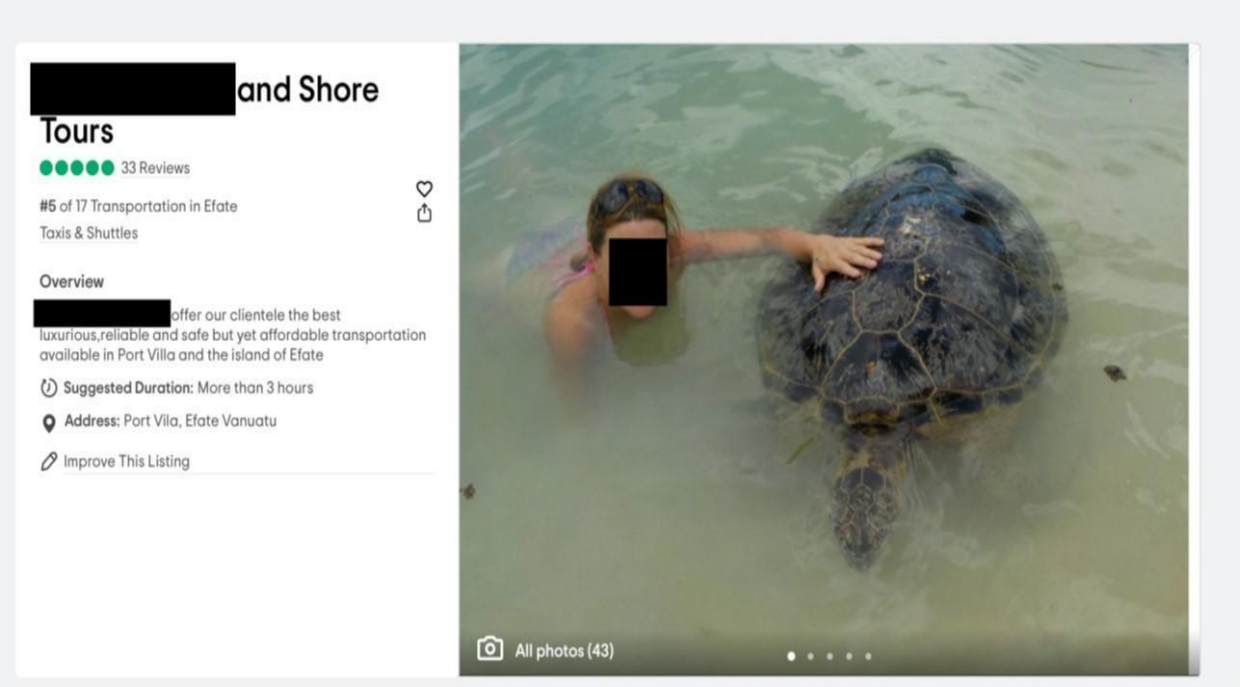
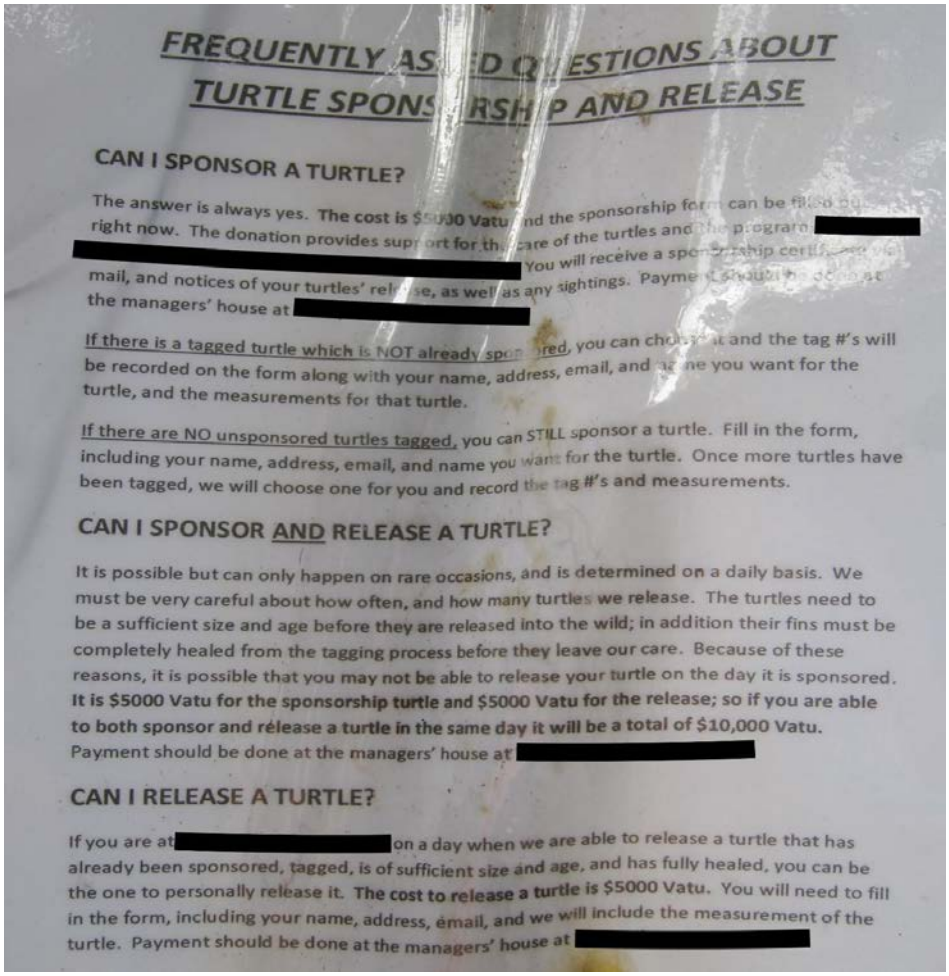


Photo D.2: Explanation of an income-generating 'turtle sponsorship' programme by a tourist operator in Vanuatu, including tagging. Source: Tourist operator facility in Vanuatu



FREQUENTLY ASKED QUESTIONS ABOUT TURTLE SPONSORSHIP AND RELEASE

CAN I SPONSOR A TURTLE?

The answer is always yes. The cost is $5000 Vatu and the sponsorship form can be filled out right now. The donation provides support for the care of the turtles and the program [redacted] You will receive a sponsorship certificate via mail, and notices of your turtles' release, as well as any sightings. Payment should be done at the managers' house at [redacted]

If there is a tagged turtle which is NOT already sponsored, you can choose it and the tag #'s will be recorded on the form along with your name, address, email, and name you want for the turtle, and the measurements for that turtle.

If there are NO unsponsored turtles tagged, you can STILL sponsor a turtle. Fill in the form, including your name, address, email, and name you want for the turtle. Once more turtles have been tagged, we will choose one for you and record the tag #'s and measurements.

CAN I SPONSOR AND RELEASE A TURTLE?

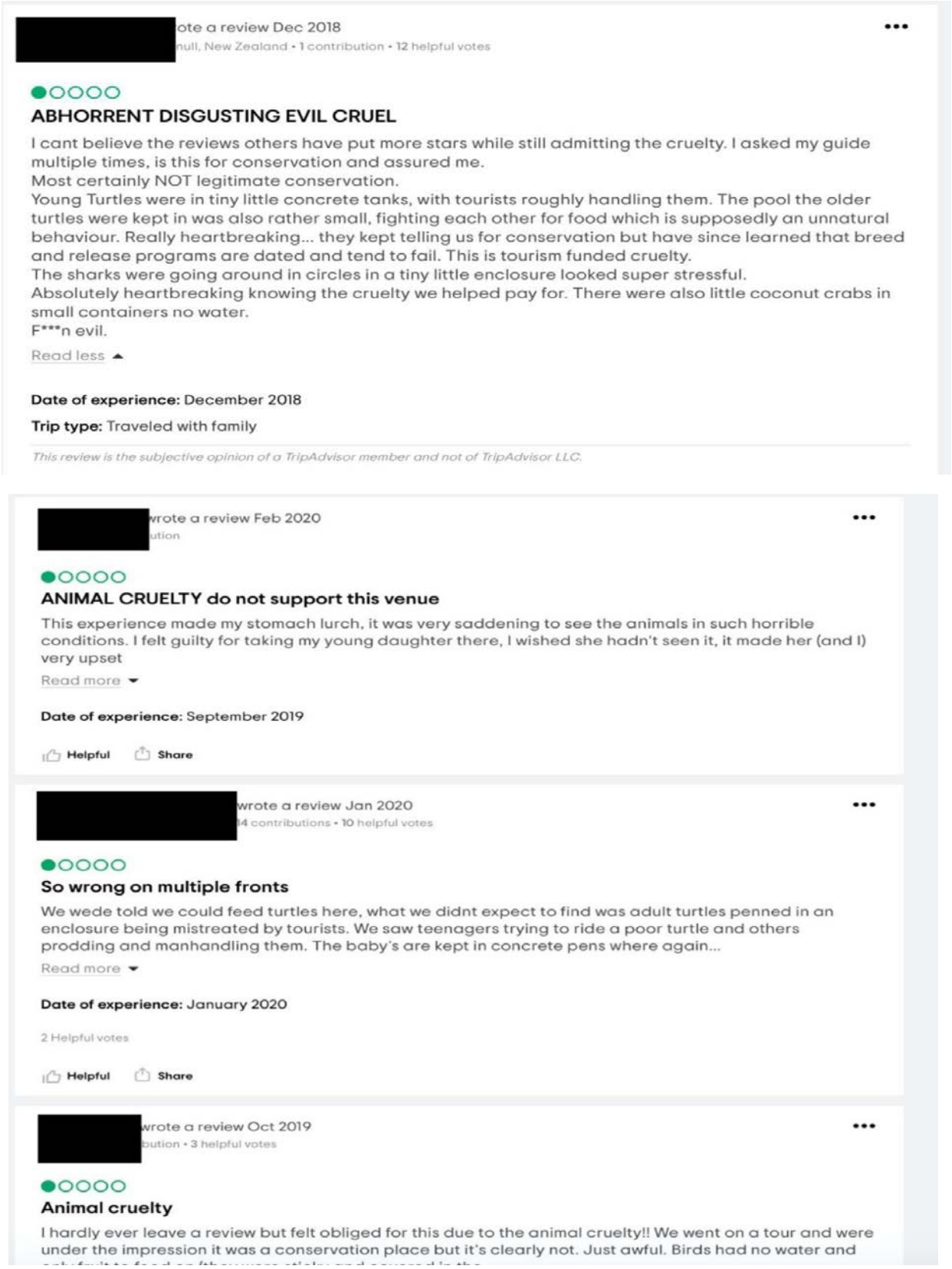
It is possible but can only happen on rare occasions, and is determined on a daily basis. We must be very careful about how often, and how many turtles we release. The turtles need to be a sufficient size and age before they are released into the wild; in addition their fins must be completely healed from the tagging process before they leave our care. Because of these reasons, it is possible that you may not be able to release your turtle on the day it is sponsored. **It is $5000 Vatu for the sponsorship turtle and $5000 Vatu for the release; so if you are able to both sponsor and release a turtle in the same day it will be a total of $10,000 Vatu.** Payment should be done at the managers' house at [redacted]

CAN I RELEASE A TURTLE?

If you are at [redacted] on a day when we are able to release a turtle that has already been sponsored, tagged, is of sufficient size and age, and has fully healed, you can be the one to personally release it. **The cost to release a turtle is $5000 Vatu.** You will need to fill in the form, including your name, address, email, and we will include the measurement of the turtle. Payment should be done at the managers' house at [redacted]

Photo D.3: Turtle hatchlings in a crowded container overgrown with algae at a head-start facility, an indicator of poor water quality for turtles. Source: C. Shaw, VESS

Photo D.4: (a, b) Negative commentary from tourists in response to existing turtle captivity practices in Vanuatu, 2018–2020. Source: TripAdvisor, online review



[redacted] ote a review Dec 2018
[redacted] hull, New Zealand • 1 contribution • 12 helpful votes

●○○○○

ABHORRENT DISGUSTING EVIL CRUEL

I cant believe the reviews others have put more stars while still admitting the cruelty. I asked my guide multiple times, is this for conservation and assured me.
Most certainly NOT legitimate conservation.
Young Turtles were in tiny little concrete tanks, with tourists roughly handling them. The pool the older turtles were kept in was also rather small, fighting each other for food which is supposedly an unnatural behaviour. Really heartbreaking... they kept telling us for conservation but have since learned that breed and release programs are dated and tend to fail. This is tourism funded cruelty.
The sharks were going around in circles in a tiny little enclosure looked super stressful.
Absolutely heartbreaking knowing the cruelty we helped pay for. There were also little coconut crabs in small containers no water.
F***n evil.

Read less

Date of experience: December 2018

Trip type: Traveled with family

This review is the subjective opinion of a TripAdvisor member and not of TripAdvisor LLC.

[redacted] wrote a review Feb 2020
[redacted] ution

●○○○○

ANIMAL CRUELTY do not support this venue

This experience made my stomach lurch, it was very saddening to see the animals in such horrible conditions. I felt guilty for taking my young daughter there, I wished she hadn't seen it, it made her (and I) very upset

Read more

Date of experience: September 2019

Helpful Share

[redacted] wrote a review Jan 2020
[redacted] 4 contributions • 10 helpful votes

●○○○○

So wrong on multiple fronts

We wede told we could feed turtles here, what we didnt expect to find was adult turtles penned in an enclosure being mistreated by tourists. We saw teenagers trying to ride a poor turtle and others prodding and manhandling them. The baby's are kept in concrete pens where again...

Read more

Date of experience: January 2020

2 Helpful votes

Helpful Share

[redacted] wrote a review Oct 2019
[redacted] bution • 3 helpful votes

●○○○○

Animal cruelty

I hardly ever leave a review but felt obliged for this due to the animal cruelty!! We went on a tour and were under the impression it was a conservation place but it's clearly not. Just awful. Birds had no water and

Supplement 1: Sea turtle data relevant for Vanuatu

Selected data are included in the present document in recognition of the challenges to accessing and collating data from the multiple owners and custodians. When data have been published, the citation here refers to the publication; please see the relevant publication for additional information about data sources.

Supplemental data on turtle by-catch.

Table S.A.1: Turtle interactions recorded by species by Vanuatu flagged longline and purse seine fishing vessels within the Western and Central Pacific Ocean region, 2005–2010. Source: VFD (2015)

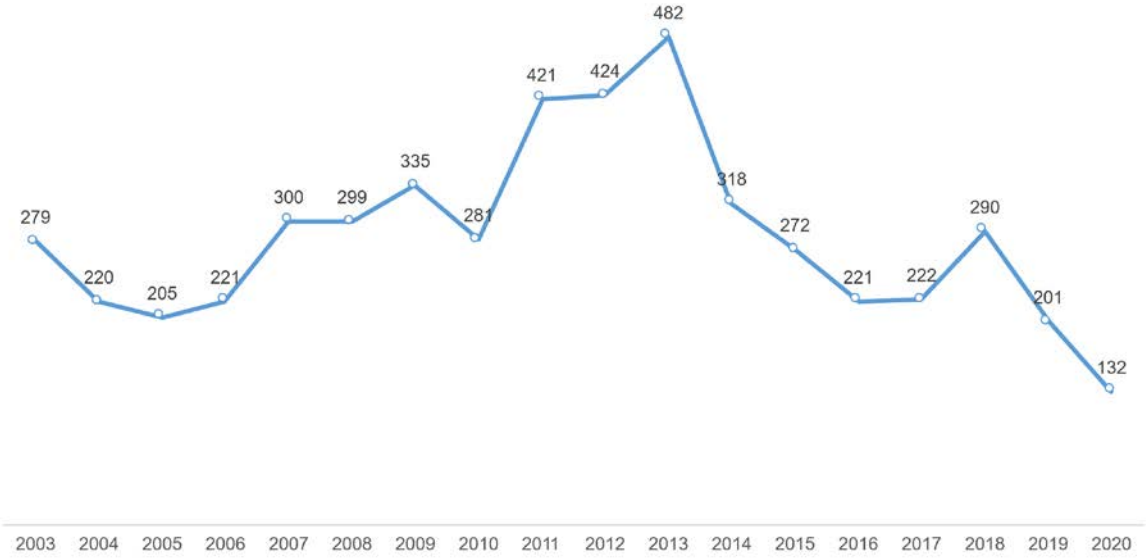
Year	Gear	Species common name	Total number	Alive	Dead
2010	Purse seine	Loggerhead	1	1	0
2010	Purse seine	Loggerhead	2	Fate unknown	
2009	Longline	Loggerhead	1	0	1
2007	Purse seine	Olive ridley	1	Fate unknown	
2006	Purse seine	Olive ridley	1	Fate unknown	
2005	Purse seine	Turtle (unidentified)	2	Fate unknown	
2005	Purse seine	Olive ridley	1	Fate unknown	

Note: The one live loggerhead turtle caught by a purse seiner in 2010 was listed in Vanuatu's annual report for the 10th regular session of the Scientific Committee of the WCPFC (2014; see Table 9). However, the other two loggerhead noted here were not.

Table S.A.2: Estimated annual sea turtle by-catch (individuals) by estimation group for the large-scale equatorial purse seine fishery in the WCPFC region, 2003 to 2020. 95% confidence intervals are provided in parentheses. Estimates for 2020 are preliminary. nei: not elsewhere identified. Source: WCPFC SC17-ST-IP-06 (Table 9), see: https://meetings.wcpfc.int/node/12542

Year	Green turtle	Olive ridley turtle	Loggerhead turtle	Hawksbill turtle	Leatherback turtle	Marine turtles nei
2003	19 (8-68)	16 (7-44)	1 (0-7)	31 (16-67)	4 (1-19)	208 (162-273)
2004	22 (12-43)	23 (15-38)	4 (2-13)	25 (17-38)	9 (5-19)	137 (108-179)
2005	40 (31-56)	33 (24-44)	19 (13-32)	25 (17-38)	10 (5-19)	78 (62-103)
2006	59 (45-79)	61 (48-79)	40 (28-59)	29 (21-41)	8 (5-15)	24 (18-35)
2007	90 (71-119)	77 (60-100)	80 (63-102)	36 (26-52)	6 (4-13)	11 (7-18)
2008	76 (56-103)	58 (45-75)	107 (83-142)	44 (32-59)	8 (4-18)	6 (3-12)
2009	74 (62-92)	84 (73-99)	108 (91-128)	57 (45-71)	5 (4-9)	7 (5-10)
2010	62 (57-68)	63 (58-69)	78 (71-86)	57 (52-64)	9 (7-11)	12 (10-14)
2011	87 (82-93)	130 (123-138)	94 (88-103)	81 (75-88)	12 (10-14)	17 (15-20)
2012	110 (104-118)	121 (114-129)	89 (83-98)	75 (69-83)	10 (8-13)	19 (17-23)
2013	140 (133-148)	110 (104-116)	97 (92-103)	107 (101-113)	11 (10-13)	17 (16-20)
2014	92 (85-101)	77 (71-85)	56 (51-62)	72 (66-80)	10 (9-13)	11 (9-13)
2015	92 (89-95)	69 (65-74)	56 (54-59)	35 (33-38)	9 (8-11)	11 (10-12)
2016	54 (50-60)	75 (70-82)	46 (42-51)	24 (22-28)	13 (12-16)	9 (7-11)
2017	67 (62-73)	71 (65-78)	42 (38-48)	26 (23-31)	8 (6-10)	8 (7-10)
2018	94 (89-101)	64 (60-68)	70 (66-76)	46 (43-50)	9 (8-12)	7 (6-8)
2019	58 (55-62)	48 (43-53)	52 (48-57)	34 (31-40)	5 (4-6)	4 (4-5)
2020	30 (23-43)	41 (31-55)	32 (22-46)	13 (8-22)	10 (6-25)	6 (4-15)

Figure S.A.1: Estimated annual sea turtle by-catch (individuals) for the large-scale equatorial purse seine fishery in the WCPFC region, 2003 to 2020. Data for 2020 are preliminary. Source: WCPFC SC17-ST-IP-06 (Table 9), see: https://meetings.wcpfc.int/node/12542



Supplemental data on turtle nesting

Table S.B.1: Hawksbill turtle nesting sites recorded in TREDS for Vanuatu, 1995–2015. Source: Siota 2015.

Location	Island	1995/ 1996	1996/ 1997	2000/ 2001	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2011/ 2012	2013/ 2014
Bamboo Bay	Malekula					1	1	32	20	19	28	22	6
Lalinda beach	Ambrym								1				
Letokas Village												1	
Malekula	Malekula					1							
Tukutuku/ Angoroa	Efate	1											
Tumaris												2	
Pinapow Beach	Malekula						1						
Rembe	Malekula				2								
Ringdove	Epi				1								
Rovoliu	Epi			1									
Tasiriki	Moso							19	30	57	58		
Tavloel	Tegua			1									
Vaipei	Espiritu Santo		1					2					
Wiawi	Malekula								7			1	
Votlo	Epi												1
Unknown													5
Total by year		1	1	2	3	2	2	53	58	76	86	26	12

Table S.B.2: Nesting hawksbill turtles by beach sector at Wiawi, 2008–2019. Source: Wan Smolbag

Year	Beach A	Beach B	Beach C	Beach D	Beach E	Beach F	TOTAL
2008				6	1		7
2009	4	2	3	9	13	1	32
2010	2	2	1	4	19	6	34
2011				2	1		3
2012					6		6
2013	1				5		6
2014	6	2	10	36	13		67
2015							
2016							
2017	4	2	7	43	13		69
2018	1		4	10	5		20
2019	36	9	42	118	76	7	244

Table S.B.3: Hawksbill turtle nesting summary by key sites, 2008–2011. Source: compiled from Fletcher and Petro 2009 unpublished, Wan Smolbag 2007–2008, 2008–2009, WSB-NOAA Vanuatu Leatherback Monitoring and Outreach Activities 2009–2010 Annual Report, 2010–2011 Annual Report.

Nesting Site	Tassiriki, Moso	Bamboo Bay	Wiawi	Maranata	Votlo
Survey start–end	**Oct 2008 – Apr 2009**	**Nov 2008 – Apr 2009**	**Dec 2008 – May 2009**	**Nov 2008 – Mar 2009**	**Oct 2008 – Apr 2009**
Number tagged	53	0	0	0	0
Number of nests laid	147	0	0	0	15
Number of nests hatched	118	0	0	0	8
Survey start–end	**Oct 2009 – Mar 2010**	**Jul 2009 – Mar 2010**	**Jul 2009 – Mar 2010**	**Nov 2009 – Feb 2010**	**Oct 2009 – Mar 2010**
Number tagged	69	24	1	0	0
Number of nests laid	93	43	44	1	0
Number of nests hatched	92	31	42	1	0
Survey start–end	**Oct 2010 – Mar 2011**	**Oct 2010 – Mar 2011**	**Jul 2010 – Feb 2011**	**Nov 2010 – Feb 2011**	**Sep 2010 – Feb 2011**
Number tagged	21	2	3	0	1
Number of nests laid	67	75	24	0	10
Number of nests hatched	65	71	23	0	4
Total hawksbills hatched 2008–2011	**275**	**102**	**65**	**1**	**12**

Table S.B.4: Nesting green turtles recorded in TREDS for Vanuatu, 1992–2014. Source: TREDS, Siota 2015

Location	Island	1992/ 1993	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2011/ 2012	2013/ 2014
Asaola	Pentecost			1											
Aniwa Lagoon	Aniwa										4				
Bamboo bay	Malekula							12		27	25	14	8	3	4
Dickson reef village	Malekula										1				
Epau village	Efate										1				
Epi	Epi						1								
Lawa	Malekula					3									
Letokas Village														3	
Litatra	Tegua				1						1				
Mafilau	Epi			1											
Malekula	Malekula							8		1				3	1
Molboe	Espiritu Santo										1				
Motalava	Motalava	1													
Okai	Malekula							3							
Rembe	Malekula							4							
Ringdove	Epi						1								
Rovoliu	Epi		1												
Tasiriki	Moso									30	3	10	3		
Tumaris														3	
Unakap	Nguna									1					
Unknown	Vanuatu													2	2
Vaipei	Espiritu Santo									2					
Vakas	Malekula							1							
Vasvasada	Pentecost									1					
Votlo	Epi					6								1	3
Votlo Research Site	Epi						2		3					1	
Wanbe	Epi									1					
Wiawia	Malekula									1	4	3		12	2
Worasivi	Pele									2					
Total by year		**1**	**1**	**2**	**1**	**9**	**4**	**28**	**3**	**66**	**40**	**27**	**11**	**28**	**12**

Table S.B.5: Green turtle nesting summary from key sites, 2008–2011. Source: compiled from Fletcher and Petro 2009 unpublished, Wan Smolbag 2007–2008, 2008–2009, WSB-NOAA Vanuatu Leatherback Monitoring and Outreach Activities 2009–2010 Annual Report, 2010–2011 Annual Report

Nesting Site	Tassiriki	Bamboo Bay	Wiawi	Maranata	Votlo
Survey start–end	**Oct 2008 – Apr 2009**	**Nov 2008 – Apr 2009**	**Dec 2008 – May 2009**	**Nov 2008 – May 2009**	**Oct 2008 – Apr 2009**
Number tagged	0	48	0	0	1
Number of nests laid	0	219	38	0	24
Number of nests hatched	0	123	37	0	10
Survey start–end	**Oct 2009 – Mar 2010**	**Jul 2009 – Mar 2010**	**Jul 2009 – Mar 2010**	**Nov 2009 – Mar 2010**	**Oct 2009 – Mar 2010**
Number tagged	10	5	1	0	0
Number of nests laid	11	20	37	0	10
Number of nests hatched	11	13	37	0	4
Survey start–end	**Oct 2010 – Mar 2011**	**Oct 2010 – Mar 2011**	**Jul 2010 – Feb 2011**	**Nov 2010 – Feb 2011**	**Sep 2010 – Feb 2011**
Number tagged	2	14	27	0	1
Number of nests laid	1	134	57	2	4
Number of nests hatched	1	113	51	0	2

Table S.B.6: Number of green turtle nests at Bamboo Bay, 2004–2019. Source: Wan Smolbag

Year	Beach A	Beach B	Beach C	Beach D	Beach E	Beach F	Beach G	Beach H	Beach I	Beach J	Dickson Reef	TOTAL
2004											2	**2**
2005		11			5						1	**17**
2006				2	5		45	3		1		**56**
2007					3		12	1				**16**
2008							8	1	2	1		**12**
2009						1	4					**5**
2010					12	2	27	3				**44**
2011					16	6	26		5	5		**58**
2012				2	4	1	46		2			**55**
2013					1		52					**53**
2014					62	29	44					**135**
2015					33	30	20					**83**
2016												
2017		1	1	33	14	4			31	15		**99**
2018							28					**28**
2019		12	2	70	169	77	321	8	84	43	3	**789**

Table S.B.7: Number of green turtle nests at Wiawi, 2013–2018. No data were available for 2016. Source: Wan Smolbag

Year	Beach A	Beach B	Beach C	Beach D	Beach E	Beach F	TOTAL
2013			2	1	6		**9**
2014	13	11	41	64	49	2	**180**
2015				2			**2**
2016							
2017				7	3		**10**
2018			2	7	4		**13**

Supplement 2: Survey questionnaire

The following modified questionnaire was used in a 2016–2017 survey of Vanuatu fishers, as part of the Dugong and Seagrass Conservation Project funded by the Global Environment Facility. For more information, see VESS (2017).

United Nations Environment Programme

Convention on the Conservation of Migratory Species of Wild Animals

UNEP/CMS OFFICE – ABU DHABI

United Arab Emirates

STANDARDISED DUGONG CATCH / BYCATCH QUESTIONNAIRE

Interviewer Name:_____ Date:_____ Data Sheet Serial Number:_____

Town:_____ Province:_____

INTRODUCTION STATEMENT

Note: Reading this statement to the interviewee is compulsory. It ensures all interviews are treated equally.

My name is_____. I work for a project run by the _____, which is an organization based in_____ *(insert location)* which is supporting research to protect the ocean for fishers and wildlife. The goal of this project is to learn more about capture of dugongs and any other marine wildlife in coastal fisheries of_____ *(insert location)*. We would like to ask you some questions about wildlife you have seen, what fishing gear you use (if any), where you fish, and questions like that. We have maps and pictures that can be used to help answer some of the questions. The questions will take between 30 to 45 minutes to complete. Information from our research could be used to help reduce the capture of dugongs and other marine mammals and sea turtles, maybe through direct community support for our goals, or possibly through more effective regulations and enforcement. **Your participation in this survey is voluntary and confidential. We will not record your name or any personal information you share with us unless this is ok with you. Individual answers will be collated and reported on as a group to provide a general idea of current status, and we will absolutely not share your individual answers to anyone outside of the research team. You do not have to answer questions you do not want to. THANK YOU FOR YOUR HELP !**

INTERVIEWEE BACKGROUND

Note: Please tick the boxes to the left of any questions not asked.

☐ 1. Name:_____

☐ 2. Age:_____ Gender: Male ☐ Female ☐

☐ 3. Have you previously participated in interviews related to:

Fishing ☐ Marine Mammals ☐ MPAs ☐ Ecotourism ☐ Sea Turtles ☐ Other ☐ None ☐

When did you participate?_____

Describe: _____

☐ 4. What is your main occupation?

Fishing ☐ Tour Guide ☐ Boat Captain / Crew ☐ Air Services ☐ Retired ☐

Other ☐ Please describe: _____

☐ 5. For how many years has this been your occupation?_____

☐ 6. Do you have a fishing background? Yes ☐ No ☐

☐ 7. Were your parents fishers? Yes ☐ No ☐ Grandparents? Yes ☐ No ☐

☐ 8. Is fishing the main way you earn a living? Yes ☐ No ☐

☐ 9. Is fishing the only way you earn a living? Yes ☐ No ☐

(if no) What is (or are) your other occupation(s)?_____

☐ 10. Which months do you normally fish (out of the last 12)?_____
(*if seasonal, indicate season start and end*)

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

☐ 11. How many days each week do you fish?_____days (low season)_____days (peak season)

☐ 12. What is your position on the boat? The captain ☐ A crew member ☐ We have no fixed positions ☐

I do not work on a boat ☐ (*skip next questions if person does not work on a boat*)

☐ 13. How many fishers, including yourself, work on the boat?_____

☐ 14. How long is the boat?_____
(*Note to interviewer: convert and provide answer in meters*)

☐ 15. Is the boat motorized? Yes ☐ No ☐ (if yes) Inboard ☐ Outboard ☐

☐ 16. What is the horsepower of the motor?_____

DUGONG CATCH / BYCATCH

☐ 17. Have you ever personally seen a dugong in our waters? Yes ☐ No ☐

Do you have another name for it?_____

☐ 18. Tell me about the difference between a dugong and a dolphin?_____

☐ 19. How long do you think a dugong lives?_____Don't know ☐

☐ 20. How do you get to see dugongs? Seen while fishing ☐ Seen while travelling to fishing areas ☐

Accidentally caught in nets ☐ Hunted ☐ Stranded on the beach ☐ Other ☐ _____

Where do you normally fish? (*Note to interviewer: Complete attached table and mark all locations on maps*)

☐ 21. How frequently have you seen dugongs? Never ☐ Once in my life ☐ Only a few times in my life ☐

Frequently ☐ Every year for the last five years ☐

In the last year, only once ☐ several times ☐ every month ☐ every week ☐ every day ☐.

☐ 22. In what month(s) do you see dugongs? (*indicate months when seasons are used*):_____

☐ 23. When was the last time you saw a dugong?_____(*if long time ago note the year*)

☐ 24. Do you know of any areas where dugongs regularly occur? Yes ☐ No ☐
(*Note to interviewer:* Regular *means certain times of year when they are always found*)

Where are these special dugong areas? (*Indicate on map*)

☐ 25. Do these dugong areas change over time? Yes ☐ No ☐ Don't Know ☐

☐ 26. How many dugongs do you think might live in these areas? 1 ☐ <10 ☐ >10 ☐ Don't Know ☐

☐ 27. Have you ever seen dugong calves / babies? Yes ☐ No ☐ When?_____(*what month(s)?*)

Where did you see them? (*ask interviewee to show on maps*)

☐ 28. Do people from other villages / communities catch dugongs? Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____What village?_____

Any other details?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

☐ 29. Do you have any dugong specialists or catchers in your village? Yes ☐ No ☐ How many?_____

☐ 30. Have people in your village / community ever caught dugongs? Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____For how long?_____Any details?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

☐ 31. Did you personally catch any dugongs in the last year? (*accidentally or hunted*) Yes ☐ No ☐
(*if yes*) How many in the last year? 1-2 ☐ ≤10 ☐ >10 ☐ Any details? (*if available*):_____
Was this is a typical number to catch in a year? Yes ☐ No ☐
(*if no*) Was it higher or lower than usual? Higher ☐ Lower ☐
Was the catch accidental or was it something you were fishing for? Accidental ☐ Hunted ☐ Both ☐

☐ 32. Did you catch any in the last five years? 0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_
How many in your life? 0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

☐ 33. How did you catch them? Harpoon ☐ Nets ☐ Other ☐ Please describe:_____
When did you catch them?_____(*what month(s)?*) Where? (*ask interviewee to show on maps*)

☐ 34. Compared to when you started fishing, are there more ☐, less ☐, or the same number of dugongs ☐ hunted / captured in fishing gear? Don't Know ☐ (*Note: this is based on actual numbers, not perception*)
(if more or less) Why do you think this?_____

☐ 35. What do you (or would you) do with a dugong if you caught one on purpose?
Eat ☐ Sell ☐ As Bait ☐ Keep for tourism ☐ Other Use ☐: _____ *(Note: do not lead interviewee)*

☐ 36. What do you (or would you) do with a dugong if you caught one accidentally?
Discard (*dead*) ☐ Release (*alive*) ☐ Eat ☐ Sell ☐ As Bait ☐ Keep for tourism ☐ Other Use ☐: __

☐ 37. Have you ever found ☐ or heard of ☐ dugongs stranded on the shore? Yes ☐ No ☐ (*explain*)
Or have you ever found ☐ or heard of ☐ dugongs dead in our waters? Yes ☐ No ☐
Or have you ever found ☐ or heard of ☐ dugongs with cut marks on their backs? Yes ☐ No ☐ (*explain*)
(if yes) Where, when and how many? (*ask interviewee to show on maps*)?_____
What happened to the animal(s)?_____

☐ 38. What would you do if you found a stranded dugong?_____

☐ 39. Have you heard of dugongs being kept in captivity for tourism purposes? Yes ☐ No ☐ (*explain*)

☐ 40. Do you know of a tourism activity where tourists can see dugongs? Yes ☐ No ☐

☐ 41. Is the viewing of dugongs incidental to another tourism activity or is the tourism specifically aimed at the dugongs? Incidental ☐ Dugongs specific ☐

☐ 42. How do the tourists view the dugongs? Kayak ☐ Canoe ☐ Motor boat ☐ Airplane ☐ Other ☐

☐ 43. How often is a dugong seen on a tour? Always ☐ Often ☐ Sometimes ☐ Rarely ☐

☐ 44. Are the dugongs attracted in any way? Food ☐ Slapping water ☐ Other ☐

☐ 45. Are the tourists allowed in the water with the dugongs? Yes ☐ No ☐

☐ 46. If yes, are they given any instructions on how to behave or interact with the dugongs? Yes ☐ No ☐
(*explain*)

☐ 47. If you have a tourism business do you mention seeing dugongs in your advertising? Yes ☐ No ☐ (*explain*)

PERCEPTIONS

☐ 48. Compared to when you started fishing, do you think there are more dugongs ☐, less ☐, or the same number of dugongs ☐? I don't know ☐

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

(if more or less) Why do you think this?_____
(*Note to interviewer: Try to determine what other impacts may be driving the trend*)

☐ 49. Do you think there will always be dugongs in the sea? Yes ☐ No ☐ Don't Know ☐

(if yes or no) Why?_____

☐ 50. Do you think having dugongs around is important? Yes ☐ No ☐ Don't know ☐ Why?_____

☐ 51. Do you know what seagrass areas are? Yes ☐ No ☐ (*Note to Interviewer: show graphics*)

Are there any seagrass areas around here? Yes ☐ No ☐ Don't know ☐ Where?_____
(*Note to Interviewer: mark on maps*)

Do you fish in these seagrass areas? Yes ☐ No ☐

Are these seagrass areas important for anything else? Yes ☐ No ☐ Why?_____

☐ 52. Is it illegal to intentionally kill a dugong Yes ☐ No ☐ Don't know ☐

What about by accident (maybe caught in a net unintentionally)? Yes ☐ No ☐ Don't know ☐

Would you report an accidental mortality to the authorities? Yes ☐ No ☐

Details (if given)?_____

☐ 53. Do you need a permit to take tourists to watch dugongs? Yes ☐ No ☐

☐ 54. Are any areas routinely / periodically patrolled? Frequently ☐ Infrequently ☐ Never ☐ Don't know ☐

☐ 55. If yes, are penalties ever imposed? Frequently ☐ Infrequently ☐ Never ☐ Don't know ☐

☐ 56. Are there any local customs, beliefs, legends or rituals or stories related to dugongs? Yes ☐ No ☐

(if yes) Please describe:_____

_____

Where / from whom did you hear this?_____

Any additional stories / incidents you wish to report:_____

FISHERY INFORMATION

Note to interviewer: Respondent should answer these questions to describe his/her individual experience, not that of their community. Use illustrations to assist where necessary.

Habitat Codes: (D) Deep Water; (C) Coral; (S) Seagrass; (F) Fine Sediments; (M) Mangroves; (R) Rocks; (E) Estuaries; (U) Unknown

☐ 57. What type of fishing gear do you use? (*Indicate what months*)

Gill or trammel nets
Only ☐ Mostly ☐ Sometimes ☐ Season:_____
Habitat:_____ Target:_____
Do you tend the nets when they are in the water? Yes ☐ No ☐
How long do you leave the nets in the water?_____hours
Do you fish during the day ☐ or night ☐? Both ☐?
What is the position of the gear? Surface ☐ Mid-water ☐ Bottom ☐
Full water depth ☐ (*normally in shallow waters*)
Describe the net: Length_____ Depth_____ Mesh size_____

Longline (*many hooks*)
Only ☐ Mostly ☐ Sometimes ☐ Season:_____
Habitat:_____ Target:_____

Bottom longline
Only ☐ Mostly ☐ Sometimes ☐ Season:_____

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

(*many hooks set at depth*) Habitat: Target:

Hook and line Only ☐ Mostly ☐ Sometimes ☐ Season:

(*one or few hooks*) Habitat:_____ Target:_____

Purse seine Only ☐ Mostly ☐ Sometimes ☐ Season:_____

(*or surround nets*) Habitat: Target:

Beach seine Only ☐ Mostly ☐ Sometimes ☐ Season:_____

Habitat: Target:

Trawl nets Only ☐ Mostly ☐ Sometimes ☐ Season:_____

(*or other towed net*) Habitat:_____ Target:_____

Traps Only ☐ Mostly ☐ Sometimes ☐ Season:

Habitat:_____ Target:_____

Other (describe):_____

Only ☐ Mostly ☐ Sometimes ☐ Season:_____

Habitat: Target:

☐ 58. In what places do you normally fish?_____

(*Use prepared road maps, charts, Google maps and have interviewee point out areas*)

Do you use different gears in different areas? Yes ☐ No ☐ If yes, please describe:

(*Use prepared road maps, charts, Google maps, and have interviewee point out areas*)

☐ 59. Do people in your village / community target sharks? Yes ☐ No ☐ No, but they are occasionally landed

Please elaborate:_____

(*Note to interviewer: This can be area sensitive*)

SEA TURTLE CATCH / BYCATCH

(*Optional if time permits and interviewee is keen*)

☐ 60. Have you ever seen sea turtles? Yes ☐ No ☐ Do you have another name for them?_____

☐ 61. What species of turtles do you see?Green ☐ Hawksbill ☐ Olive Ridley ☐ Loggerhead ☐

Flatback ☐ Leatherback ☐ Don't know ☐

Do you know the difference between these turtle species? Yes ☐ No ☐ Don't know ☐

(*Note to Interviewer; Show ID chart or graphics*)

Please describe:_____

Do they have different names? (if yes) Please list: (*determine for each species*)

☐ 62. How long do you think a turtle lives? Don't know ☐

☐ 63. How do you see turtles? Seen while fishing ☐ Seen while travelling to fishing areas ☐

Coming ashore to lay eggs ☐ Accidentally caught in nets ☐ Hunted ☐ Stranded on the beach ☐

(*Note to interviewer: Refer to and complete attached table and mark all locations on maps*)

☐ 64. How frequently have you seen turtles? Never ☐ Once in my life ☐ Only a few times in my life ☐

Frequently ☐ Every year for the last five years ☐

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

In the last year, only once ☐ several times ☐ every month ☐ every week ☐ every day ☐

☐ 65. When do you see turtles? (*indicate months or seasons*):_____

☐ 66. When was the last time you saw one?_____(*if long time ago note the year*)

☐ 67. Do you know of any areas where turtles regularly occur? Yes ☐ No ☐
(*Note to interviewer:* Regular *means certain times of year when they are always found. Indicate on maps*)

☐ 68. Do these turtle areas change over time? Yes ☐ No ☐ Don't Know ☐

☐ 69. How many turtles do you think might live in these areas? <10 ☐ >10 ☐ >100 ☐ Don't Know ☐

☐ 70. Do you see mating turtles? Yes ☐ No ☐ When?_____Where (*use maps*)?_____

☐ 71. Do people from other villages / communities catch turtles? Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____What village?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

☐ 72. Do people in your village / community catch turtles? Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____For how long?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

☐ 73. Did you personally catch any turtles in the last year? Yes ☐ No ☐

(if yes) How many in the last year? 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

Was this is a typical number to catch in a year? Yes ☐ No ☐

(if no) Was it higher or lower than usual? Higher ☐ Lower ☐

Was the catch accidental or was it something you were fishing for? Accidental ☐ Hunted ☐ Both ☐

☐ 74. Did you catch any in the last five years? 0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_

How many in your life? 0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

☐ 75. How did you catch them? Harpoon ☐ Nets ☐ Other ☐ Please describe:_____

When did you catch them?_____(*what month(s)?*) Where? (*ask interviewee to show on maps*)

☐ 76. Compared to when you started fishing, are there more ☐, less ☐, or the same number of ☐ turtles captured in fishing gear? Don't Know ☐ (*Note: based on actual numbers, not perception*)

(if more or less) Why do you think this?_____

☐ 77. What do you (or would you) do with a sea turtle if you caught one on purpose?

Eat ☐ Sell ☐ As Bait ☐ Keep for tourism ☐ Other Use ☐: _____ *(Note: do not lead interviewee)*

☐ 78. What do you (or would you) do with a sea turtle if you caught one accidentally?

Discard (*dead*) ☐ Release (*alive*) ☐ Eat ☐ Sell ☐ As Bait ☐ Keep for tourism ☐ Other Use ☐:__

☐ 79. Have you ever found ☐ or heard of ☐ turtles stranded on the shore? Yes ☐ No ☐

Or have you ever found ☐ or heard of ☐ turtles dead in our waters? Yes ☐ No ☐ (*explain stranded*)

Or have you ever found ☐ or heard of ☐ turtles with cut marks on their backs? Yes ☐ No ☐ (*explain*)

(if yes) Where, when and how many? (*ask interviewee to show on maps*)?_____

What happened to the animal(s)?_____

☐ 80. What would you do or did you do if you found a stranded turtle?_____

☐ 81. Have you heard of turtles being kept in captivity for tourism purposes? Yes ☐ No ☐ (*explain*)

☐ 82. Do you know of a tourism activity where tourists can see turtles? Yes ☐ No ☐

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

☐ 83. Is the viewing of turtles incidental to another tourism activity or is the tourism specifically aimed at the turtles? Incidental ☐ Turtle specific ☐

☐ 84. How do the tourists view the dugongs? On shore (captive) ☐ Kayak/Canoe ☐ Motor boat ☐ Airplane ☐ Other ☐

☐ 85. How often is a turtle seen on a tour? Always ☐ Often ☐ Sometimes ☐ Rarely ☐

☐ 86. Are the turtles attracted in any way? Food ☐ Slapping water ☐ Other ☐

☐ 87. Are the tourists allowed in the water with the turtles or to touch / handle the turtles? Allowed in water ☐ allowed to touch ☐ Not allowed in water or to touch ☐

☐ 88. If yes, are they given any instructions on how to behave or interact with the turtles? Yes ☐ No ☐ (*explain*)

☐ 89. If you have a tourism business do you mention seeing turtles in your advertising? Yes ☐ No ☐ (*explain*)

☐ 90. Compared to when you started fishing, do you think there are more turtles ☐, less ☐, or the same number of turtles ☐? I don't know ☐

(if more or less) Why do you think this?_____
(*Note to interviewer: Try to determine what other impacts may be driving the trend*)

☐ 91. Do you think there will always be turtles in our waters? Yes ☐ No ☐ Don't Know ☐

(if yes or no) Why?_____

☐ 92. Do you think having turtles around is important? Yes ☐ No ☐ Why?_____

☐ 93. It is illegal to intentionally kill a turtle? Yes ☐ No ☐ Don't know ☐

What about by accident (maybe caught in a net unintentionally)? Yes ☐ No ☐ Don't know ☐

☐ 94. Do you need a permit to take tourists to watch turtles? Yes ☐ No ☐

☐ 95. Are there any local customs, beliefs, legends or rituals or stories related to turtles?

Yes ☐ No ☐ (if yes) Please describe:_____

Where / from whom did you hear this?_____

DOLPHIN CATCH / BYCATCH

(*Optional if time permits and interviewee is keen*)

☐ 96. Have you ever seen dolphins? Yes ☐ No ☐ Do you have another name(s) for them?_____

_____(*list by species*)

☐ 97. What species of dolphins do you see (*describe*)?_____

Any other cetaceans (*describe*)?_____Don't know ☐

☐ 98. How long do you think dolphins live?_____Don't know ☐

☐ 99. How do you get to see dolphins? While fishing ☐ While travelling to fishing areas ☐

Accidentally caught in nets ☐ Hunted ☐ Stranded on the beach ☐

Are these areas different by species? Yes ☐ No ☐ Don't Know ☐

(if yes) Please explain:_____
(*Note to interviewer: mark locations on maps by species*)

☐ 100. How frequently have you seen dolphins? Never ☐ Once in my life ☐

Only a few times in my life ☐ Frequently ☐ Every year for the last five years ☐

In the last year: Only once ☐ Several times ☐ Every month ☐ Every week ☐ Every day ☐

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

☐ 101. When do you see dolphins? (*indicate months or seasons*):_____

☐ 102. When was the last time you saw one?_____(*if long time ago note the year*)

☐ 103. Do you know of any areas where dolphins regularly occur? Yes ☐ No ☐

Where are these dolphin areas?:_____
(*Note to interviewer:* Regular *means certain times of year when they are always found. Indicate on maps*)

☐ 104. Do these dolphin areas change over time? Yes ☐ No ☐ Don't Know ☐

☐ 105. How many dolphins do you think might live in these areas? <10 ☐ >10 ☐ >100 ☐ Don't Know ☐

☐ 106. Do people from other villages / communities catch dolphins / other marine mammals?

Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____What village?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

☐ 107. Have people in your village / community ever caught dolphins / other marine mammals?

Yes ☐ No ☐ Don't Know ☐

(*if yes*) How many (people)?_____For how long?_____

Is the catch accidental or on purpose? Accidental ☐ On purpose ☐ Both ☐

☐ 108. Did you personally catch any dolphins in the last year? Yes ☐ No ☐

(if yes) How many in the last year? 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

Was this is a typical number to catch in a year? Yes ☐ No ☐

(if no) Was it higher or lower than usual? Higher ☐ Lower ☐

Was the catch accidental or was it something you were fishing for? Accidental ☐ Hunted ☐ Both ☐

☐ 109. Did you catch any in the last five years? Yes ☐ No ☐

0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

How many in your life? 0 ☐ 1-2 ☐ ≤10 ☐ >10 ☐ Specifics (*if available*):_____

☐ 110. How did you catch them? Harpoon ☐ Nets ☐ Other ☐ Please describe:_____

When did you catch them?_____(*what month(s)?*) Where? (*ask interviewee to show on maps*)

☐ 111. Compared to when you started fishing, are there more ☐, less ☐, or the same number of ☐ dolphins captured in fishing gear? Don't Know ☐ (*Note: based on actual numbers, not perception*)

(if more or less) Why do you think this?_____

☐ 112. What do you (or would you) do with a dolphin if you caught one on purpose?

Eat ☐ Sell ☐ As Bait ☐ Other Use ☐: _____ *(Note: do not lead interviewee)*

☐ 113. What do you (or would you) do with a dolphin if you caught one accidentally?

Discard (*dead*) ☐ Release (*alive*) ☐ Eat ☐ Sell ☐ As Bait ☐ Other Use ☐: _____

☐ 114. Have you ever found ☐ or heard of ☐ dolphins stranded on the shore? Yes ☐ No ☐

(if yes) Where, when and how many? (*ask interviewee to show on maps*)?_____

Have you ever found ☐ or heard of ☐ dolphins dead in our waters? Yes ☐ No ☐ (*explain stranded*)

Or have you ever found ☐ or heard of ☐ dolphins with cut marks on their backs? Yes ☐ No ☐ (*explain*)

(if yes) Where, when and how many? (*ask interviewee to show on maps*)?_____

What happened to the animal(s)?_____

☐ 115. What would you do or did you do if you found a stranded dolphin?_____

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

☐ 116. Have you heard of dolphin being kept in captivity for tourism purposes? Yes ☐ No ☐ (*explain*)

☐ 117. Do you know of a tourism activity where tourists can see dolphins? Yes ☐ No ☐

☐ 118. Is the viewing of dolphins incidental to another tourism activity or is the tourism specifically aimed at the dugongs? Incidental ☐ Dolphin specific ☐

☐ 119. How do the tourists view the dolphins? Kayak ☐ Canoe ☐ Motor boat ☐ Airplane ☐ Other ☐

☐ 120. How often is a dolphin seen on a tour? Always ☐ Often ☐ Sometimes ☐ Rarely ☐

☐ 121. Are the dolphins attracted in any way? Food ☐ Slapping water ☐ Other ☐

☐ 122. Are the tourists allowed in the water with the dolphins? Yes ☐ No ☐

☐ 123. If yes, are they given any instructions on how to behave or interact with the dolphins? Yes ☐ No ☐ (*explain*)

☐ 124. If you have a tourism business do you mention seeing dolphins in your advertising? Yes ☐ No ☐ (*explain*)

☐ 125. Compared to when you started fishing, do you think there are more dolphins ☐, less ☐, or the same number of dolphins ☐? I don't know ☐

(if more or less) Why do you think this?_____
(*Note to interviewer: Try to determine what other impacts may be driving the trend*)

☐ 126. Do you think there will always be dolphins in our waters? Yes ☐ No ☐ Don't Know ☐

(if yes or no) Why?_____

☐ 127. Do you think having dolphins around is important? Yes ☐ No ☐ Why?_____

☐ 128. It is illegal to intentionally kill a dolphin? Yes ☐ No ☐ Don't know ☐

What about by accident (maybe caught in a net unintentionally)? Yes ☐ No ☐ Don't know ☐

☐ 129. Do you need a permit to take tourists to watch dolphins? Yes ☐ No ☐

☐ 130. Are there any local customs, beliefs, legends or rituals or stories related to dolphins?

Yes ☐ No ☐ (if yes) Please describe:_____

Where / from whom did you hear this?_____

Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

CONFIDENTIAL INTERVIEWER COMMENTS

131. How open and honest did the fisher seem about answering bycatch questions?

Very open/honest ☐ Somewhat open/honest ☐ Not honest ☐

132. How interested and engaged did the fisher seem with interview?

Very interested ☐ Moderately interested ☐ Bothered/ Not interested ☐

133. How certain did the fisher seem about answers to numerical questions?

Very sure ☐ Reasonable sure ☐ Unsure ☐

134. How comfortable were you about the respondents' ability to discriminate between the species

Very comfortable ☐ Reasonable ☐ Not comfortable ☐

135. Why do you think this?_____

_____

_____

136. Please indicate why (if any) questions were not asked _____

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