Reference Number: AA-001226-002

Detailed Project Engineering Design, Bid Documents and Associated Safeguard Instruments Preparation for Agua Grande Coastal Protection and Reconstruction of Marginal Road

VOLUME 2 – ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

ANNEX 8 – SEA TURTLES

FINAL EDITION

São Tome

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1 INTRODUCTION

São Tomé and Príncipe harbours important breeding and feeding grounds for five of the seven species of sea turtles that exist in the world, all species listed in IUCN Red List of Threatened Species: the Olive Ridley (*Lepidochelys olivacea*), the Leatherback (*Dermochelys coriacea*) and the Loggerhead (*Caretta caretta*), are vulnerable; the Green turtle (*Chelonia mydas*) endangered and the Hawksbill (*Eretmochelys imbricata*) critically endangered (Castroviejo e et al. 2004, Monzón-Arguello e tal. 2011).

Sea turtles nesting occurs in almost all sandy beaches of São Tomé Island that offer suitable conditions for nesting. The distribution and density varying according to each species. Sea turtles nesting occurs on the northern, eastern and southern coasts. On the western coast of São Tomé the lack or very low nesting is due of rocky beaches. The large human settlements are in the northern and eastern coast and the southern beaches are remote. The capital city is located in eastern coast.

Sea turtles have been traditionally exploited for human consumption, but since 2009 a regional law for Príncipe island Law Decree nº 03/2009 protects sea turtles and a national law Law Decree nº8/2014 , criminalize the consumptive use of sea turtles and their by-products in São Tomé.

São Tomé and Príncipe also ratified several international conventions that support biodiversity conservation as the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Convention on International Trade in Endangered Species (CITES) and the Abidjan Convention (United Nations Environment Programme).

In West and Central Africa (including STP), sea turtles have been victims of direct exploitation for centuries, and even today remain vulnerable to incidental capture by industrial fishing fleets (Billes et al., 2006). Females are sought after for their meat, eggs, and shells are used in the local craft industry. In some areas of Africa, traditional fishing of sea turtles still persists (Billes et al., 2006). Other threats to the population include severe habitat changes (in particular development on nesting beaches) and fishing, floating plastics and pollution, where the emerging threat of hydrocarbon pollution along the West African coast is included (Billes et al., 2006; Tomas et al., 2010).

Climate change in the study area has been leading to substantial erosion of the coastline and beaches throughout the island of São Tomé, with particular incidence on the bays located in the capital city.

Sandy beaches are the natural places were sea turtles hutch's and therefore It is anticipated that the area will no longer be suitable for sea turtles in the near future due to the impact of climate change on the coastline, particularly the disappearance of coastal sand deposits.

Sea turtle protection programs and NGOs activities has got success in population sensitize and a corresponding consolidation of a sea turtle monitoring program and scientific researches in the island. Consequences are the increasing population in STP of some species like the *Chelonia mydas* and the *Lepidochelys olivacea*. Causes of major disturbance in nestings beaches in São Tomé are the illegal extraction of sand, water pollution, touristic facilities and increase in artificial lighting.

The project : Coastal Protection and Reconstruction of the Marginal Protection Road, will contribute to improve the road network and the tourist development of the island and consists of the design of coastal protection elements, landscaping and reconstruction of the Marginal Road from the airport of São Tomé (TMS) until 1 km south of the Pirata Bar to the south of Pestana Hotel (9 km approximate total length). The design scope comprises three civil engineering chapters, Road Rehabilitation, Coastal Protection and Landscaping. Coastal protection actions include beach nourishments at some sandy beaches section along the project, particularly at the Lagarto Bay section.

Based on the above, Environmental Impact Assessment exercise considers preparing an independent report on Sea Turtles under the Project and attached to the main EIA report. The report follows the EIB's Standard 3: "Biodiversity and Ecosystems" and the Guidance note prepared for.

2 INTERNATIONAL TREATIES AND CONVENTIONS

International conventions protecting sea turtles signed by São Tomé and Príncipe

- Convention on Biological Diversity (CBD ratified by STP in 1999;
- Convention on International Trade in Endangered Species (CITES) ratified by STP 2001;
- Convention on Migratory Species of Wild Animals (CMS) ratified by STP in 2001;
- Abidjan Convention (Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region) ratified by STP in 2002.

3 OBJECTIVE AND SCOPE

This report undertakes a critical assessment of the project site in relation to the concerned sea turtle species, in line with the applicable provisions in EIB Standard 3 on Biodiversity and Ecosystems.

The report tries to determine the impact of the project on the nesting resources for sea turtle species and the severity of the direct impact on nesting beach resources and to the turtle population of STP due to project implementation.

The report also proposes mitigative and adaptive measures that can be implemented to avoid and minimize the identified impacts.

4 SPECIES OF CONCERN

Based on the report Sea Turtles in the West Africa/East Atlantic Region (MTSG Regional Report 2020. Report of the IUCN-SSC Marine Turtle Specialist Group, 2020) the following four species nest in São Tomé e Príncipe,

- *Chelonia mydas*
- *Lepidochelys olivacea*
- *Eretmochelys imbricata*
- *Dermochelys coriacea*

According to the above said report, *Chelonia mydas* and *Lepidochelys olivacea* are the most common species in the country, followed by a small but regionally significant nesting population of the critically endangered *Eretmochelys imbricata* nesting population and of the vulnerable *Dermochelys coriacea*.

Although *Caretta caretta* have been occasionally reported in coastal waters, there are no confirmed nesting occurrences in São Tomé.

Next section summarizes the available information and data on the species of concern. Main sea turtle data from IUCN assessment reports and its supplementary information.

A summary for the turtle species status is given below:

Common name	Scientific name	IUCN Red List Statute	Protection Status STP
Green Turtle	*Chelonia mydas*	Endangered	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered	Critically Endangered
Leather Back turtle	*Dermochelys coriacea*	*Vulnerable* (* Least Concern)	*Vulnerable*
Olive Ridley Turtle	*Lepidochelys olivacea*	Vulnerable	Vulnerable
Loggerhead Turtle	*Caretta caretta*	Vulnerable	Vulnerable

(*) 2019 IUCN red list assessment update for Green turtle *Dermochelys coriacea*, South Atlantic subpopulation

Table 1 Sea turtles Protection Status

In summary *Eretmochelys imbricata* is the only sea turtle specie listed as Critically Endangered, followed by one specie listed as Endangered and three species are listed as vulnerable, and according to the IUCN the global population trend for Dermochelys olivacea might no longer meet thresholds for IUCN Threatened categories (i.e., Vulnerable, Endangered, Critically Endangered)

The following sections describe marine turtle species, main nesting data and other relevant information.

5 GREEN TURTLE (*CHELONIA MYDAS*)

5.1. HABITAT AND ECOLOGY

The ecology and habitat of Green Turtles have recently been reviewed by Seminoff *et al*. (2015), where life history traits for regional populations are also presented where available. The typical life cycle for this species is similar to other species of marine turtle; females lay multiple clutches (~100 eggs/clutch) in a breeding year; eggs incubate for 6–8 weeks and sex of offspring is determined by incubation temperature, with most studies recording female biased offspring sex ratios (Seminoff *et al*. 2015). Upon hatching, offspring leave the nesting beach and spend the first few years in the pelagic zone where they are thought to associate with ocean currents before recruiting to coastal habitats where they adopt an herbivorous diet and mature. Green Turtles are migratory as adults, moving between nesting and foraging sites every 2–4 years to breed and showing high site fidelity and natal philopatry. Green Turtles are long-lived, inhabit vast areas of the ocean and nest on beaches often remote and geographically scattered, which makes data collection a challenging and expensive undertaking. As a result, there is a paucity of data on life history traits such as longevity and ageing, confounded by issues such as tag loss. Data from long term monitoring sites (e.g. French Frigate Shoals, Hawaii and Heron Island, Australia) are now providing valuable new insights into the life history of Green Turtles (see below).

5.2. RANGE DESCRIPTION

The Green Turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Mediterranean Sea; Pacific Ocean – eastern central, northwest, southwest, western central). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

5.3. POPULATION AND SUBPOPULATION

In West Africa, notable rookeries are also found on other islands of the Bijagos Archipelago in Guinea Bissau (Ferreira 2012, IBAP 2016), and in the Gulf of Guinea, in the islands of Bioko, (Equatorial Guinea, Honarvar *et al.* 2016), São Tomé and Príncipe (ATM 2013, ATM/MARAPA 2016).

From the rookeries for which we had ≥10 years of data we estimated that a minimum of 77,000 nests are laid each year. Data for other sizeable rookeries (>100 nests per year in this region) for which we were unable to assess trends indicate that at least an additional 7,000 nests are laid in this region each year.

São Tomé and Príncipe Nesting Grounds

The green sea turtle is the most common species in the archipelago of São Tomé and Príncipe. Its nesting has been confirmed in virtually all sandy beaches of both islands, ranging in São Tome from 49 to 1 177 nests per year and in Príncipe 287 to 2050 from 2014 to 2020. Data collected since 2014, confirms what was observed in the initial surveys done in the 90s, green turtles in São Tomé nest mainly in the south, with Praia Jalé being the preferred beach (70% of the total nests of the species) followed by Praia Grande, both in Porto Alegre district. This area is characterized by high rainfalls, high vegetation cover, beaches with steeper slopes and high wave exposure. In Príncipe, green turtles nest mainly in Praia Grande do Norte in the north area of the island. Based on the records made on the last years, green turtle nesting occurs from July to May, with a nesting peak in December and January (Ferreira-Airaud et al. 2022).

Hancock et al. (2019) studied the inter-nesting behaviour of Green Turtles in STP having determined an average inter-nesting period of 12.3 days, similar to other observations of this type of behaviour in the Atlantic, Indian and Pacific.

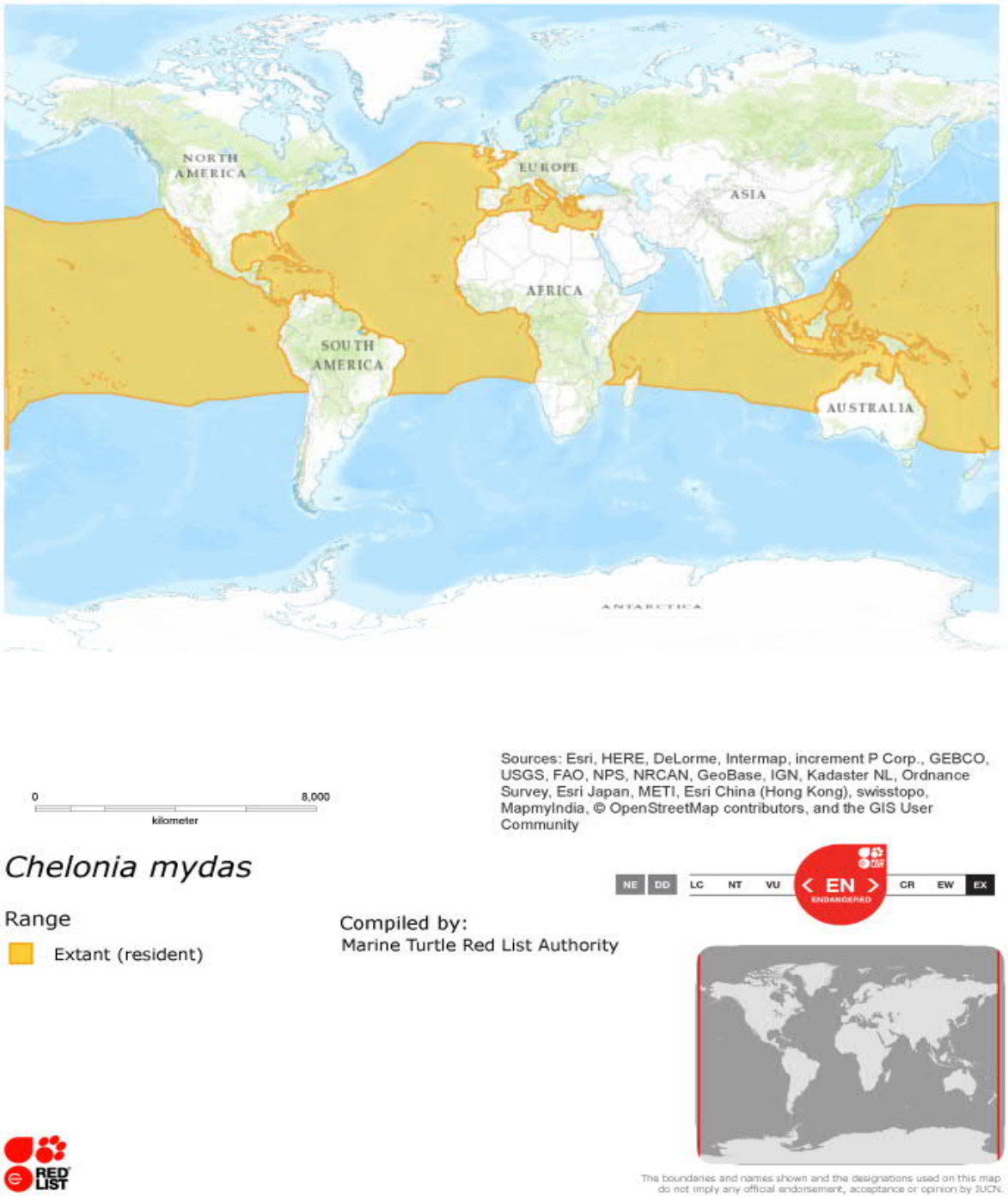

Figure 1*Chelonia mydas* Distribution map

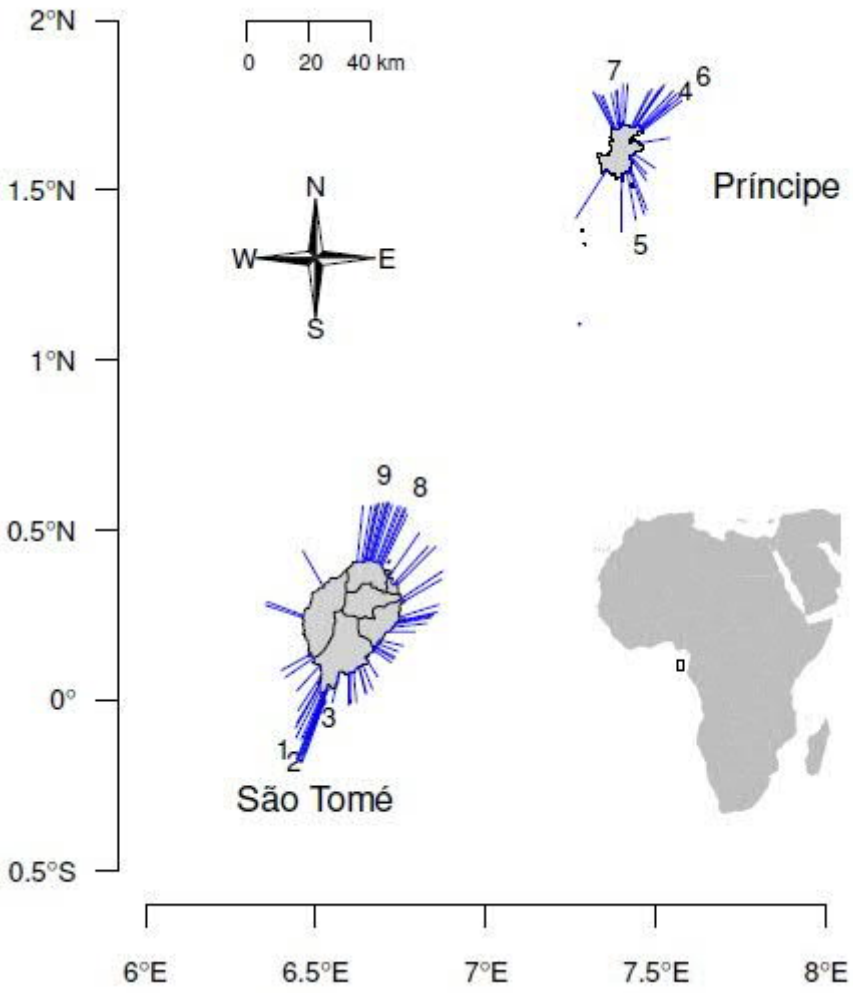

Figure 2 Beaches used by Green Turtles and Olive Ridley Turtles in STP for nesting. Source: Hancock et al., 2019

6 LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*)

6.1. HABITAT AND ECOLOGY

D. coriacea is an oceanic, deep-diving marine turtle inhabiting tropical, subtropical, and subpolar seas. Leatherbacks make extensive migrations between different feeding areas at different seasons, and to and from nesting areas. Leatherbacks feed predominantly on jellyfishes, salps and siphonophores. Females usually produce several (3-10) clutches of 60-90 eggs in a reproductive season, and typically have a re-migration interval of multiple years (2+) between subsequent reproductive seasons.

6.2. RANGE DESCRIPTION

Leatherbacks are distributed circumglobally, with nesting sites on tropical sandy beaches and foraging ranges that extend into temperate and sub-polar latitudes.

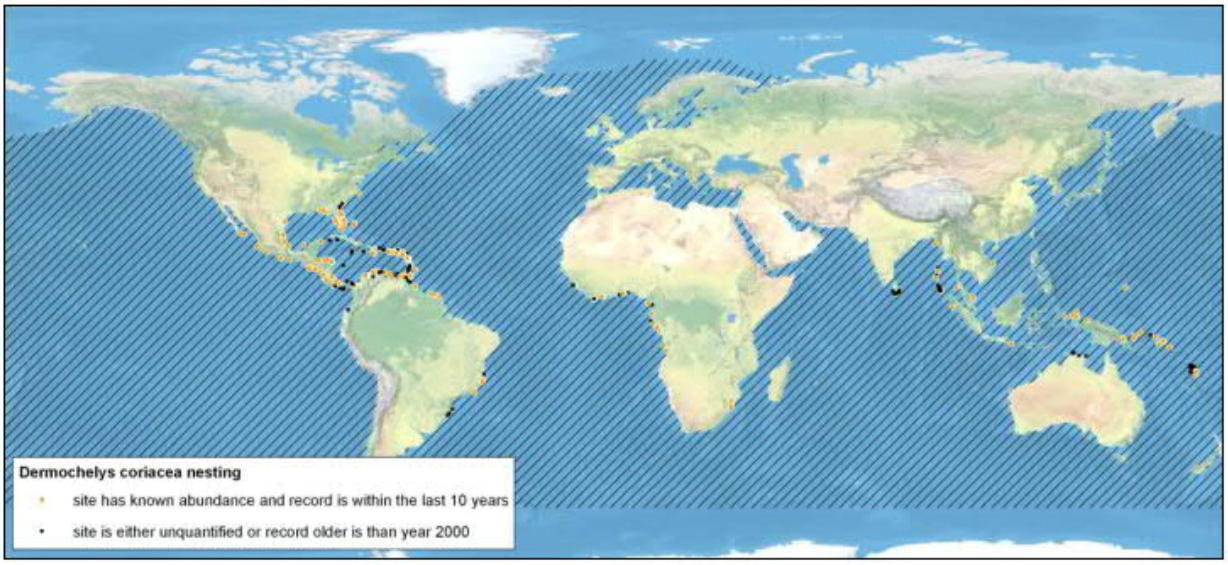

Figure 1. Global distribution and nesting sites for the Leatherback Turtle.

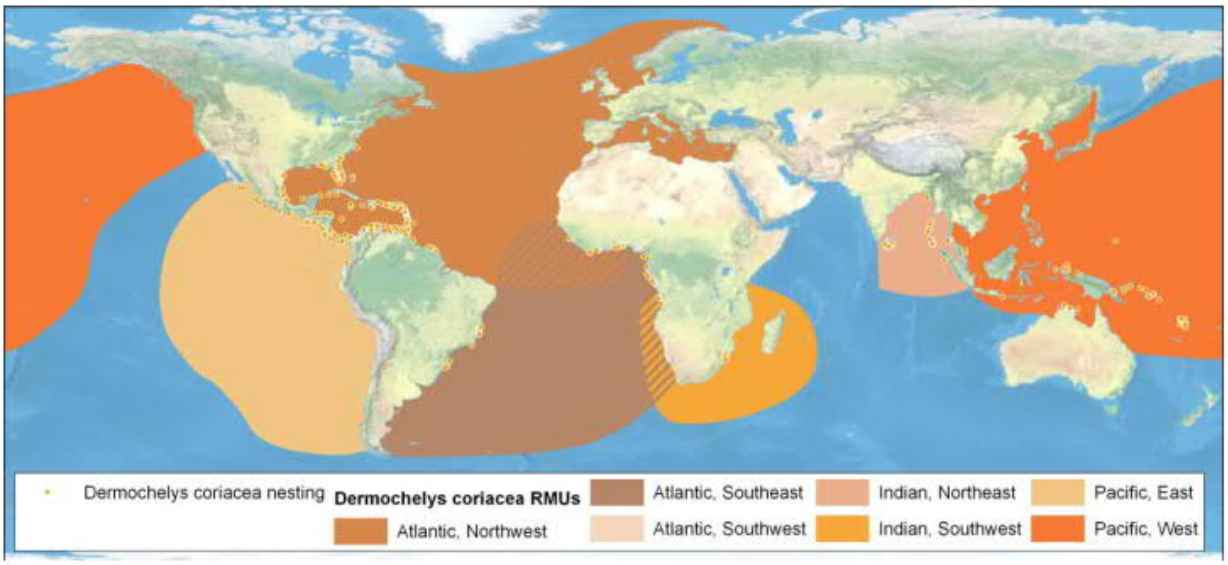

Figure 2. Global map of the seven subpopulations (RMUs) of Leatherbacks and their nesting sites.

Figure 3 Distribution map and nesting sites for Dermochelys olivacea. Global map of the seven subpopulations.

6.3. POPULATION

The global population of Leatherback turtles (*Dermochelys coriacea*) comprises seven subpopulations (see Figure above) that vary widely in population size, geographic range, and population trends, and are the appropriate units for assessment of global conservation status for this species (Wallace *et al*. 2010, 2011).

Due to this species' geographically widespread distribution, Criterion A was the only appropriate criterion for assessment that could be applied to the global Leatherback population.

Assessment of the data under Criterion A4—past, present, and future abundance—revealed that the global Leatherback population trends over three generations will no longer meet thresholds for threat categories by 2020 (-29.4%), and will be increasing by 2030 (3%) and beyond (104% by 2040). Therefore, within the next ten years, the global Leatherback population might no longer qualify as "Threatened"—i.e. a category listing of Vulnerable, Endangered, or Critically Endangered—according to the IUCN Red List Criteria.

The Southeast Atlantic subpopulation—i.e. West Africa, especially Gabon—is the largest in the world (Witt *et al*. 2009), but long-term trend data are not available for this assessment (TEWG 2007). The existence of these large (and increasing in at least one case) subpopulations makes it extremely unlikely that Leatherbacks globally will go extinct in the near future.

If current trends continue, future global population sizes are projected to increase to 184,662 nests yr^{-1} (approximately 26,380-36,932 females yr^{-1}, 79,141-110,797 adult females total) within one generation (i.e. by 2040). The projected abundance of the Northwest Atlantic subpopulation alone will account for nearly 99% of the global Leatherback population abundance by that time (Figure 3 and Table 3 in Supplementary Material), and increase from 46% of historical global population abundance three generations ago.

According to our assessment of the data under Criterion A4, it would no longer qualify as "Threatened" according to IUCN Red List Criteria by 2020 (three-generation decline of 29.4%), and would qualify as Least Concern by 2030 (3% increase) under IUCN Guidelines (IUCN 2011)

IUCN reports gives no data for São Tomé, Majority of abundance of this Southeast subpopulation occurs in Gabon for which trend data are unavailable.

Leatherback turtles are considered widespread in West Africa and their breeding grounds range from Mauritania to Angola (Fretey, 2001; Billes et al., 2006). The island of Bioko is considered the second most important nesting area after Gabon for leatherback turtles (Tomas et al., 2010). In most leatherback turtle populations, females cover extensive areas between nesting events, although they usually remain within the continental shelf (Georges et al., 2007). Furthermore, Eckert (2006) having studied the movements and behaviour of female leatherback sea turtles up to one year after leaving their nesting beaches, determined that female leatherback turtles spend most of their time directly on nesting beaches and up to 30 km offshore during the inter-nesting period.

SãoTomé and Príncipe Nesting Grounds

One of the major nesting grounds for leatherbacks are located in Gabon, around 300 km away from São Tomé and Príncipe, with as many as 36 185 to 126 480 nests, approximating to 5 865 to 20 499 breeding females per annum (Witt et al. 2009). In São Tomé and Príncipe, the leatherback is the less abundant species, ranging from 15 to 155 nests per year in São Tomé and 3 to 44 nests per year in Príncipe, from 2014 to 2020, nesting from September to March, with a nesting peak in December. Although this species has a more heterogeneous distribution, there is a certain preference for the beaches in the south of São Tomé and in the north of Príncipe Island (Ferreira-Airaud et al. 2022).

7 OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*)

7.1. HABITAT AND ECOLOGY

Like most other sea turtles, Olive Ridleys display a complex life cycle, which requires a range of geographically separated localities and multiple habitats (Márquez 1990). Females lay their nests on coastal sandy beaches from which neonates emerge and enter the marine environment to continue their development. They remain in a pelagic phase, drifting passively with major currents that disperse far from their natal sites, with juveniles sharing some of the adults' habitats (Kopitsky *et al*. 2000) until sexual maturity is reached (Musick and Limpus 1997). Reproductively active males and females migrate toward coastal zones and concentrate near nesting beaches.

However, some males appear to remain in oceanic waters and mate with females en route to their nesting beaches (Plotkin *et al*. 1996, Kopitsky *et al*. 2000). Their post-breeding migrations are complex, with pathways varying annually (Plotkin 1994) and with no apparent migratory corridors, swimming hundreds or thousands of kilometers over large ocean expanses (Morreale *et al*. 2007), commonly within the 20°C isotherms (Márquez 1990). In the East Pacific, they are present from 30°N to 15°S and often seen within 1,200 nautical miles from shore although they have been sighted as far as 140°W (IATTC 2004). Western Atlantic Olive Ridleys appear to remain in neritic waters after breeding (Pritchard 1976, Reichart 1993).

7.2. RANGE DESCRIPTION

The Olive Ridley sea turtle has a circumtropical distribution, with nesting occurring throughout tropical waters (except the Gulf of Mexico) and migratory circuits in tropical and some subtropical areas (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Pacific Ocean – eastern central, northwest, southwest, western central) (Pritchard 1969). Nesting occurs in nearly 60 countries worldwide. Migratory movements are less well studied than other marine turtle species but are known to involve coastal waters of over 80 countries. With very few exceptions they are not known to move between ocean basins or to cross from one ocean border to the other. Within a region, Olive Ridleys may move between the oceanic and neritic zones (Plotkin *et al.* 1995, Shanker *et al*. 2003) or just occupy neritic waters (Pritchard 1976, Reichart 1993).

Ridley's olive ridley turtles nest in virtually all countries along the west coast of Africa from Guinea-Bissau to Angola (Billes et al., 2006).

Dawson (2017) monitored the inter-nesting movements of 21 olive ridley sea turtles from Pongara National Park, one of the largest nesting beaches in Gabon, over three nesting seasons (2012, 2013 and 2015). Telemetry tracks indicated that tagged females remained in close proximity to the nesting beach (<20 km), and spent most of their time within the Komo estuary; with some of the females have remained in the area for over a month before switching to the transit phase and moving south, likely to known foraging areas off the coast of Angola. Similar results were obtained by Maxwell et al. (2011).

The olive ridley turtle is the second most numerous species on São Tomé Island, although its distribution is less wide than that of the green turtle; furthermore, it has been observed that this species only nests on São Tomé and does not do so on Príncipe Island (Hancock et al. 2019).

The fishermen know it as the "lazy turtle" because they are easily caught when they go to the beach to lay their eggs. For this reason, the protection of this species is a priority for the conservation of natural resources in the archipelago. A study conducted by Carvalho (2008) for the NGO MARAPA, reported that the local population captures this species of turtle due to the scarcity of other types of meat food resources.

Hancock et al. (2015) indicated that for Ridley's Olive Ridley Turtle the nesting season generally begins in August and extends into February each year, with a peak in December and January.

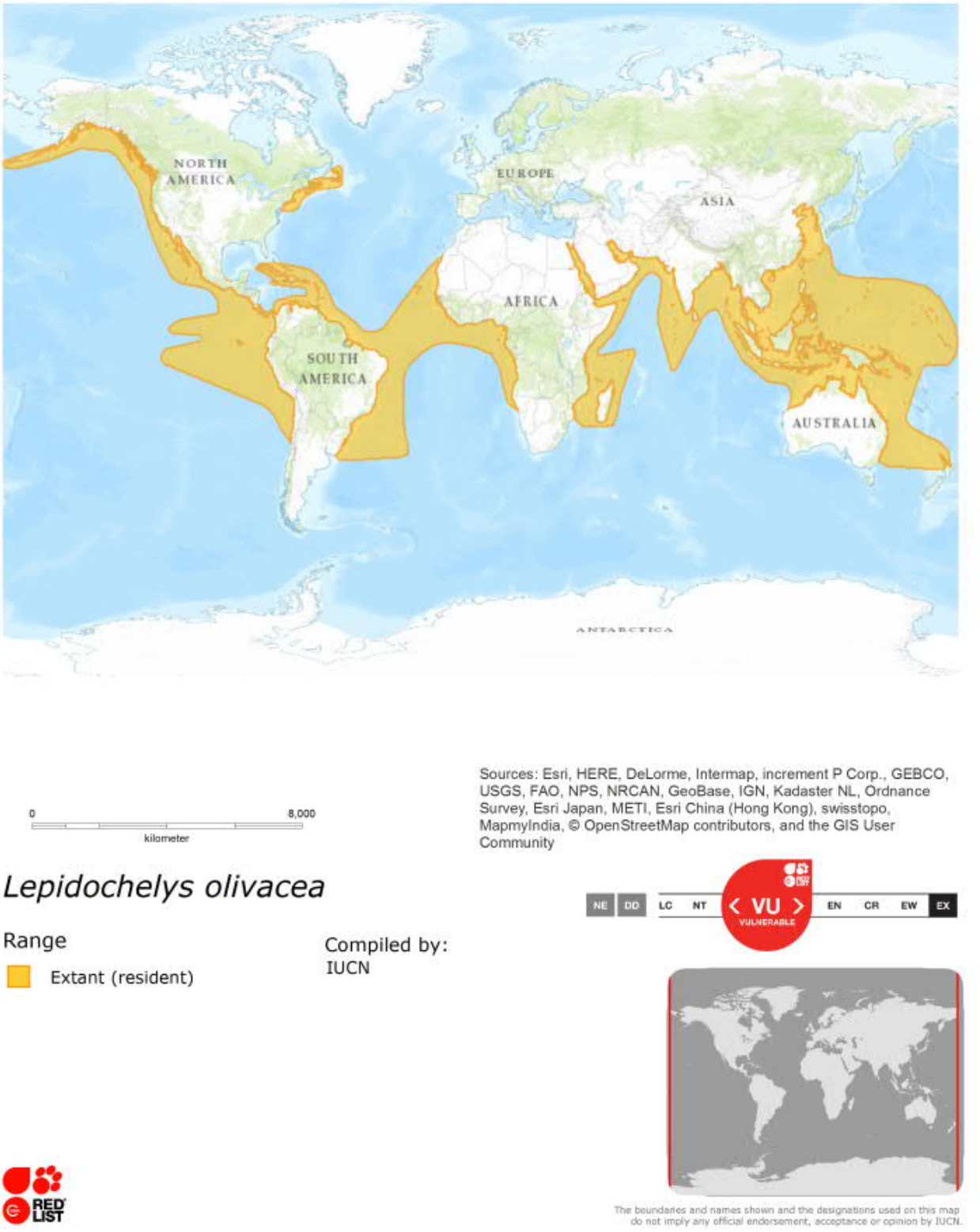

Figure 4 *Lepidochelys olivacea* Distribution map

7.1. POPULATION

In spite of the Olive Ridley being the most abundant sea turtle, available quantitative information is extremely scarce and unevenly distributed across regions. In spite of scarcity in historical data, information from diverse sources has made it possible to evaluate a global decline for this widely distributed species over time periods ranging from decades to 2-3 generations. Striking regional differences are observed in the estimations that undoubtedly indicate far lower survival probabilities in some of the regions than what the global results would suggest.

Data from IUCN report estimates present annual nesting female global population in 941.309.

Supplementary information report (IUCN) shows decline of -31% to -36 % of population in the past years. No data for São Tomé and Príncipe are available in these reports.

São Tomé and Príncipe Nesting Grounds

Major nesting grounds of Olive Ridleys in West Africa are located in Angola and Gabon (Metcalfe et al. 2015; Morais and Tiwari, in press). Nevertheless, this is the second most numerous species in São Tomé ranging from 326 to 683 nests per year between 2014 and 2020 (our data). In Príncipe only two nesting observations were recorded in 2012 and 2018 on Praia Macaco and Praia Grande do Norte, respectively. This species nests year-round (except June) with a nesting peak in November and December. Olive Ridleys seem to prefer the northern area of São Tomé from Juventude to Conchas, adjacent to the fishing communities of Micoló, Fern o Dias, and Morro Peixe, where 90% of the nesting occurs. This area is characterized by lower rainfall, gentle sloping beaches, an extensive shallow shelf and low wave exposure shores. The northern part of São Tomé is also notable for the presence of seagrass meadows, an ecologically valuable marine habitat and feeding grounds for the green turtle (Ferreira-Airaud et al. 2022).

8 HAWKSBILL SEA TURTLES (*ERETMOCHELYS IMBRICATA*)

8.1. HABITAT AND ECOLOGY

Hawksbills nest on insular and mainland sandy beaches throughout the tropics and subtropics. They are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (for review see Witzell 1983).

Available data indicate that newly emerged hatchlings enter the sea and are carried by offshore currents into major gyre systems where they remain until reaching a carapace length of some 20 to 30 cm. At that point they recruit into a neritic developmental foraging habitat that may comprise coral reefs or other hard bottom habitats, sea grass, algal beds, or mangrove bays and creeks (Musick and Limpus 1997) or mud flats (R. von Brandis unpubl. data). As they increase in size, immature Hawksbills typically inhabit a series of developmental habitats, with some tendency for larger turtles to inhabit deeper sites (van Dam and Diez 1997, Bowen et al. 2007). Once sexually mature, they undertake breeding migrations between foraging grounds and breeding areas at intervals of several years (Witzell 1983, Dobbs *et al*. 1999, Mortimer and Bresson 1999).

Global population genetic studies have demonstrated the tendency of female sea turtles to return to breed at their natal rookery (Bowen and Karl 1997), even though as juveniles they may have foraged at developmental habitats located hundreds or thousands of kilometers from the natal beach. While Hawksbills undertake long migrations, some portion of immature animals may settle into foraging habitats near their beaches of origin (Bowen *et al*. 2007).

8.2. RANGE DESCRIPTION

The Hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. Hawksbills are migratory and individuals undertake complex movements through geographically disparate habitats during their lifetimes. Hawksbill nesting occurs in at least 70 countries, although much of it now only at low densities. Their movements within the marine environment are less understood, but Hawksbills are believed to inhabit coastal waters in more than 108 countries (Groombridge and Luxmoore 1989, Baillie and Groombridge 1996; see Regional Overviews in Supplementary Material).

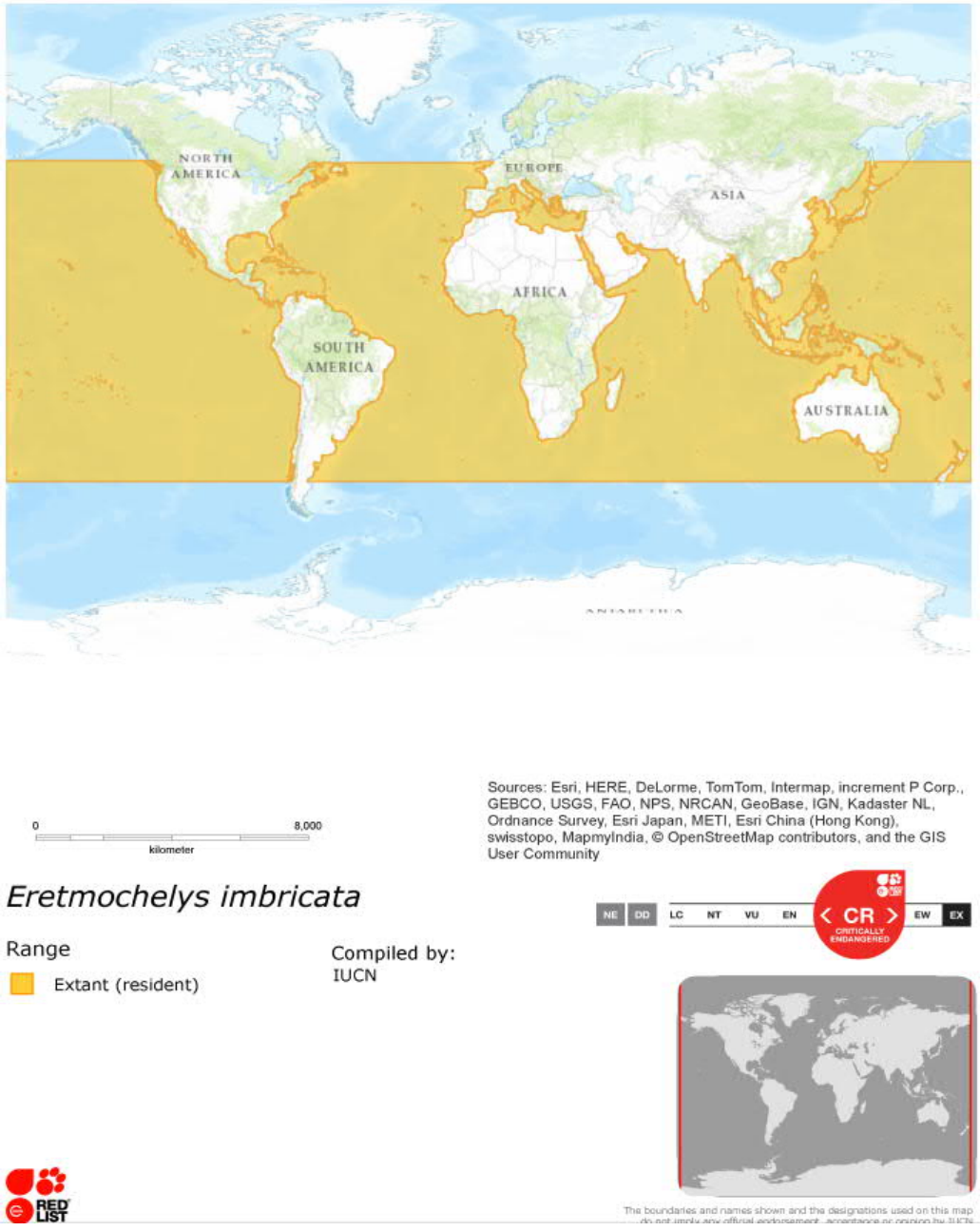

Figure 5. Eretmochelys imbricate distribution map

8.3. POPULATION

Subpopulation declines in all major ocean basins over the last three Hawksbill generations as a result of over-exploitation of adult females and eggs at nesting beaches, degradation of nesting habitats, take of juveniles and adults in foraging areas, incidental mortality relating to marine fisheries, and degradation of marine habitats. Analyses of subpopulation changes at 25 Index Sites distributed globally (show an 84 to 87% decline in number of mature females nesting annually over the last 3 Hawksbill generations. Numerous populations, especially some of the larger ones, have continued to decline since the last assessment of the species (Meylan and Donnelly 1999). Today, some protected populations are stable or increasing, but the overall decline of the species, when considered within the context of three generations, has been in excess of 80%.

Significant increases in nesting populations during the past two decades have been recorded at a number of nesting localities, particularly in the Atlantic Ocean at the following Index Sites: Antigua (Jumby Bay), Barbados, Cuba (Doce Leguas Cays), Mexico (Yucatan Peninsula), Puerto Rico (Mona Island), and US Virgin Islands (Buck Island Reef National Monument). The observed population increases correlate with implementation of protective measures at these nesting sites in combination with decreased exploitation at neighbouring foraging grounds (especially in Cuba). However, most of these now-increasing populations were not monitored prior to implementation of protective measures (the presence of researchers on the beach is often a significant element of the actual protection afforded such sites).

Analysis of historic and recent published and unpublished accounts indicate extensive subpopulation declines in all major ocean basins over the last three Hawksbill generations as a result of over-exploitation of adult females and eggs at nesting beaches, degradation of nesting habitats, take of juveniles and adults in foraging areas, incidental mortality relating to marine fisheries, and degradation of marine habitats. Analyses of subpopulation changes at 25 Index Sites distributed globally show an 84 to 87% decline in number of mature females nesting annually over the last 3 Hawksbill generations . Numerous populations, especially some of the larger ones, have continued to decline since the last assessment of the species (Meylan and Donnelly 1999). Today, some protected populations are stable or increasing, but the overall decline of the species, when considered within the context of three generations, has been in excess of 80%.

Eastern Atlantic

Sea turtles in the Eastern Atlantic have received little attention until recently. In the last several decades Hawksbills have been sighted or captured along the entire seaboard of the Eastern Atlantic from Western Sahara into the waters of Namibia. Nesting has been confirmed in some but not all of these countries (Brongersma 1982, Groombridge and Luxmoore 1989, Fretey *et al*. 2002). Today, Hawksbills are known to forage and nest in two areas, from Mauritania to west of the Ivory Coast, including Cape Verde, and in the Gulf of Guinea (Fretey *et al*. 2002).

São Tomé and Príncipe Nesting Grounds

Fewer than 100 Hawksbills now nest in all of West and Central Africa each year, with the best nesting on Bioko Island (Equatorial Guinea) and the islands of São Tomé and Príncipe. Nesting is sporadic in other countries (Fretey 1998, Fretey *et al*. 2002), and historical accounts are limited, but Hawksbills may have nested in numerous places along the coast in the years before and after 1900 (Brongersma 1982, Groombridge and Luxmoore 1989)

STP is considered an important nesting site for hawksbill sea turtles, although this species has also been recorded as a nesting along the coast of Central Africa, with its southern boundary being the Congo (Billes et al., 2006).

The largest populations of hawksbill turtles are thought to nest on the STP islands, as well as an important year-round population of juveniles, sub-adults and adult male foragers (Monzón-Argüello et al., 2011). In particular, it has been assessed that, on average, 152 comb turtle nests are installed per year on the beaches of STP, with a particular focus on the eastern side of the islands (Girard et al., 2016). Adult females are only considered to be present in this aggregate during the breeding season (November to February) (Monzón-Argüello et al., 2011).

The hawksbill sea turtle is the most threatened population in São Tomé and Príncipe and nowadays its distribution is less wide due to the indiscriminately harvested for its meat and shell during the past years. Currently, the number of nests appear to be increasing slightly, ranging from 13 to 246 per year in São Tomé and 43 to 118 per year in Príncipe, from 2014 to 2020.

Most of its nesting in São Tomé occurs on Rolas Islet, south of São Tomé, where 60% of the total nests of the species occurs, demonstrating the importance of this islet as a priority site for the conservation of this critically endangered species. In Príncipe, the preferred beaches are Praia Infante in the south and Praia Grande do Norte, in the north. Hawksbill nesting occurs from August to April, with a nesting peak in December and January.Like green turtles, hawksbills seem to prefer beaches characterized by high vegetation cover, steeper slopes and high wave exposure and areas with high rainfall levels (Ferreira-Airaud et al. 2022).

Hancock gives a distribution map of the surveyed sites of São Tomé island where all species have reproductive activity and was monitored and therefore identified.

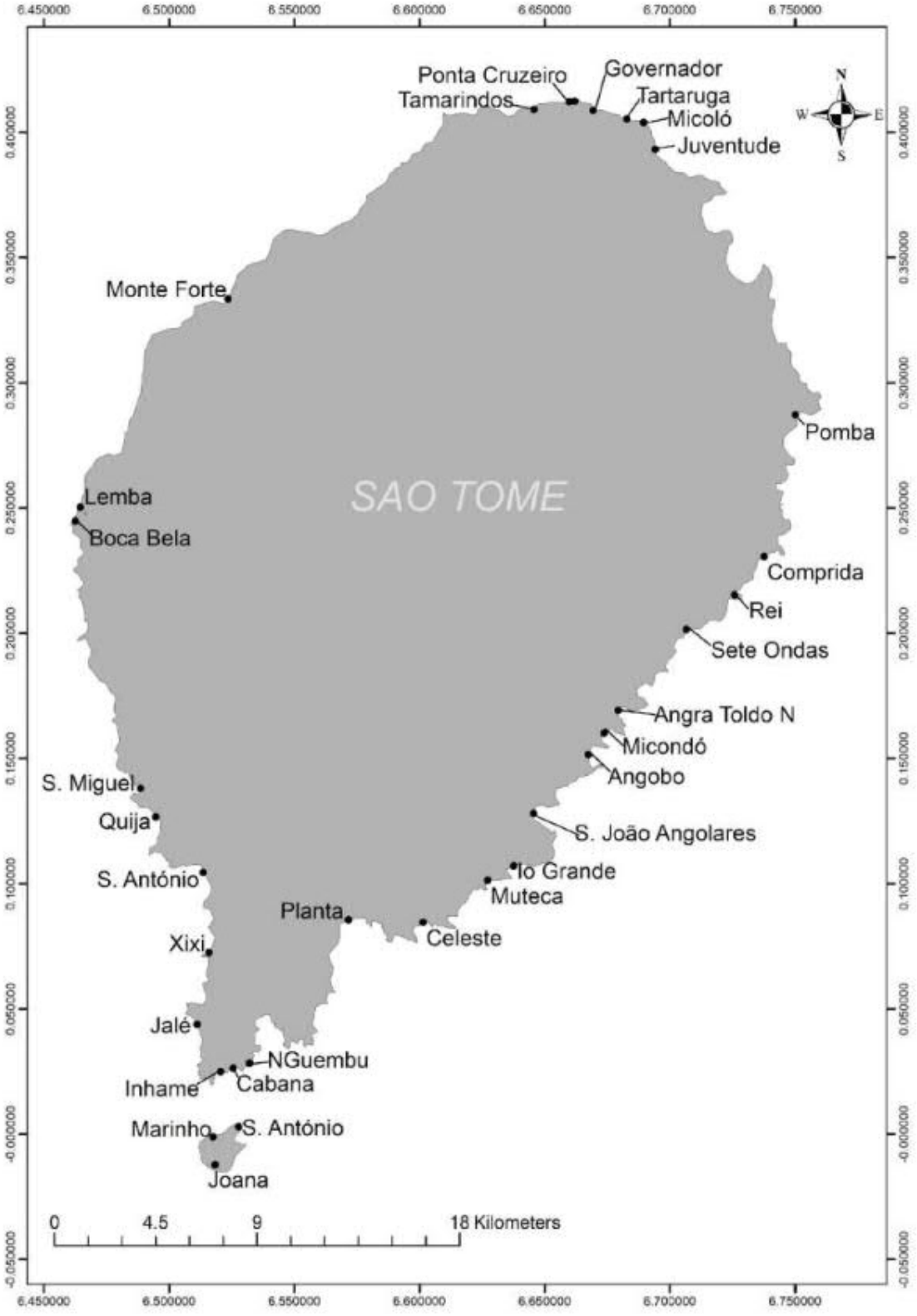

Figure 6 Map of São Tomé island, and location of the beaches where monitoring was conducted during 2015-2016 and 2016-2017 seasons by Programa Tatô. J.Hancock M. 2019

According to Hancock, nesting activity of Eretmochelys is highly concentrated on the southern shore of São Tomé island, with only 19 % occurring between the northernmost beaches of Lembá on Micoló. Príncipe, nesting is more diffused, with most activity recorded in both north and southern beaches, (figure below).

Analysis of temporal distribution of nesting seasons shows that it starts at the end of October and extents to late March with nest activity picking between late December and early January.

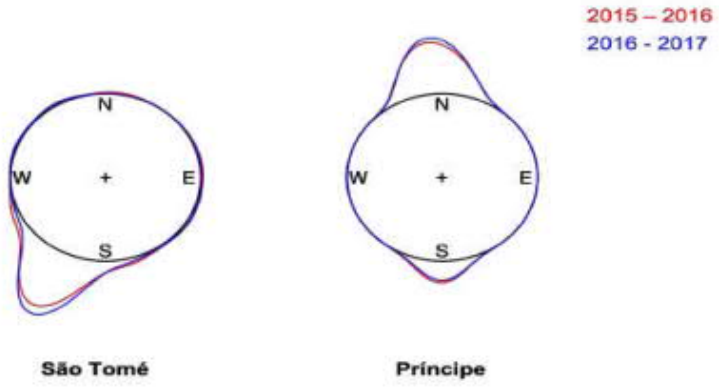

Figure 7 Distribution patterns of Eretmochelys in São Tomé and Príncipe islands. Hancock 20129, Showing clear preferences for the southern shores in Saò Tomé island.

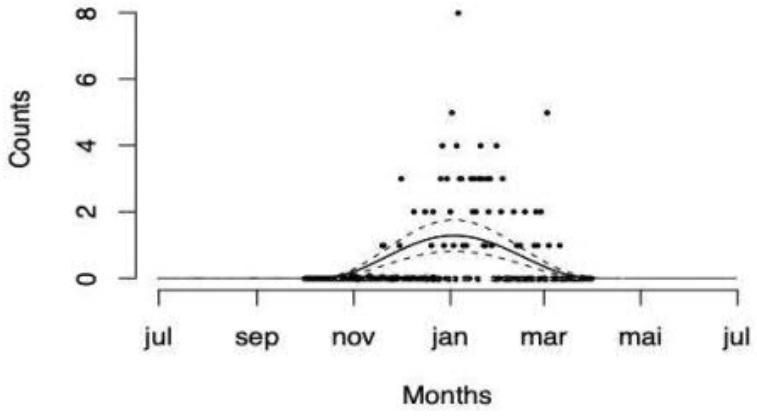

Figure 8 Eretmochelys temporal nesting distribution in Joana beach, Rolas islet STP. Hancock 2019

9 LOGGERHEAD TURTLE (*CARETTA CARETTA*)

9.1. HABITAT AND ECOLOGY

The Loggerhead Turtle nests on insular and mainland sandy beaches throughout the temperate and subtropical regions worldwide. Like most sea turtles, Loggerhead Turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Bolten and Witherington 2003). Upon leaving the nesting beach, hatchlings begin an oceanic phase in major current systems (gyres) that serve as open-ocean developmental grounds (Bolten and Witherington 2003, Putman and Mansfield 2015). After 4-19 years in the oceanic zone, Loggerheads recruit to neritic developmental areas rich in benthic prey or epipelagic prey where they forage and grow until maturity at 10–39 years (Avens and Snover 2013). Upon attaining sexual maturity Loggerhead Turtles undertake breeding migrations between foraging grounds and nesting areas at remigration intervals of one to several years with a mean of 2.5–3 years for females (Schroeder et al. 2003) while males would

have a shorter remigration interval (e.g., Hays et al. 2010, Wibbels et al. 1990). Migrations are carried out by both males and females and may traverse oceanic zones spanning hundreds to thousands of kilometres (Plotkin 2003). During non-breeding periods adults reside at coastal neritic feeding areas that sometimes coincide with juvenile developmental habitats (Bolten and Witherington 2003)

9.2 RANGE DESCRIPTION

The Loggerhead Turtle is globally distributed throughout the subtropical and temperate regions of the Mediterranean Sea and Pacific, Indian, and Atlantic Oceans (Wallace et al. 2010) (see following Figure).

9.1. POPULATION

Loggerheads are a single species globally comprising 10 biologically described regional management units (RMUs; Wallace et al. 2010) – hereafter subpopulations - which describe biologically and geographically explicit population segments by integrating information from nesting sites, mitochondrial and nuclear DNA studies, movements and habitat use by all life stages..

Loggerhead turtles are predominantly found in the northern part of the Gulf of Guinea region and only appear sporadically south of the Cape Verde Islands. Loggerhead turtle mating has been observed in São Tomé waters and incidental capture has also been reported on several occasions (Billes et al., 2006). Fishermen describe the loggerhead turtle as "rare" and are not of the opinion that it nests in São Tomé (Graff, 1996). Juveniles of this species have also been observed in STP waters and in Gabon, Cameroon and Congo (Fretey, 2001). However, according to the Sea Turtle Conservancy (2015), the loggerhead turtle does not nest on equatorial beaches, preferring more subtropical and temperate regions for its reproductive stages.

Historically in São Tomé and Príncipe there have been only a couple of observations of loggerhead nesting in São Tomé, but there are no evidences that this species has ever nested frequently in São Tomé and Príncipe (Fretey 2001).

Since 2014, there was only one single nesting event registered in São Tomé in January 2017 in Praia Inhame in the south of the island (Porto Alegre district). Besides these isolated events loggerhead turtles are only sporadically observed at sea (Ferreira-Airaud et al. 2022).

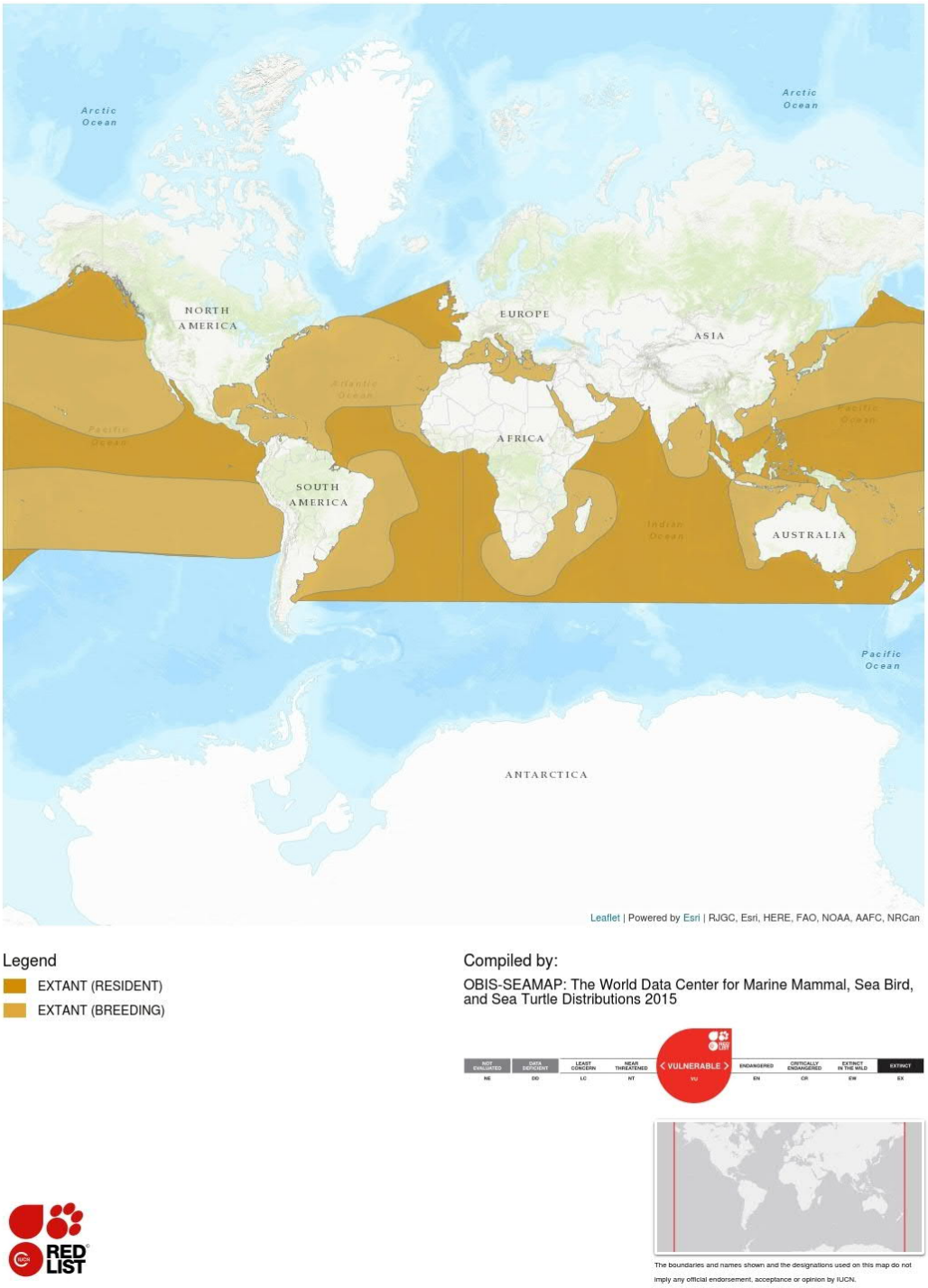

Figure 9 *Caretta caretta* distribution map

10 SEA TURTLE NESTING IN STUDY AREA

Some stretches of shores in the project's area of influence presents conditions for the occurrence of sea turtle nesting species.

In an interview with Programa Tatô, the NGO responsible for the conservation of sea turtles in São Tomé, it was reported that four species of sea turtles are observed in the study area: (*Chelonia myda* – Green Turtle; *Lepidochelys olivacea* – Olive ridley *Eretmochelys imbricata* – Hawksbill e *Dermochelys coriacea* – Leatherback). All of them use the beaches in the area of study for nesting. The graph below shows the nesting frequency on the sea turtle nesting beaches located in the direct influence area in the last 5 years.

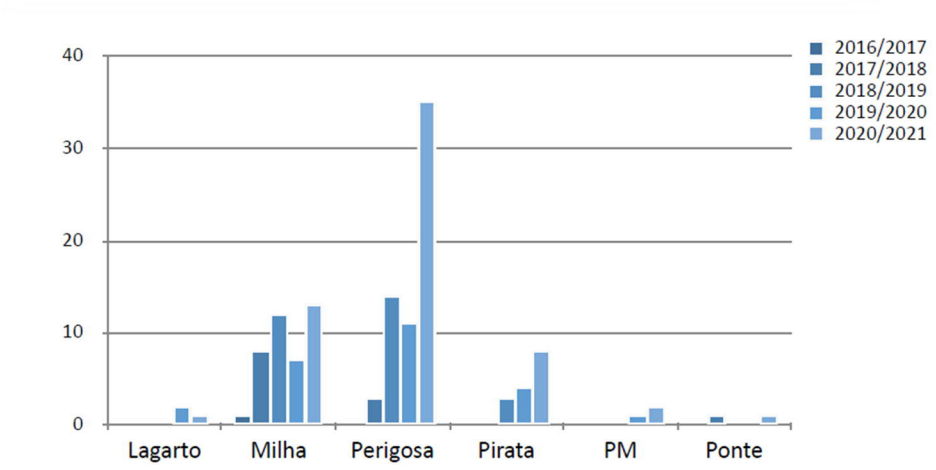

Figure 10 Nesting records of *Chelonia mydas*; *Lepidochelys olivacea*; *Eretmochelys imbricata* and *Dermochelys coriacea* in the area of direct influence in the last 5 years. Source Programa Tatô, 2021

According to these records, the year 2021 was the year in which it was reported the largest number of nesting events on the beaches of the project area, with a total of 59 nests: 2 Leatherbacks, 5 Green Turtles, 9 Hawksbills, 33 Olive ridleys and 10 non identified nests. The beaches with the highest nesting occurrences in the nesting season of 2020/2021 were: Praia Perigosa with 35 nests, Praia Emilia (Milha) with 14 nests, Praia de São Gabriel Beach (Pirata) with 8 nests, Praia Museu (PM) with 2 nests and Praia Lagarto with 1 nests. The figures above show the same trend of , at some extent, increasing population of sea turtles in Saò Tomé island during the past years.

The high incidence of human activities on these beaches, and the strong presence of dogs on them, increase the disturbance of nesting females and the level of nests predation by the dogs. To mitigate those impacts, Environemntal authority and Programa Tatô monitors these areas frequently and all nests laid on those beaches, considered to be at risk due to poaching, predation or beach erosion, are immediately collected and relocated to the closest sea turtle hatchery located at Micoló.

The map below shows the location of these beaches in the area of direct influence.

Figure 11 The beaches with the occurrence of the nest in the project area

Pictures from Lagarto, Milha, Ponte, PM and Perigrosa are shown below

Praia Lagarto

Praia Milha

Praia Ponte

Praia P.M.

Praia Perigrosa

11 SEA TURTLE NESTING SEASON

Nesting seasons of sea turtle species in Sao Tomé depends on sea turtle specie. Following chart summarizes nesting seasons and sea turtles specialist reference.

Scientific name	IUCN Statute	January	February	March	April	May	June	July	August	September	October	November	December	References
Chelonia mydas	E	■	▒	▒	▒	▒		▒	▒	▒	▒	▒	■	July to May, with a nesting peak in December and January (Ferreira-Airaud et al. 2022).
Eretmochelys imbricata	CE	■	▒									▒	■	November to February (Monzón-Argüello et al., 2011).
		■	▒	▒	▒				▒	▒	▒	▒	■	From August to April, with a nesting peak in December and January. (Ferreira-Airaud et al. 2022
		■											■	Nesting peak occurs in December and January. (Hancock, et al. 2015)
Dermochelys coriacea	*Vu*	▒	▒	▒						▒	▒	▒	■	September to March, with a nesting peak in December. (Hancock et al 2015)
Lepidochelys olivacea	Vu	▒	▒	▒	▒	▒		▒	▒	▒	▒	■	■	Nests year-round (except June) with a nesting peak in November and December (Ferreira-Airaud et al. 2022).
		▒	▒						▒	▒	▒	▒	■	Begins in August and extends into February each year, with a peak in December and January. (Hancock et al. (2015)
Caretta caretta	Vu													No evidences that this species has ever nested frequently in São Tomé and Príncipe (Fretey 2001).

Table 2 Sea turtles Nesting seasons

For environmental protection measures to nesting behavior of sea turtles and for Project implementation viability a 7 months Sea turtle nesting protection period, from October to April, has been assumed in this report. This period includes the identified peak months (December and January) and gives a buffer of 2 pre-peak months and 3 three post-peak months.

This Sea turtle nesting protection period should be considered for Project work plan and implementation, considered that Project´s action that can disturb or impact on sea turtle females trying to or nesting in Project beach areas shall be avoided.

12 NGOS IN REGARDS OF SEA TURTLE

In 1998, ECOFAC the Program for the Biodiversity and Ecosystems Conservation of Central Africa, funded by European Union, created PROGRAMA TATÔ, with the purpose of protecting sea turtles. But later in 2002, ECOFAC passed on to MARAPA, a recent created local NGO, Programa Tatô's coordination. For years, MARAPA had the support of several national and international organizations. Over the years, Programa Tatô team has grown and the coordination team has been taking shape.

20 years later, in 2018, everything changed, Programa Tatô was no longer just a project. The coordination team together with Marapa and with the support and encouragement of its technical and financial partners decided to give more autonomy and sustainability to this program and created an international NGO, Programa Tatô, thus maintaining the name, already known by all communities, national authorities, civil society, as well as internationally.

The local NGOs have been reporting since a steady reduction in female harvesting by humans, largely as a result of continuous education efforts directed at members of the local communities that have produced greater environmental awareness. Efforts to create alternative activities, particularly for turtle sellers and tortoiseshell craftsman have been conducted by Programa Tatô in São Tomé (Vieira et al. 2017), which have been partially successful in reducing the offer of sea turtle products in the capital's market and souvenir stalls. The confirmation of Ilhéu das Rolas as the main nesting site for this species in the archipelago spells positive news as this islet is actively managed by a local resort fully engaged with sustainability practices, and in response to the high nest predation rate by pigs, implemented the use of a turtle hatchery. On the other hand, Príncipe island as a whole was declared as a Biosphere Reserve in 2012, which resulted in the reinforcement of sea turtle monitoring and protection through the implementation of Programa Têtuaga and its successful "Zero Capture" campaign, which initiated in 2016. Several conservation and research activities are currently taking place in both islands, and a new project aiming at establishing a network of Marine Protected Areas across the archipelago.

During elaboration of ESIA and fieldworks, environmental team contacted scientists involved in research on sea turtles in STP and Programa Tatô in regards of sea turtle. Programa Tatô is in STP the organization responsible for sea turtle conservation and monitoring have a large history, they have been engaged in several scientific researches and yearly monitoring of sea turtle nesting. Additionally, they carry out important awareness programs within the population.

13 PROJECT JUSTIFICATION

Because of its location, on a volcanic chain of islands, STP's population and economic activities are mainly located along the coastline, away from the steep inland slopes that comprise the rest of the islands. Tourism has been associated with these coastal areas and remains an important source of revenue for the national economy. These coastal roads and increased tourism activity along them exacerbate the damage done by coastal erosion and increase the economic costs from loss.

According to the Preliminary Environmental Impact Study CDR (2019), climate change in the study area has been leading to substantial erosion of the coastline and beaches throughout the island of São Tomé, with particular incidence on the bays located in the capital city.

The damages caused can be seen in the figure below and include:

- Dilapidation and disintegration of walls in Ana Chaves bay, and partially in Pantufo;
- Deterioration of pavements and collapsing of retaining walls;
- Beach erosion and consequent reduction of the fishermen's landing places;

- Occasional overtopping of the waves and resultant flooding of the marginal access roads.

Apart from climate change impacts, it is also important to consider that the local populations have been extracting considerable amounts of sand from the beaches of São Tomé city during years and the two coastal neighborhoods of Vila Maria and Bairro São João are home of many people that depend from illegal sand extraction on the beaches of Praia Perigosa and Lagarto Bay respectively even if illegal activity under national law.

Figure 12 Effects of sea level rise on São Tomé and Príncipe's marginal. Source: CDR, 2019
Legend: (a) overtopping in the northern part of Ana Chaves bay and flooded road b) destruction of the retaining wall and pavement in Ana Chaves bay; c) damage to the road protection; d) collapse of the retaining wall in Ana Chaves bay; e) beach erosion near the access to Pantufo.

Several physical adaptation measures will be implemented in the road sections to be rehabilitated in the current project. These measures will guarantee sustainability and resilience to the predicted changes and protect the urban infrastructures and the local population (including the fishermen community) from the negative consequences of the climate changes in this coastal area.

13.1. PROJECT ADAPTATION TO CLIMATE CHANGE

The adaptation to climate change of the project considers coastal protection as the primary defense against these impacts. The aim is to avoid the direct impacts with protection elements that prevent structure failure, significant overtopping that affect the road or pedestrians and erosion along the coastline. In the Project areas, actions in coastal protection have been classified according to the state of the existing structures themselves and the need to adapt to future conditions as follows:

- Good: structure has its defense capacity, but some additional measures to reduce overtopping may be needed,
- Damaged: structure needs structural repair, and some additional measures to reduce overtopping may be needed
- Collapsed: structure needs to be replaced.

14 TRENDS OF EVOLUTION OF SEA TURTLES IN INTERVENTION AREA WITHOUT PROJECT

As mentioned before, climate change in the study area has been leading to substantial erosion of the coastline and beaches throughout the island of São Tomé, with particular incidence on the bays located in the capital city.

Sandy beaches are the natural places were sea turtles hutch's and therefore It is anticipated that the area will no longer be suitable for sea turtles in the near future due to the impact of climate change on the coastline, particularly the disappearance of coastal sand deposits.

15 PROJECT ALTERNATIVES AND SEA TURTLES

For project details please refer to Final Design. This section focuses on Alternatives assessment and Project actions for the Lagarto bat section where beach nourishment has been proposed.

The project at the stage of Final Design has been divided into three sections:

- Lagarto Bay
- Ana Chaves Bay
- Pantufo Coastline.

15.1. ALTERNATIVE ASSESSMENT

Based on Vulnerability Analysis, the subsequent revisions of the Feasibility Report and the comments and discussion regarding the draft revisions, three Alternatives (Alternative A, B and C) for the combination of coastal protection and road rehabilitation were prepared.

Based on the pros and cons of Alternative A and B, Alternative C including a combination of Alternative A and B was prepared and confirmed as the Preferred Alternative.

On 10th November 2020, the Executive Director of INAE confirmed Alternative C as the preferred option considering that it best responds to the need to rebuild the Marginal both from the point of view of road design and coastal protection.

The Final Design follows the alternative selected in the feasibility Study, while reviewing coastal protection proposals of alternative C for the Lagarto Bay and to the Ana Chaves Bay section were beach nourishment is also prosed as social improvement for fisheries activity. Pantufo coastline remain without any update of the alternative C solution. Following a comparative assessment is made for Lagarto Bay and Ana Bay section between the one selected in the Feasibility Study and the one proposed by the Final Design, mainly in regards of beach nourishment and coastal protection.

15.2. ALTERNATIVE C FROM THE FEASIBILITY STUDY FOR LAGARTO BAY SECTION AND ANA CHAVES SECTION

Lagarto Bay

The current beach has a small width at high tide periods in Lagarto Bay. This area of the bay is a popular weekend spot for the inhabitants of the city of São Tomé and a potential touristic development. The road is located at a low level, with no walkways and storm water runoff. Overtopping and coastal erosion are visible on some days of the year. The length of this coast section is of approx. 1.100 meters.

The selected Alternative C at the Feasibility study, considers a rock revetment along the northern part of the bay combined with a new road design at a higher level and walkways up to the beach walls, considered the most appropriate adaptation Climate Change measure.

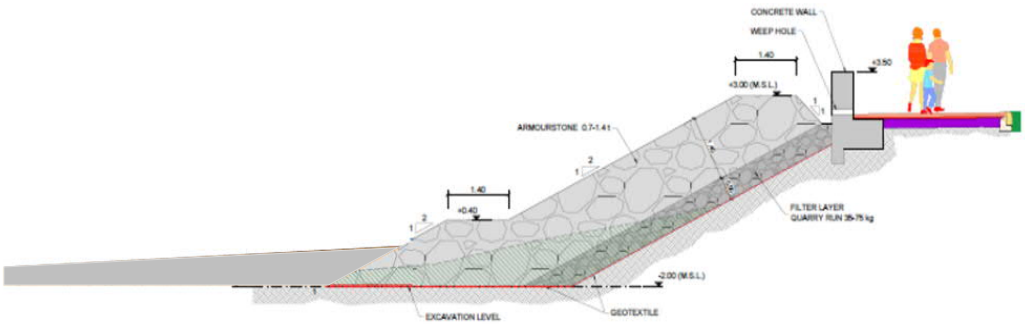

Figure 13 Cross section at Lagarto Bay. Alternative C at the Feasibility study

The Feasibility Study reached hasty conclusions, based primarily on the assumption that sand would have to be obtained from marine dredging, and therefore be scarce, expensive and cause high environmental impacts.

Ana Chaves

Alternative C proposed wall plus rock revetment as coastal protection action.

14.3 ASSESSMENT FOR THE DETAILED DESIGN FOR LAGARTO BAY SECTION AND ANA CHAVES SECTION

Lagarto Bay

Detailed Design review the above coastal protection for Lagarto Bay and proposed a smaller rock revetment plus a beach nourishment also considered as appropriate solution as adaptation measures in regards to climate change. Layout and Cross section are shown below:

Figure 14 Lagarto Bay beach nourishment. Detailed Design December 2021

Figure 15 Cross section proposed for Lagarto Bay. Detailed Design December 2021

Combining rock revetment and beach nourishment for the southern part of Lagarto Bay is considered the best solution.

Ana Chaves

Some subsections for beach nourishment were proposed along the Ana Chaves Bay section, therefore the beach nourishment is motivated by providing landing sites for fishermen. Therefore, beach nourishment is here proposed only as a measure to improve fisheries activity.

The solution for Ana Chaves Bay was reconsidered according to the final decision to relocate the San Pedo Fishery landing site from the site identified in the feasibility study to one finally chosen by INAE, in the sense to create one new beach protected by groynes at chanaige 4+950 to 5+200, close to the new fishermen's facilities and public toilets within project´s social measures.

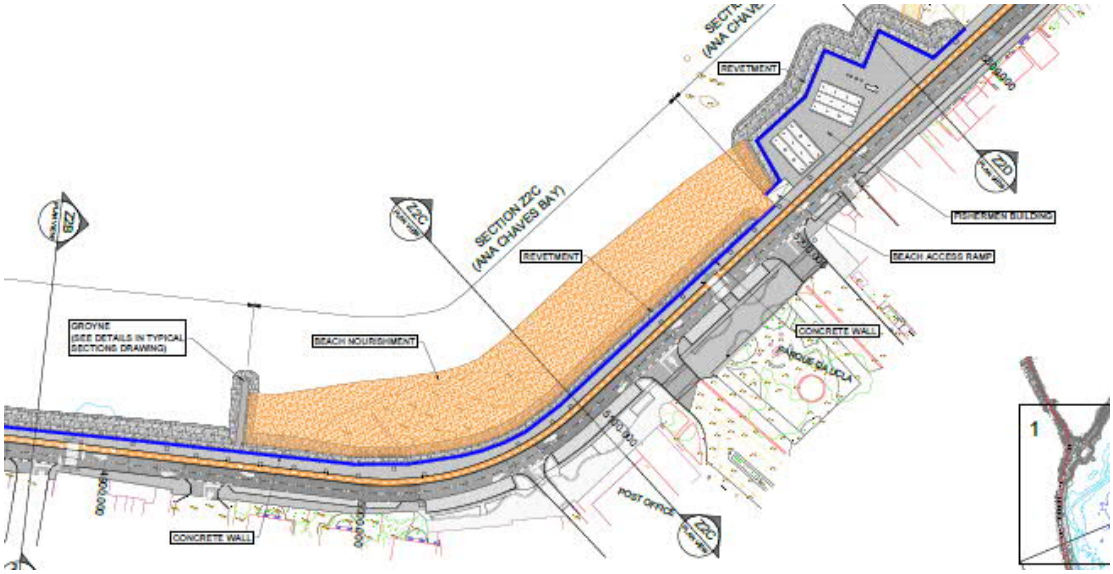

Figure 16 Ana Chaves beach Nourishmen Detailed Design December 2021

16 DETAILED DESIGN BRIEF DESCRIPTION

The project consists of the design of 1) reconstruction of The Marginal Road 2) coastal protection elements, and 3) landscaping. Project component that could affect the shoreline and sandy beaches are the one related to coastal protection elements.

Construction of the said coastal protection elements can affect the beach due to machinery movement and /or equipment during coastal protection construction.
To show the extents of project elements on coast and beach, some cross sections and layouts corresponding to Lagarto Bay, Ana Chaves Bay and Pantufo coastline are added to illustrate project´s design.

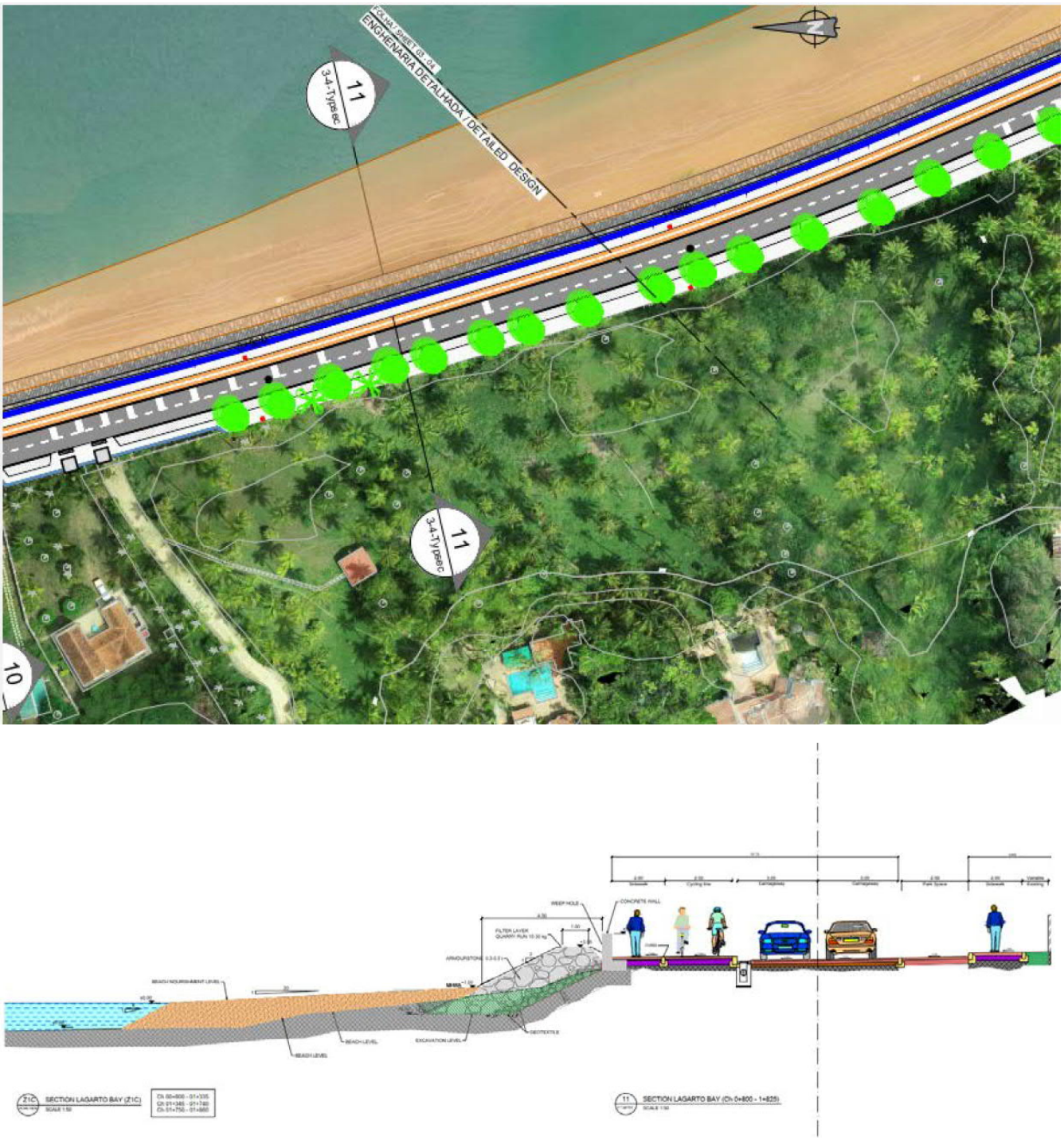

Figure 17 Lagarto Bay Detailed design layout and typical cross section. Rock revetment and sand nourishment are shown in the figures above

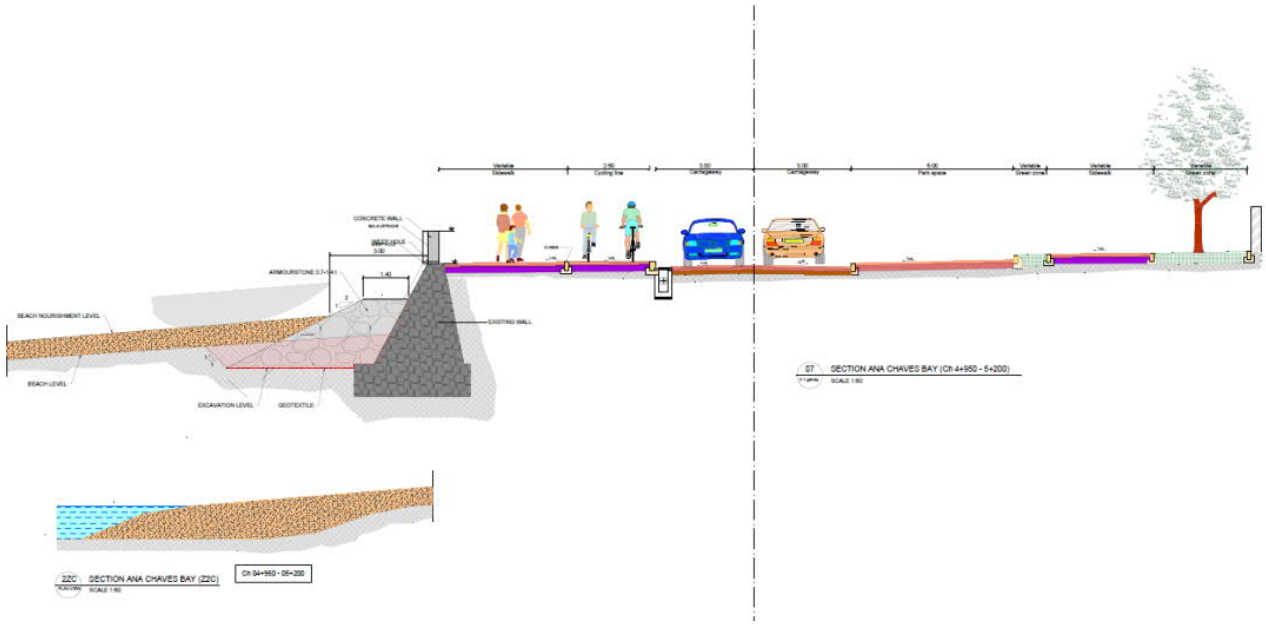

Figure 18 Ana Chaves section, layout showing the new social facilities and beach nourishment and typical cross section

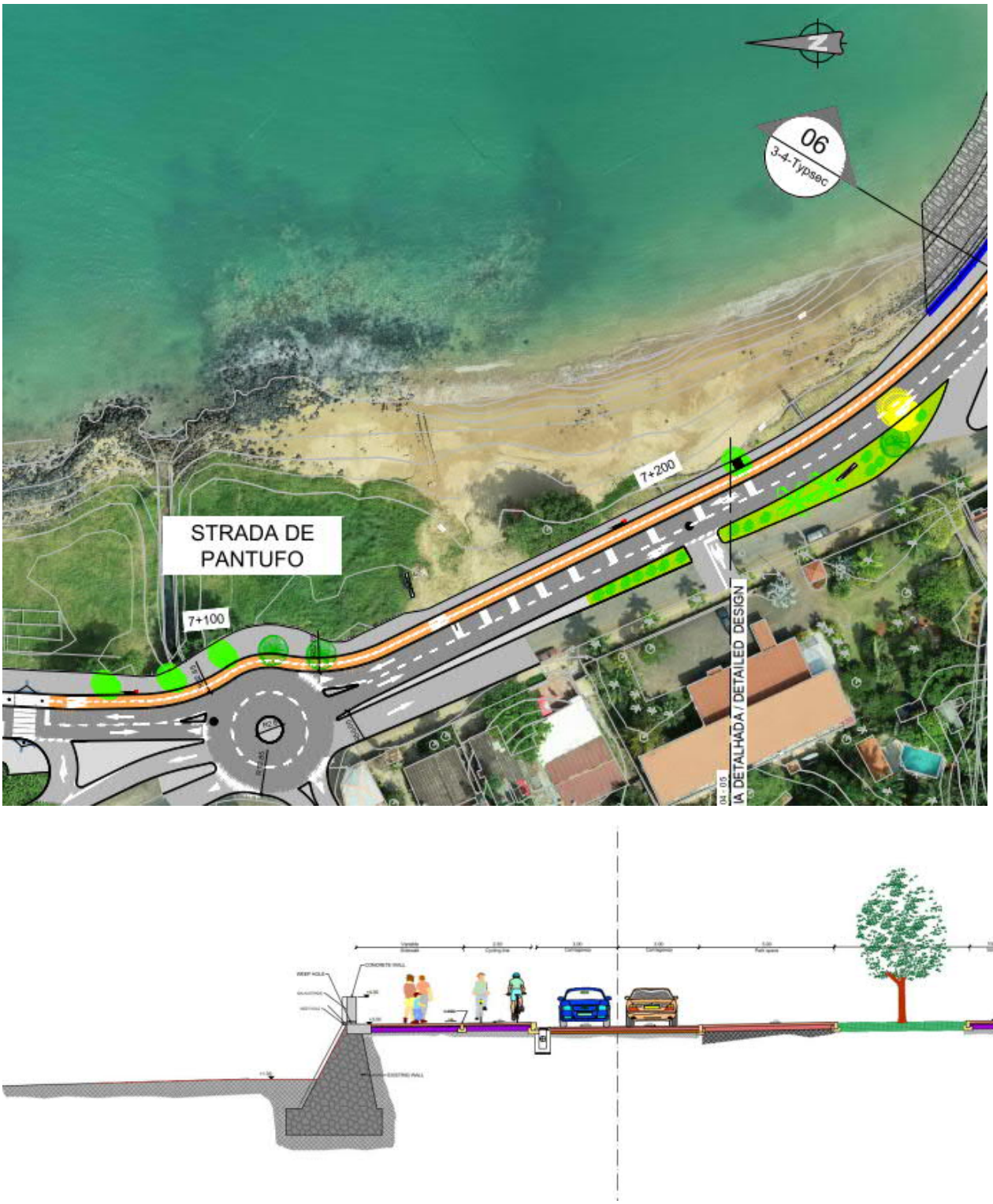

Figure 19 Pantufo coastline section. Project layout and typical cross section at Praia perigrosa. Project does not impact directly on the beach.

17 PROJECT ACTIONS TO SEA TURTLE NESTING

Upon turtle hatching, offspring leave the nesting beach and spend the first few years in the pelagic zone where they are thought to associate with ocean currents before recruiting to coastal habitats where they adopt an herbivorous diet and mature. Sea Turtles are migratory as adults, moving between nesting and foraging sites every year to breed and showing high site fidelity and natal philopatry. Sea Turtles are long-lived, inhabit vast areas of the ocean.

During non-breeding periods sea turtles move within pelagic zone and coastal habitat, moving from an to feeding areas. During breeding sea turtles move to coastal neritic areas. Beaches are visited for spawning and only by females.

Project can impact on sea turtles when a project action affect a nest buried in the sand by the female or by disturbing female's behavior when trying to spawn in the sand of the beach.

Therefore, Project shall avoid:

- any actions on the beach to prevent impacts on nests and
- disturbance to females when arriving the beach to spawn.

As said before the Project´s component that could affect the sandy beaches are those related to coastal protection. Design of Coastal protection, particularly rock revetment, could affect the top or high part of the beach in contact with the road rehabilitation. This is the major identified project action that shall be monitor and for which mitigation measures shall be put in place during construction phase to eliminate impact on the sea turtle nesting resource.

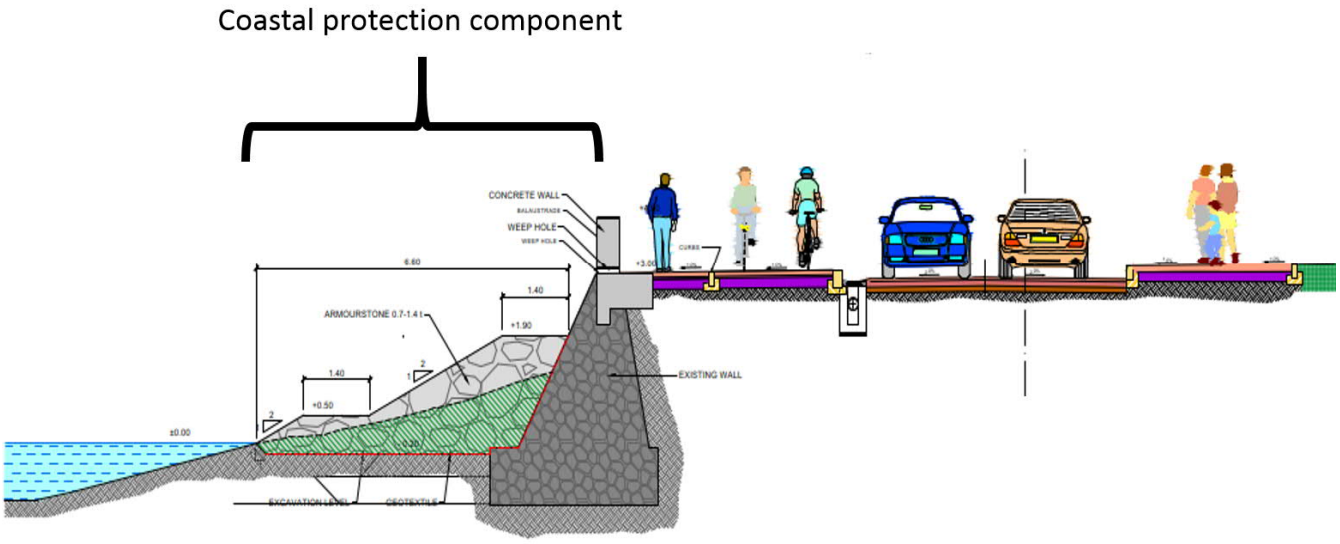

Figure 20 Coastal protection component (over a typical cross section)

18 BEACH NOURISHMENT IN LAGARTO BAY AND ANA CHAVES AND SEA TURTLES

Although, even being narrow beaches under an important dynamic of waves and storms and under an increasing human disturbance, sea turtle nesting activity have been recorded in some sections of the shore within the Project area of influence.

It is possible that in the near future, under exacerbated climate change conditions and urban growth, Lagarto Bay, Ana Chaves Bay and Pantufo coastline, sand beaches may no longer be attractive to sea turtles as a nesting site.

Beach nourishment give an opportunity to this section of the coast to recover its suitability for sea turtle nesting, and therefore, beach nourishment can be considered an adaptive measure for sea turtle conservation.

Additionally, the solution of coastal protection for Lagarto Bay consisting in rock revetment plus beach nourishment has the following environmental considerations:

Adaptation to climate change for the combined solution of the detailed design has been carried out considering the sea level rise (SLR) values. The rise in sea level causes the coastline to recede, but also increases the wave height and increases the energy that reaches the coastal protections.

Based on the results of the analysis carried out in the detailed design and ESIA report, an optimization of the cross-sections where the overtopping was exceeded was performed and the solutions for coastal protection of Lagarto Bay of the Detailed design, rock revetment plus beach, already take in consideration the results of the study and respective simulations, presenting the best technical solution for protecting the area from the predicted climate changes.

Lagarto Bay is historically and at present sandy beach section of the project´s shoreline. Even if straight and under important waves and storm dynamic, natural system of this coastal stretch responds to a loose deposit of sand. Sandy beaches support a particular community of organisms and are connected to other coastal ecosystems. Particularly, even if in minor figures and not the main place in the islands, sea turtles have been recorded using the beach for eggs laying.

Detailed design option added the beach nourishment to a lesser rock revetment. Under an environmental point of view this option is preferred, since environmental conditions will be preserved instead of a large sole rock revetment.

Keeping the strip of beach at Lagarto Bay is important for tourism and recreational purposes and for the fishery landing sites, but also for other social and cultural aspects.!

This area of the bay is a popular weekend spot for the inhabitants of the city of São Tomé. The beach's disappearance would have a major impact on the city's inhabitants.

Regarding Ana Chaves, beach nourishment for the new fisheries landing sites will play a similar role as the described above for Lagarto Bay, probably beach suitability for turtles could be limited due to fisheries activity.

Figure 21 Pictures from Lagarto Bay beach (July 20219). Narrow beach, at present with little suitability for turtle eggs laying

19 MITIGATION MEASURES RECOMMENDED.

19.1. CONSTRUCTION PHASE

Although unlikely, a turtle could try to lay eggs on the stretches of beaches identified previously: Lagarto, Milha, Ponte, P.M., perigrosa and Pirata, during the construction period. In this case, some measures can be taken to avoid possible impacts on sea turtles.

Project can impact on sea turtles when a project action affects a nest buried in the sand by the female or by disturbing female's behavior when trying to spawn in the sand of the beach. Therefore, Project shall avoid: any actions on the beach to prevent impacts on nests and, disturbance to females when arriving the beach to spawn.

Project´s component that could affect the sandy beaches is the coastal protection component.

In this sense, project shall not carry out any action in regards of Coastal protection elements during the 7 months Sea turtle nesting period, from October to April.

Secondly to avoid disturbances to females arriving at the beach the Project shall put in place procedures to avoid disturbances and to avoid any action from contractors' personnel that may affect sea turtle individual and how to proceed for such an occurrence.

In the even that a nests are finally located, procedures shall also be taken to clearly define how to manage such an occurrence.

To monitor the above, the project shall incorporate a Sea turtle management Plan during the construction period.

Therefore:

- The main mitigation measure to be taken for turtle nesting during construction period is to restrict and avoid any work activities on the sandy beaches during the nesting season. An exclusion period for any project activity on the beach from October to April shall be included in the Project's work plan.
- Remove eggs or disturb turtle, moving or turning it back to the sea, can´t be done by contractor or contractor´s personnel. Contractor shall inform immediately to the Engineer and Environmental Authority for such an occurrence, Environmental Authority is the one to take any action on turtles, nests or eggs.
- The project will need to pay a special attention to the source of the sand that will be used in the beach nourishment of Lagarto Bay and Ana Chaves Bay in order to avoid negative impacts on ecosystems mainly marine and coastal ones. Guarantees should be given by all sand suppliers of the Project about the responsible and sustainable origin of the sand that will be used.
- A sea turtle Management Plan should be prepared and implemented in coordination with Environmental authority, additionally and in coordination with Environmental authority NGO´s in regards of the protection of sea turtles in São Tomé Island, Programa Tatô, can be involved in such a monitoring. Monitoring, among others, should focuses on sea turtles occurrence in the beach, to duly inform the Supervisor and the Environmental authority.

The Environmental and Social Impact Assessment report and the Environmental and social management Plan identified and proposes mitigation measures for sea turtles during construction and operation. A summary of the measures and management are the following:

- Mitigation measures in construction phase, prior construction works in beaches, recommended to achieve a positive conservation outcome are:
    - Work program for construction activities in beach between October and April, nesting sea turtles' season;
    - Beach Nourishment Management Plan;
    - Turtles find procedures;

- Preparation of Code of Conduct with prohibitions regarding the interaction of construction site employees with wildlife present in the area to be intervened: including hunting, touching, handling or collecting;
- Turtles management Plan preparation.

- Construction Phase:
  - Turtles Management Plan implementation.
  - Contractor's Workers sensitization.

19.2. OPERATIONAL PHASE

It is recommended that the promoter engage the local NGO, Programa Tatô during the operational period to monitor nesting occurrences in the nourished beach to assess the success of the intervention and, if any, recommend actions to improve its suitability.

For recurrent nourishment a beach nourishment management plan for shall also be put in place with the aims to avoid impacts and to incorporate further recommendations.

19.3. CONCLUSIONS

- Detailed design solution for the Lagarto Bay section could be considered an environmental adaptive mitigation measure for sea turtles.
- Mitigation measures during construction and operation phases be undertaken to avoid impacts on sea turtle nesting, such as: period without construction works in sand beaches from October to April; and preparation of a Sea turtle management Plan that includes daily census to register sea turtle nesting attempts;
- If re-nourishment of the beach is needed an environmental management plan shall be put in place to avoid impacts on sea turtles.
- During the operational phase it is recommended to assess the success of the intervention.

20 STANDARD 3, APPLICABILITY AND CRITERIA

20.1. ECOLOGICALLY APPROPRIATE AREA OF ANALYSIS (EAAA)

The identified project area of influence includes:

- Areas physically occupied by infrastructure and project facilities and where project activities will be carried out, including facilities directly connected with or necessary to support the project,
- Areas that may be affected by emissions and effluents,
- Areas occupied or affected by associated facilities.
- The physical footprint of non-project activities in the surrounding area that are caused by or stimulated by the project ("induced growth"), plus any areas affected by their emissions and effluents.
- Tourism activities, recreational activities.

For the purposes of this report and in accordance with Standard 3 of EIB, EAAA has been defined particularly for Sea turtle species and for project area.

The Project can impact not on the ecosystem or habitat where sea turtles forage, breed or even live, while being marine animals, but particularly where these species lay their eggs; the coast and terrestrial stretch of coast sand deposits: the sandy beaches.

Project area of influence is therefore the beach, the terrestrial stretch next to the coastline and the tidal interval of the coastline from airport at the starting point until Pantufo coastline at the end of the project.

20.2. CRITICAL HABITAT DETERMINATION AND POPULATION OF A CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE SPECIES

The following table summarized the applicable criterions under Critical Habitat Determination and population of a critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of EIB Standard 3 and EIB Guidance Note for Environmental and Social Standard 3 on Biodiversity and Ecosystems.

Criterions, Standard 3 Biodiversity and Ecosystems	Applicable to the Project Assessment
Criterion 1: Highly threatened or unique ecosystems.	No
Criterion 2: Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant legislation.	Yes
Criterion 3: Population range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species.	No
Criterion 4: Habitat required for the survival of migratory species and/or congregatory species.	Yes
Criterion 5: Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups.	No
Criterion 6: Habitat of key scientific value and/or associated with key evolutionary processes.	No

Table 3 Criteria Standards Biodiversity and Ecosystems

- Criterion 1 has been considered not applicable since Lagarto Bay beach or any other beach sections along São Tomé city can´t be considered so.
- For criterion 3 it has been considered not applicable since sea turtles are not considered endemic or restricted species.
- Criterion 5 and 6 are directly not applicable since this is not the case for the project.

20.3. POPULATION OF SEA TURTLES ESTIMATED ON PROJECT AREA OF INTERVENTION

Besides the low numbers of nests and its occasionally occurrence within the EAAA and although these are not the main nesting areas in the island its occurrence should not be neglected.

The data exposed in the above chapters regarding turtle population and trends, in a conservative way, are used for assessment in the sections below.

Criterion 2. Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant legislation.
Areas will be considered critical habitat under Criterion 2 if they are occupied by or are needed to support:

a) A population of an IUCN Red-listed endangered or critically endangered species that is > 0.5% of the global population and/or > 5 established reproductive units of an endangered or critically endangered species;

Endangered or critically species in project area is <0.5% of the global population.

Endangered (*Chelonia mydas*) - 1 reproductive unit (about 6 nets by year in project area, each female lays about 5 nests, which is equivalent to 1 female per year)

Critically endangered (*Eretmochelys imbricata*) - 3 reproductive units (about 11 nests by year in project area, each female lays about 4 nests, which is equivalent to 3 maximum females per year**).**

Project does not meet the above criterion 2a.

b) Significant concentration of an IUCN Red-listed vulnerable species or of multiple IUCN Red-listed vulnerable species, especially where the loss of the area would result in the change of the IUCN Red List status to endangered or critically endangered.

Dermochelys coriacea - 1 reproductive unit in project area and *Lepidochelys olivacea* – 13 reproductive units in project area.
Project does not meet the above criterion 2b.

c) Nationally or regionally-important concentration of a species listed as endangered or critically endangered on a regional/national IUCN Red List, or equivalent on national/regional listing.

Applicable endangered *Chelonia mydas* - Green or a critically endangered *Eretmochelys imbricata* - Hawksbill are regionally important.

The EAA does not hold important concentration of turtle species, being the “population size” or nests per year for E and CE species at a minor figure of the total for the STP.

Project does not meet the above criterion 2c.

d) A population of species listed in Annex II and IV of the Habitats Directive.

Criterion 2d has been considered not applicable since geographic distribution of these species does not match with geographical range of application of EU Habitats directive.

Based on the population size and its estimation for the four sea turtles, Project area does not meet any of the above criterion.

Criterion 4: Habitat required for the survival of migratory species and/or congregatory species.
Areas will be considered as critical habitats under Criterion 4 if:

a) They sustain ≥ 1%of the global population of a migratory or congregatory species at any point of the species’ lifecycle on a cyclical or otherwise regular basis.

b) They are needed to support migratory or congregatory species during periods of environmental stress.

Based on the population size and its estimation for the four sea turtles, Project area does not meet any of the above criterion.

Caretta caretta is not assessed since only sporadic observations are made. Only two nests were recorded, in 2017 Praia Inhame and 2021 Praia Marcação.

The following Table summarizes the assessment of whether the identified habitats trigger criteria 2 and 4 or not. An assessment has been carried out for Critically Endangered (CR), Endangered (EN) and Vulnerable species (VU).

Criterions	Critical Habitat for Project Area summary table for species Trigger Criterion Yes/ No			
	Chelonia mydas (EN)	*Eretmochelys imbricata (CE)*	*Dermochelys coriacea (VU)*	*Lepidochelys olivacea (VU)*
Criterion 2				
a) A population of an IUCN Red-listed endangered or critically endangered species that is > 0.5% of the global population and/or > 5 established reproductive units of an endangered or critically endangered species;	No	No	No	No
b) Significant concentration of an IUCN Red-listed vulnerable species or of multiple IUCN Red-listed vulnerable species, especially where the loss of the area would result in the change of the IUCN Red List status to endangered or critically endangered.	No	No	No	No
c) Nationally or regionally-important concentration of a species listed as endangered or critically endangered on a regional/national IUCN Red List, or equivalent on national/regional listing.	No	No	No	No
d) Population of species listed in Annex II and IV of the Habitats Directive.	NA	NA	NA	NA
Criterion 4				
a) They sustain ≥ 1%of the global population of a migratory or congregatory species at any point of the species' lifecycle on a cyclical or otherwise regular basis.	No	No	No	No
b) They are needed to support migratory or congregatory species during periods of environmental stress	No	No	No	No

Table 4 Critical Habitat for Project Area

21 NET GAIN AND NO NET LOSS

No Net Loss: The Project will not directly affect turtles population, coastal protection component, a critical component of the project, could affect the high subsection of some sandy beaches during construction of rock revetment since that type of coastal protection is needed as adaptive measures against climate change for the marginal road of São Tomé city. We can consider that the project will not means a loss of critical or natural habitat and therefore meets the No Net Loss definition.

Net gain: Additionally, beach nourishment will improve the current conditions of Lagarto bay beach and a section of Ana Chaves Bay coastline, both currently under high erosion pressure. Beach nourishment can improve beach conditions for turtle nesting since gives a large surface and volume of sand nesting resources for sea turtles, therefore increase the suitable coastline for sea turtle nesting not only within the EAAA but for the north-east shoreline of Saò Tomé island That can be considered as a Net gain for sea turtles critical or natural habitat.

22 CONCLUSIONS

São Tomé is facing climate change effects particularly on the shoreline of São Tomé city, additionally climate change effects on sandy beaches could impact on sea turtle nesting places.

As mentioned before, climate change in the project area has been leading to substantial erosion of the coastline and beaches throughout the island of São Tomé, with particular incidence on the bays located in the capital city.

Sandy beaches are the natural places where sea turtles nest and therefore It is anticipated that the area will no longer be suitable for sea turtles in the near future due to the impact of climate change on the coastline, particularly the disappearance of coastal sand deposits.

The sea turtle protection program under the Government and ONG activities has got success in population sensitization and the consolidation of a monitoring program. Consequences are the promising signs of recovery and increasing population of sea turtle species nesting in São Tomé Island.

Sea turtle have been recorded nesting at some places in the beaches close to Saò Tomé city, even though these coast sections are not the main places in the island for turtle nesting. These nesting figures could be probably linked with the increasing of turtle population in the last years.

The aim of the Project is the improve of the São Tomé Marginal road and to put on place climate change adaptation measures. Feasibility Study of the project carried out and alternatives assessment and proposed, among others, walls and rock revetment along the coast of the marginal road as the selected coastal protection against climate change impact.

Beach nourishment can be considered as a mitigation measures and environmental adaptive measures for sea turtles, given the possibility to turtle population to find a suitable place where to hutch.

Additionally, mitigation measures during construction and operation as well as a monitoring program are proposed within the Environmental Impact Assessment.

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