Sea turtles in the North Atlantic & Wider Caribbean Region

2021 Marine Turtle Specialist Group regional report

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North Atlantic & Wider Caribbean Regional Overview

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This Region comprises 48 parties, amongst countries and territories (Anguilla, Antigua & Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, British Virgin Islands, Canada, Cape Verde, Cayman Islands, Colombia, Costa Rica, Cuba, Curacao, Dominica, Dominican Republic, French Atlantic & Channel coasts, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Monserrat, Nicaragua, Panama, Portugal, Puerto Rico, Saba (Dutch West Indies), Saint Barthélemy, Saint Vincent & The Grenadines, Saint Eustach, Saint Maarten, Saint Kitts & Nevis, Saint Lucia, Saint Pierre & Miquelon, Suriname, Trinidad & Tobago, United Kingdom [U.K.], the United States [U.S.], U.S. Virgin Islands, Venezuela). The present report includes a total of 19 parties (39.5%, Belize, Canada, Colombia, Cuba, Curacao, France Atlantic, French Guiana, Guadeloupe, Guatemala, Martinique, Mexico, St. Bartholome, St. Eustach, St. Lucia, St. Martin, St. Pierre et Miquelon, UK-Ireland, the U.S., and Venezuela).

It demands a large and constant effort to bring together the detailed information from all the parties, and although there are still several parties to include in this document, as it stands it is intended to provide panorama of the complete information on the reproductive ecology and status for sea turtle populations in the North Atlantic.

1. RMU: *Caretta caretta* – Northwest Atlantic

1.1. Distribution, abundance, trends

1.1.1. Nesting sites

The rookeries reported for this compilation are located in 30 countries and territories (Table 1). More than 300 nesting beaches for this species are found in the U.S. across 2,585 km, with Florida accounting for ~90% of the loggerhead nest numbers in the Northwest Atlantic region (Ceriani and Meylan 2017). The U.S. reports more than 87,000 loggerhead nests per year over the 2010 – 2018 period, with more than 77 major sites and more than 104 minor sites (see U.S. chapter for details). The recent overall loggerhead nesting trend (1989-2018) for Florida is stable (Ceriani et al. 2019). Mexico and Cuba together host a total of 65 nesting beaches for this species (Figure 1). These countries report nesting beaches with more than 1,000 nests per year for the period 2000 – 2016, with a total of 15 major sites and 18 nesting sites considered minor (<20 nests/yr). The total estimated length of the nesting beaches in Mexico and Cuba is 266 km, where even more than 150 nesting females per year may be recorded (Cuba). The recent trends (last 20 years) at major nesting sites (Mexico and Cuba) is going up (approximately 6%/year, 2000-2016), with the oldest documented abundance of nests/year of 8 and 58 in 1983 and 1998, respectively, in Cuba.

1.1.2. Marine areas

Pelagic and benthic foraging grounds for this species are reported in several of these countries (Table 1). Telemetry tracking of this species is reported for individuals from 11 countries, with also data of mark-recapture projects in these same countries. In six countries there are long-term monitoring projects at foraging sites from 1988 and ongoing.

1.2. Other biological data

Please see Table 1 – Main Table.

1.3. Threats

1.3.1. Nesting sites

Please see Table 1 – Main Table.

1.3.2. Marine areas

Please see Table 1 – Main Table.

1.4. Conservation

This species is protected under national law in all the countries that contributed to this chapter of the Regional Report, and there are several long-term conservation projects particularly in seven countries. See Table 3 in the country chapters for individual conventions and laws applied to sea turtles in each country.

2. RMU: *Dermochelys coriacea* – Northwest Atlantic

2.1. Distribution, abundance, trends

2.1.1. Nesting sites

Eighteen countries in this region report nesting activity of *D. coriacea* in some of their beaches. Five of these countries have beaches that are considered major nesting sites (Colombia, French Guiana, Suriname, U.S.) with more than 800 nests/year (2013 – 2017). Anguilla, Aruba, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela all have minor sites (with less than 25 nests/year). (Figure 2).

The estimated total length of nesting beach for this species was reported as little more than 100 km, hosting between 100 and 250 nesting females per year, particularly in French Guiana, St. Bartholome, St. Eustatius and St. Martin. The recent trend for these rookeries is positive and considering the oldest documented abundance of 10 nests in 2002 in St. Eustatius and French Guiana, although there is also one decreasing report in the region. In the U.S. leatherback turtles nest across more than 534 km. Number of nesting females per year has not been determined for the U.S. rookery. The leatherback nest recent trend (1989-2017) in the U.S. is positive.

2.1.2. Marine areas

Pelagic foraging grounds for this species are reported in Belize, Colombia, Cuba, France Atlantic, French Guiana, Mexico, U.S., Canada, UK-Ireland, Venezuela; and benthic foraging grounds only in Colombia, French Guiana and Venezuela. There are big information gaps regarding the usage of marine areas this species does in this region, with limited published information on growth rates, remote tracking, foraging ecology and mark-recapture studies, mainly from U.S. and Canada.

In Venezuela there is a long-term monitoring project at foraging grounds that started in 2000 and it is still operating.

2.2. Other biological data.

Please see Table 1 – Main Table.

2.3. Threats

2.3.1. Nesting sites

Please see Table 1 – Main Table.

2.3.2. Marine areas

Please see Table 1 – Main Table.

2.4. Conservation.

Please see Table 1 for national laws and Table 3 in the country chapters for international conventions. A majority (74%) of the countries included in this Report protect *D. coriacea* under national law (14/19).

Together Anguilla, Aruba, Colombia, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S. report >5 years-long-term conservation projects, some started in 1979 and are still ongoing.

3. RMU: *Chelonia mydas* – Northwest Atlantic.

3.1. Distribution, abundance, trends.

3.1.1. Nesting sites.

Chelonia mydas is also a widely distributed species in this RMU, it was reported by 20 different countries (Anguilla, Aruba, Belize, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, French Guiana, Martinique, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, U.S., Venezuela), and it is certainly the species with the highest nesting abundance in the region with a values higher than 18,000 nests/year (2012-2016) in tens of nesting beaches (Table 1). For this RMU there are at least 28 major nesting sites and more than 205 minor sites (Figure 3).

The total length of the nesting beaches is >400 km in only 12 of the countries, and these littorals receive between 175 and >18,000 nesting females per year. The recent trends for Cayman Islands, Cuba, Mexico, Venezuela, U.S. are positive, with increases of more than 15% per year (2000-2016), and the oldest documented abundance of 20 nests/yr in Cuba and 200 in Venezuela, and >2,000 in Suriname. Similarly, green turtle nesting trends on Florida index nesting sites, which is where green turtles nest almost exclusively in the U.S., has increased exponentially during the 1989–2017 period.

3.1.2. Marine areas.

Anguilla, Bahamas, Canada, Colombia, French Guiana, St. Bartholome, St. Martin, U.S., Venezuela reported pelagic foraging grounds for this species, and 18 countries reported to host benthic foraging grounds for adults and juveniles

(Table 1). There are multiple studies on several aspects of this species in marine areas, including stocks defined by genetic markers, remote tracking, foraging ecology and mark-recapture.

In at least four countries (Anguilla, Bahamas, Belize, Colombia, Cuba, Curacao, Mexico, Portugal (Mainland), St. Eustatius, Turks & Caicos, U.S.) long-term monitoring projects are found at foraging sites, some of them started in 1982 and still ongoing.

3.2. Other biological data.

Please see Table 1 – Main Table.

3.3. Threats.

3.3.1. Nesting sites

Please see Table 1 – Main Table.

3.3.2. Marine areas

Please see Table 1 – Main Table.

3.4. Conservation.

In this RMU all the countries reported to have protection under national law for this species (Table 1), with at least 7 long-term conservation projects that operate since 1990 and still ongoing (Cuba, Mexico, St. Bartholome, St. Eustatius, St. Martin, the U.S. and Venezuela).

See Table 3 in the country chapters for individual conventions and laws applied to sea turtles in each country.

4. RMU: *Eretmochelys imbricata* – Northwest Atlantic

4.1. Distribution, abundance, trends

4.1.1. Nesting sites

This species was reported by 21 countries in the region (Anguilla, Aruba, Belize, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Guatemala, Martinique, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos, U.S., Venezuela). Reproductive values are reported by these countries (but the U.S.) having close to 1,000 nests/year (1995 – 2016) with >20 important major nesting sites (Colombia, Cuba, Guadeloupe, Mexico, St. Eustatius, St. Lucia, St. Martin) and at more than 60 minor sites (Figure 1.4). Although hawksbill turtles were reported by the U.S., only one to two nests are documented each year.

The total length of the nesting beaches in the countries that reported the presence of this species is almost 500 km, receiving between 90 and even more than 1000 nesting females per year. The recent trend for this species in Cuba is up (1998 – 2016), and for Mexico in slightly going down (1995 – 2010), with the oldest documented abundance between 10 and 300 nests/year in 1983 (Cuba, Mexico, St. Eustatius and Venezuela).

4.1.2. Marine areas

Anguilla, Colombia, Mexico, St. Bartholome, St. Martin, U.S., Venezuela reported pelagic foraging grounds, and 16 countries reported benthic foraging grounds. There are several studies for this species in marine areas, including mark-recapture, foraging ecology and remote tracking. In all these countries there are long-term monitoring projects at foraging sites (1992 – ongoing).

4.2. Other biological data

Please see Table 1 – Main Table.

4.3. Threats

4.3.1. Nesting sites

Please see Table 1 – Main Table.

4.3.2. Marine areas

Please see Table 1 – Main Table.

4.4. Conservation.

All the above-mentioned countries reported to have national law to protect *E. imbricata*. There are more than nine long-term conservation projects that have been operating since 1990 and are still ongoing in Cuba, Mexico, St. Eustatius and Venezuela.

See Table 3 in the country chapters for individual conventions and laws applied to sea turtles in each country.

5. RMU: *Lepidochelys kempii* – Northwest Atlantic

5.1. Distribution, abundance, trends

5.1.1. Nesting sites

This species is the most restricted species within the Northwest Atlantic, it is circumscribed to the Gulf of Mexico, and some isolated reports in the North Atlantic. For this report, Mexican littoral in the Gulf of Mexico is recognized to host several nesting sites, with its main beach at Rancho Nuevo, northwest Gulf of Mexico. In recent years the average of nests per year is around 12,000 (2009 – 2015), with three major nesting sites and seven minor ones. Nesting for this species also occurs in Texas, U.S. Between 1978 and 2014, the annual number of nests of Kemp's ridley turtles in the U.S. has increased. However, since 2010, nesting trends have leveled, remaining well below predicted levels at all locations throughout their range, including the U.S.

The total length of the nesting beach is 212 km in Mexico, hosting more than 5,000 nesting females per year. The trend is clearly positive (1995 – 2015). In the U.S. nesting occurs across 590 km, with in average 29 nesting/females a year.

5.1.2. Marine areas

The Gulf of Mexico's waters host important pelagic and benthic foraging areas for this species. There are several in-water studies and long-term projects occurring in this region making this species one of the better studied in this RMU

5.2. Other biological data

Please see Table 1 – Main Table.

5.3. Threats

5.3.1. Nesting sites

Please see Table 1 – Main Table.

5.3.2. Marine areas

Please see Table 1 – Main Table.

5.4. Conservation

Mexico and the U.S. have national law that protect this species all over its distribution range in the RMU. The bi-national conservation project for this species started in 1975 and it is still ongoing.

The recovery of its populations is one an example of successful multinational collaboration and the capacity of recovery by these species.

See Table 3 in the country chapters for individual conventions and laws applied to sea turtles in each country.

6. RMU: *Lepidochelys olivacea* – Northwest Atlantic

6.1. Distribution, abundance, trends

6.1.1. Nesting sites

For this species, only French Guiana, Suriname and Venezuela reported to have nesting sites along their littoral (Table 1). The recent trend in French Guiana is of almost 3,000 nests/year (2008 – 2016), with 2 major nesting sites and equal number of minor sites.

The estimated average number of nesting females in this country is 1,700 (2009 – 2016), with 1.3 nests per female per season. The recent trend reported for this species is stable, with the oldest documented abundance of for more than 3,000 nests per year in French Guiana.

6.1.2. Marine areas

Both French Guiana and Venezuela reported to have benthic foraging grounds for adults, but only the former reported to host pelagic foraging grounds. There is not much published information regarding the ecology and population features of this species in the RMU.

6.2. Other biological data

Please see Table 1 – Main Table.

6.3. Threats

6.3.1. Nesting sites

Please see Table 1 – Main Table.

6.3.2. Marine areas

Please see Table 1 – Main Table.

6.4. Conservation

At least Venezuela has protection under national law for this species, and this same country has a long-term conservation project that started in 2009.

See Table 3 in the country chapters for individual conventions and laws applied to sea turtles in each country.

Table 1. Biological and conservation information about sea turtle Regional Management Units in the North Atlantic and Wider Caribbean Region.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Nesting sites	Y	Anguilla, Aruba, Belize, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Guatemala, Martinique, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos, U.S., Venezuela	Y	Mexico, U.S.	Y	French Guiana, Suriname, Venezuela	Y	Anguilla, Aruba, Belize, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, French Guiana, Martinique, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, U.S., Venezuela	Y	Aruba, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Montserrat, U.S., Venezuela	Y	Anguilla, Aruba, Bahamas, Colombia, Cuba, French Guiana, Guadeloupe, Guatemala, Martinique, Mexico, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Suriname, U.S., Venezuela

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Pelagic foraging grounds	Y	Anguilla, Colombia, Mexico, St. Bartholom e, St. Martin, U.S., Venezuela	Y	Canada, Mexico, U.S.	Y	French Guiana	Y	Anguilla, Bahamas, Canada, Colombia, French Guiana, St. Bartholome, St. Martin, U.S., Venezuela	Y	Azores, Canada, Colombia, Madeira, Portugal (Mainland), U.S., Venezuela	Y (both)	Bahamas, Belize, Canada, Colombia, Cuba, France Atlantic, French Guiana, Mexico, Portugal (Mainland), UK-Ireland, U.S., Venezuela
Benthic foraging grounds	Y	Aruba, Bahamas, Belize, Bonnaire, Cayman Islands, Colombia (JA), Cuba, Curacao, Mexico, Montserrat, St. Bartholom e, St. Eustatius, St. Martin, Turks & Caicos,	Y	Mexico, U.S.	Y (A)	French Guiana, Venezuel a	Y (both)	Aruba, Bahamas, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, French Guiana, Madeira, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Turks &	Y (both)	Bahamas, Bonnaire, Canada, Colombia, Cuba, Curacao, Mexico, Montserrat, Portugal (Mainland), Turks & Caicos, U.S., Venezuela	Y	Colombia, French Guiana, Portugal (Mainland), Venezuela

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
		U.S., Venezuela						Caicos, U.S., Venezuela				
Key biological data												
Nests/yr: recent average (range of years)	3.1 (Col), 5-25 (2015-2019(Aru, Gua, Cayman)), 50 - 60 (1982-2018(St. Barth), Anguilla); 125 (T&C), 940.1 (1995-2016(Mex), 2010-2015)	Anguilla, Aruba, Bonnaire, Cayman Islands, Colombia, Cuba, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, U.S., Venezuela	12000 (2009-2015, Mex) 170 (2009-2014, U.S.)	Mexico U.S.	2997 (2008-2016); 32 (Suriname)	French Guiana, Suriname.	5-150 (1990-2018, Anguilla, Aruba, Colombia, St. Bartholome, St. Martin); 200-300 (Cayman) 3,000->5,000 (2000-2016, Mexico, Cuba, St. Eustatius, Suriname, Venezuela, French Guiana,	Anguilla, Aruba, Bonnaire, Cayman Islands, Colombia, Cuba, French Guiana, Guadaloupe, Mexico, St. Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, U.S., Venezuela	<10 (2007-2018, Colombia); 10-300 (2010-2018 Aruba, Bonnaire, Cuba, Cayman); up to 500 (2002-2016 Venezuela); >1000 (2000-2016) (Mexico) 97,447 (2014-2018, U.S.)	Aruba, Bonnaire, Cayman Islands, Colombia, Cuba, Mexico, U.S., Venezuela	1-1,500 (Colombia); 733 (Suriname); 1-10 (1982-2018 St. Bartholome; Anguilla); 3-10 (St. Eus., Venezuela); 50 (Aru); ; 1 (2011-2019, Gua) 1,352 (2012-2016, U.S.)	Anguilla, Aruba, Colombia, French Guiana, Guadeloupe, Guatemala, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S., Venezuela

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
							Guadaloupe) 18,883 (2012-2016, U.S.)					
Nests/yr: recent order of magnitude	10->500 1 (U.S.)	Bonnaire, Colombia, Cuba, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, U.S., Venezuela	10,000 (2009-2015; Mexico); 100 (2009-2014; U.S.)	Mexico, U.S.	1586-3955	French Guiana	<10 (Colombia); <50 (Aru, Bonna); up to 5000 (Cuba); up to 250 (St. Bartholome, St. Martin); 2,500-5000 (2000-2016) (Mexico, Cuba, Grenada, St. Eustatius, Venezuela, FG)	Aruba, Bonnaire, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela, U.S.	<10 (Colombia); 10-50 (Aru, Bonna); 50-400 100,000 (2010-2018; U.S.)	Aruba, Bonnaire, Colombia, Cuba, Mexico, U.S., Venezuela	(10-150 (Colombia, 2014-2018); <25; 50-120 (Aru); 1,000 (2012-2016; U.S.)	Aruba, Colombia, Cuba, Guadeloupe, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela, U.S.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
							10,000 (2012-2016; U.S.)					
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	23	Bonnaire, Colombia, Cuba, Guadeloupe, Mexico, St. Eustatius, St. Lucia, St. Martin	3	Mexico	2	French Guiana	28 (Cuba, French Guiana, Mexico, St. Eustatius, St. Martin); 3-41 (U.S.; see text)	Bonnaire, Cuba, French Guiana, Mexico, St. Eustatius, St. Martin, Suriname	16 (Cuba, Mexico); 77-210 (U.S.; see text)	Bonnaire, Cuba, Mexico	4 (French Guiana, Suriname); 4-27 (U.S.; see text)	Colombia, French Guiana, Suriname, U.S.
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	88 (Anguilla, Aruba, Colombia, Cuba, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Martin,	Anguilla, Colombia, Cuba, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela	7 (Mexico); 9 (U.S.)	Mexico, U.S.	4	French Guiana, Suriname	60 (Aruba, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St. Martin); 123-161	Anguilla, Aruba, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St. Martin	24 (Aruba, Colombia, Cuba, Venezuela); 104-237 (U.S.; see text)	Colombia, Cuba, Venezuela	41 (Anguilla, Aruba, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St.	Anguilla, Aruba, Colombia, Cuba, French Guiana, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
	Venezuela); 13 (U.S.)						(U.S.; see text)				Martin, Venezuela); 80-103 (U.S.; see text)	
Nests/yr at "major" sites: recent average (range of years)	163.15 (2009-2019)	Cuba, St. Lucia, St. Martin, Mexico, US (No estimates)	12000 (2009-2015)	Mexico, US (no estimates)	n/a		>3000 (2000-2018); 50 (St. Martin), Suriname, US (No estimates)	Cuba, Mexico, St. Martin, Suriname, US	253.5 (2000-2016); 322.66 (2010-2015 Cuba), US (no estimates)	Cuba, Mexico, US (no estimates)	700 (Suriname), >1,000 (Colombia), US (no estimates)	Colombia, Suriname, US (no estimates)
Nests/yr at "minor" sites: recent average (range of years)	5-42 (2010-2017), 51 (Anguilla)	Anguilla, Colombia, Cuba, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Martin, Venezuela	48 (U.S.)	U.S.	n/a		<10 (Anguilla, Colombia); <50, US (No estimates)	Anguilla, Colombia, Cuba, Mexico, St. Bartholome, St. Eustatius, St. Martin, US (no estimates)	<10(Colombia); 19.83 (2010-2015)	Colombia, Cuba, US (no estimates)	<20 (Mexico, St. Eustatius); <5 (Anguilla, Cuba, St. Bartholome, St. Martin); 10-200 (Colombia), US	Anguilla, Colombia, Cuba, Mexico, St. Bartholome, St. Eustatius, St. Martin, US (No estimates)

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
											(no estimates)	
Total length of nesting sites (km)	603.43	Anguilla, Aruba, Cayman Islands, Cuba, Guatemala, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos, Venezuela	212(Mex) 590 (U.S.)	Mexico U.S.	13	Suriname	485	Anguilla, Aruba, Cayman Islands, Cuba, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, Venezuela	298.3 >2585 (U.S.)	Aruba, Cayman Islands, Cuba, Mexico, Montserrat, Venezuela U.S.	115 >534 (U.S.)	Anguilla, Aruba, Guatemala, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S., Venezuela.
Nesting females/yr: mean (95% confidence interval) [range of years]	3 (Aru, Gua), <50 (Anguilla); 90 - >1000	Aruba, Cuba, Guatemala, Mexico, St. Eustatius, St. Lucia,	5000 (Mex) 29 (U.S.)	Mexico U.S.	1700 (2009-2016), <50 (Suriname)	French Guiana, Suriname	10 (Anguilla, Aru); 100-150 (Cayman), 175-4200	Anguilla, Aruba, Cayman Islands, Cuba, French	3-10 (Aru); 167 (Cuba); 16,639-99,739	Aruba, Cuba, U.S.	100-250 (St. Eustatius, French Guiana, Suriname,	Anguilla, Aruba, Cuba, French Guiana, Guatemala, St.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
		Turks & Caicos					(Mexico, Suriname, U.S.)	Guiana, Guadaloupe, Mexico, St. Eustatius, Suriname, Turks & Caicos, Venezuela	(2014-2018; U.S.)		); 1 (Gua, Ang); <25 (Aru)	Bartholome, St. Eustatius, St. Martin, Suriname, Venezuela
Nests/female/season (clutch frequency): mean or range of means, range (number of females)	2.51 (>1000), 5 (St. Luc)	Cuba, Guadeloupe, Mexico, St. Lucia,	2 (Mexico); 1.3-1.45 (735; U.S.)	Mexico	1,3 (2012)	French Guiana	2.425 (>5000); 3.0 (145; U.S.)	Cuba, French Guiana, Guadeloupe, Mexico, U.S.	<5 (Cuba, Mexico); 2.44-5.4 (>9,300; U.S.)	Cuba, Mexico, U.S.	1 to 8 (French Guiana, Guadeloupe); 4.2-4.4 (>500; U.S.)	Cuba, French Guiana, Guadeloupe, St. Bartholome, St. Martin, U.S., Venezuela
Female remigration interval (yrs) (Number of females)	2.43 (>1000)	Cuba, Guadeloupe, Mexico, St. Lucia,	2.7 (236)	U.S.	n/a		2.428 (Cuba, Guadeloupe, Mexico, St. Eustatius, St. Martin, Venezuela); 2.0 (U.S.)	Cuba, Guadeloupe, Mexico, St. Eustatius, St. Martin, Venezuela	3.37 (>1000; Cuba, Mexico); 2.54-5.0 (>1200; U.S.)	Cuba, Mexico, U.S.	2 to 5 (Guadeloupe); 2.2-2.7 (>200; U.S.)	Cuba, Guadeloupe, St. Bartholome, St. Martin, U.S., Venezuela
Sex ratio: Hatchlings (F / Tot) (N)	0.64	St. Lucia	n/a		n/a		0.8-1.0 (50)	Cuba	0.33(3)-0.90(4) See table 19.6.5 (U.S.)	Cuba U.S.	n/a	Cuba, St. Bartholome, St. Martin, Venezuela

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Sex ratio: Immatures (F / Tot) (N)	0.46 (>100) See table 19.6.5 (U.S.)	Mexico, St. Lucia U.S.	See table 19.6.5 (U.S.)	U.S.	n/a		n/a See table 19.6.5 (U.S.)	U.S.	See table 19.6.5 (U.S.)	U.S.	n/a	Cuba, St. Bartholome, St. Martin, Venezuela
Sex ratio: Adults (F / Tot) (N)	0.76-0.84 (>5000), 0.4 (St. Luc) See table 19.6.5 (U.S.)	Cuba, St. Lucia, U.S.	n/a		n/a		See table 19.6.5 (U.S.)	U.S.	See table 19.6.5 (U.S.)	Cuba U.S.	n/a See table 19.6.5 (U.S.); 0.65 (80, Can)	Canada, Cuba, France Atlantic, St. Bartholome, St. Martin, Venezuela, U.S.
Min adult size, CCL or SCL (cm)	64 CCL (Cuba), 72 (St. Luc), 181.45 CCL (77, Guadeloupe); 80.0 SCL (U.S.), 80-90 (Aru)	Aruba, Cuba, Mexico, Guadeloupe, St. Eustatius, St. Lucia, U.S.	63.5 CCL; 60 SCL (UK-Ire); 55.7 SCL (U.S.)	Mexico, UK-Ireland, U.S.	n/a		92.5-95.64 ± 0.43 CCL (>1000); 91.1 SCL (U.S.); 90-100 cm (Aru)	Aruba, Cuba, Guadeloupe, Martinique, Mexico, St. Eustatius, U.S., Venezuela	80-85 CCL; 60 SCL (UK-Irl); 80.2 SCL (U.S.), 90 (Aru)	Aruba, Cuba, UK-Ireland, U.S.	86 (St. Luc); 110-145 (Aruba, St. Eustatius, France, Guadeloupe, Martinique); 102 cm (UK-Ire); 118.9 CCL (U.S.)	Aruba, Cuba, France, Guadeloupe, Martinique, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, UK-Ireland; U.S.
Age at maturity (yrs)	15-20; 25-30 (St. Luc)	Mexico, St. Lucia	14-25 (Mexico); 14.1 (U.S.)	Mexico, U.S.	n/a		14-30 (Mexico, St. Eustatius); 27.5	Cayman Islands, Mexico, St. Eustatius, U.S.	33.6 (U.S.)	U.S.	19.0 U.S.)	Cuba, St. Bartholome, St. Martin, U.S., Venezuela

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
							(U.S.); 15-19 ys (Cayman, captive)					
Clutch size (n eggs) (Number of nests)	98.2 (St. Luc), 100-125 (3, Gua, Ang), 130-155 (>1000) (Aruba, Mexico, Bonna, Cayman, Cuba, St. Eustatius, Guadeloupe), 148(Col); 135.0 (6; U.S.)	Anguilla, Aruba, Bonnaire, Cayman Islands, Colombia, Cuba, Guatemala, Mexico, Guadeloupe, St. Eustatius, St. Lucia, U.S.	95 (Mexico); 96.7 (1,552; U.S.)	Mexico; U.S.	146	Suriname	90-125 (>500); 125-140 (Bonna, Suriname); 124.8 (>1,900: U.S.)	Anguilla, Aruba, Bonnaire, Cayman Islands, Cuba, French Guiana, Guadaloupe, Mexico, St. Eustatius, Suriname, U.S., Venezuela	115-130 (73, Colombia, Aru, Bonna); 93-113.69; 113.8 (>97,000; U.S.; 131 Bahamas.	Aruba, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba, Mexico, U.S.	80-90 (>300) (St. Eustatius, Guadeloupe, Martinique, Suriname); 77.0 (>500; U.S.); 104 2016-2018, Ang)	Anguilla, Aruba, Cuba, Guadeloupe, Martinique, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S., Venezuela
Emergence success (hatchlings/egg) (Number of nests)	60-65 (Aru); 65-75 (Bonna); 84 (Ang), 95-142.5 (>1000); 58 (4; U.S.)	Anguilla, Aruba, Bonnaire, Colombia, Cuba, Guatemala, Guadeloupe, Mexico, St. Eustatius, St. Lucia, U.S.	0.57 (10560); 87 (3,219; U.S.)	Mexico; U.S.	63	Suriname	0.75-0.90 (>15000); 63 (>5,500; U.S.)	Anguilla, Aruba, Bonnaire, Cuba, Guadeloupe, Mexico, St. Eustatius, Suriname, U.S.	50 (73, Colombia); 83.065 (0.72-0.82 (612) Cuba, Aruba, Bonna); 64 (>30,000; U.S.); 100-125	Aruba, Bahamas, Bonnaire, Colombia, Cuba, Mexico; U.S.	12% (>1500) (St. Eustatius); 52-60(868; U.S., Aru, Suriname), 68 (Ang)	Anguilla, Aruba, Cuba, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S., Venezuela

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
									(Bahamas, Cayman)			
Nesting success (Nests/ Tot emergence tracks) (N)	0.46 (>6500), 0.27 (Ang)	Anguilla, Cuba, St. Eustatius, St. Lucia	n/a		n/a		0.11 (Ang), 0.60-0.70); 0.47-0.50(>1,500; U.S., Cayman)	Anguilla, Cayman Islands, Cuba, St. Eustatius, U.S.	0.67 (18 yr); 0.50 (>7,100; U.S., Cayman)	Cuba, Cayman Islands, U.S.	17% (180) (St. Eustatius); 60-0.70 (111; U.S.; Ang)	Anguilla, Cuba, St. Bartholome, St. Eustatius, St. Martin, U.S., Venezuela
Trends												
Recent trends (last 20 yrs) at nesting sites (range of years)	Slightly Down (MEX,1995-2010, Cayman); Up (CUB,1998-2016); Slightly Down (Cuba,2010-2018; Bonna); Stable (Aru)	Aruba, Bonnaire, Cayman Islands, Cuba, Mexico	Up (1995-2015) Up (1978-2014, U.S.)	Mexico U.S.	Stable (F. Guiana); Decreasing (Suriname)	French Guiana, Suriname,	Up ≈19% (2010-2018), Up [1989-2017], +75.71%/yr, U.S. Stable (Aru, Suriname)	Aruba, Cayman Islands, Cuba, Mexico, Suriname, Venezuela, U.S.	Up ≈6.7% (2000-2016) (Cuba: Up (r=0.48;1998-2016); 3 up 2 down (2010-2018)) Stable (1989-2018, U.S., Aru)	Aruba, Bonnaire, Cayman Islands, Cuba, Mexico, U.S.	Up (1979-2008), +10.2%/yr; U.S. Stable (Aru); Decreasing (Suriname)	Aruba, Cuba, St. Bartholome, St. Martin, Suriname, Venezuela, U.S.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		Up (1995-2009; 1991-2013, U.S.)	U.S.	n/a		Up (1995-2009; 1982-2006; 1991-2010, U.S.)	U.S.	Up (1995-2009; 2000-2011; 2011-2012; 1982-2006, U.S.); Stable (Azo, Mad)	Azores, Madeira, Cuba U.S.	n/a, decrease sighting and strandings (UK-Ire) Stable (2001-2014, Can)	Canada, Cuba, France Atlantic, St. Bartholome, St. Martin, UK-Ireland Venezuela.
Oldest documented abundance: nests/yr (range of years)	4-300 (1983-1998); 125-160 ((1990-1992) Belize)	Belize, Cayman Islands, Cuba, Mexico, St. Eustatius, Turks & Caicos, Venezuela	4 (1995)	U.S.	>3250	French Guiana, Suriname	10-20 (CUB, 1982; 50 (T&C), cayman, 1971); 200 (VEN, 1979); >50 (1989-1991, Belize); 201 (1979-1983; U.S.), >2,000 (Suriname)	Belize, Cayman Islands, Cuba, U.S., Turks & Caicos, Suriname, Venezuela	8 (1983); 58 (1998); 60, 768 (1989-1993; U.S.); 65,632 (1989-1993; U.S.)	Cayman Islands, Cuba, U.S.	10 (2002) (St. Eustatius, French Guiana); 31 (1979-1983; U.S.); <500 (Suriname)	Cuba, French Guiana, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S., Venezuela
Published studies												

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Growth rates	Y	Bahamas, Bonnaire, Cayman Islands, Cuba, Mexico, St. Lucia, Turks & Caicos, U.S.	Y	Mexico U.S.	N	Venezuel a	Y	Bahamas, Bonnaire, Cayman Islands, Cuba, Martinique, Mexico, Turks & Caicos, U.S., Venezuela	N Y (Azo)	Azores, Bahamas, Cuba, Madeira, Mexico, Venezuela, U.S.	N	Bahamas, Cuba, St. Bartholome, St. Eustatius, St. Martin, Venezuela, U.S.
Genetics	Y	Bonnaire, Cayman Islands, Colombia, Cuba, Guadeloup e, Mexico, Montserrat, Turks & Caicos, U.S.	N Y	Mexico U.S.	N	Venezuel a	Y	Bahamas, Bonnaire, Canada, Cayman Islands, Colombia, Cuba, French Guiana, Guadeloupe, Martinique, Mexico, Montserrat, Turks & Caicos, U.S., Venezuela	Y	Azores, Canada. Colombia, Cuba, Madeira, Mexico, Venezuela, U.S.	Y (France Atlantic)	Canada, France Atlantic, Guadeloupe, Martinique, St. Eustatius, U.S.
Stocks defined by genetic markers	Y	Anguilla, Bahamas, Cayman Islands, Colombia, Cuba, Guadeloup	Y	U.S.	N	Venezuel a	Y	Anguilla, Bahamas, Bonnaire, Cayman Islands, Colombia, Cuba,	Y	Azores, Bahamas, Colombia, Cuba, Madeira, U.S.	Y (France Atlantic)	Anguilla, France Atlantic, Guadeloupe, Martinique, St. Eustatius, U.S.

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
		e, Mexico, Turks & Caicos, U.S.						Guadeloupe, Martinique, Mexico, Turks & Caicos, U.S., Venezuela,				
Remote tracking (satellite or other)	Y	Anguilla, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Guadeloupe, Mexico, St. Bartholome, St. Lucia, Turks & Caicos, U.S.	Y	Mexico, U.S.	N	French Guiana, Venezuela	Y	Anguilla, Bahamas, Bonnaire, Cayman Islands, Cuba, French Guiana, Guadeloupe, Martinique, Mexico, St. Eustatius, Turks & Caicos, U.S., Venezuela,	Y	Azores, Belize, Bonnaire, Canada, Cayman Islands, Cuba, Madeira, Mexico, Venezuela, U.S.	N	Canada, Cuba, France, Guadeloupe, Martinique, St. Bartholome, St. Eustatius, St. Martin, Suriname, Venezuela, U.S.
Survival rates	N		Y	U.S.	N	Venezuela	Y	Venezuela	N Y(U.S.)	Azores, Cuba, Madeira, Mexico, Venezuela U.S.	N Y (U.S.)	Cuba, St. Bartholome, St. Eustatius, St. Martin, Venezuela, U.S.
Population dynamics	Y	Cuba, Guadeloupe, Mexico	Y	Mexico, UK-Ireland, U.S.	N	Venezuela	Y	Bahamas, Bonnaire, Cuba, Guadeloupe, Mexico, Venezuela	Y	Azores, Bahamas, Bonnaire, Cuba, Madeira, Mexico,	Y (UK-Ireland, U.S., Can); N	Canada, Cuba, France Atlantic, Guadeloupe, St. Bartholome,

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
								U.S.		UK-Ireland, U.S.		St. Eustatius, St. Martin, UK-Ireland, Suriname, Venezuela U.S.
Foraging ecology (diet or isotopes)	Y	Bahamas, Cayman Islands, Cuba, Mexico, St. Lucia, Turks & Caicos, U.S.	Y	Mexico U.S.	N	Venezuel a	Y	Bahamas, Bonnaire, Cuba, Guadeloupe, Martinique, Mexico, Turks & Caicos, U.S., Venezuela	N Y(U.S.)	Azores, Bahamas, Cuba, Madeira, Mexico, Portugal (Mainland), Venezuela U.S., Canada	N Y(U.S.)	Canada, Cuba, France Atlantic, St. Bartholome, St. Eustatius, St. Martin, Venezuela U.S.
Capture-Mark-Recapture	Y	Anguilla, Bahamas, Belize, Cayman Islands, Colombia, Cuba, Martinique, Mexico, Montserrat, St. Lucia, Turks & Caicos, U.S., Venezuela,	Y	Mexico U.S.	N	Venezuel a	Y	Anguilla, Bahamas, Cayman Islands, Colombia, Cuba, Martinique, Mexico, Montserrat, St. Eustatius, Suriname, Turks & Caicos, U.S., Venezuela	Y	Bahamas, Belize, Canada, Cuba, Mexico, Turks & Caicos, U.S., Venezuela	Y	Canada. St. Eustatius, Suriname, Venezuela U.S.

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
Threats												
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL; SN; DN; Turtle Nets; PLL; FP)	Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Guatemala, Mexico, St. Bartholom e, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	Y (SN, ST)	Mexico, Portugal (Mainland), UK-Ireland	Y (SN, DN)	Suriname, Venezuel a	Y (PLL, DLL, SN, FP)	Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Portugal (Mainland), St. Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, Venezuela	Y (DLL; SN; DN; Turtle Nets)	Bonnaire, Cayman Islands, Cuba, Curacao, Mexico, Portugal (Mainland), Turks & Caicos, UK-Ireland, Venezuela	Y (DLL; SN; DN; Turtle Nets); PLL, SN, OTH (UK-Ire)	Colombia, Cuba, France Atlantic, Grenada, Guatemala, Mexico, Portugal (Mainland), St. Bartholome, St. Martin, Suriname, UK-Ireland, Venezuela
Bycatch: presence of industrial fisheries?	Y (PLL, DLL, ST, MT, FP) Y (PLL, DLL, SN, DN, ST,	Cuba, Curacao, Guatemala, Mexico U.S.	Y (ST, Mex) Y (PLL, DLL, SN, DN, ST, MT, FP, PN,	Mexico U.S.	Y (ST)	French Guiana, Suriname	Y (PLL, DLL, ST, MT, FP) Y (PLL, DLL, SN, DN, ST,	Cuba, Curacao, Mexico, Suriname, Venezuela U.S.	Y Y (PLL, DLL, SN, DN, ST, MT, FP, PN,	Azores, Canada, Cuba, Curacao Madeira, U.S.	Y (PLL, SN, BT, OTH, UK-Ire) Y (PLL, DLL, SN,	Canada, Colombia, Cuba, France Atlantic, Guatemala, Suriname,

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
	MT, FP, PN, OTH, U.S.)		OTH, U.S.)				MT, FP, PN, OTH, U.S.)		OTH, U.S.) Y (PLL, Can)		DN, ST, MT, FP, PN, OTH, U.S.) Y (PLL, FP, OTH, Can)	UK-Ireland, U.S.
Bycatch: quantified?	Y	Bonnaire, Cuba, Curacao, Guadeloupe, Martinique, Mexico, U.S.	Y	Mexico, UK-Ireland, U.S.	n/a		Y	Bonnaire, Colombia, Cuba, Curacao, Guadeloupe, Mexico, Suriname, U.S.	Y	Azores, Bonnaire, Canada, Cuba, Curacao, Mexico, Saint Pierre et Miquelon, UK-Ireland, U.S.	Y	Cuba, France Atlantic, Guadeloupe, Suriname, UK-Ireland, U.S.
Take. Intentional killing or exploitation of turtles	Y, N (Cur, Gua)	Bahamas, Belize, Cayman Islands, Colombia, Cuba, Curacao, Guadeloupe, Guatemala, Martinique,	Y	Mexico	N	Venezuela	Y, N(Cur)	Anguilla, Aruba, Bahamas, Belize, Cayman Islands, Colombia, Cuba, Curacao, Grenada, Guadeloupe,	Y, N (Cur)	Bahamas, Belize, Cayman Islands, Colombia, Cuba, Curacao, Grenada, Mexico, Venezuela	Y; N (Gua)	Colombia, Guatemala, St. Martin, Suriname, Venezuela

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
		Mexico, Montserrat, St. Martin, St. Lucia, Turks & Caicos, Venezuela						Martinique, Mexico, Montserrat, St. Martin, Turks & Caicos, Venezuela				
Take. Egg poaching	Y	Belize, Colombia, Curacao, Guadeloupe, Guatemala, Mexico, St. Lucia, Turks & Caicos	Y	Mexico	Y	Suriname	Y	Belize, Cayman Islands, Curacao, Guadeloupe, Martinique, Mexico, Suriname, Turks & Caicos	Y	Belize, Bonnaire, Colombia, Curacao, Mexico, Venezuela	Y	Colombia, Guatemala, St. Bartholome, St. Lucia, St. Martin, Suriname
Coastal Development. Nesting habitat degradation	Y	Anguilla, Aruba, Bahamas, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Guadeloupe, Guatemala, Martinique,	Y	Mexico U.S.	Y	Suriname, Venezuela	Y	Anguilla, Aruba, Bahamas, Belize, Cayman Islands, Colombia, Cuba, Guadeloupe, Madeira, Mexico, Montserrat, St.	Y	Aruba, Bahamas, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Montserrat, Turks &	Y	Anguilla, Aruba, Colombia, Guadeloupe, Guatemala, Martinique, Mexico, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Suriname, U.S.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
		Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, St. Lucia, Turks & Caicos						Bartholome, St. Eustatius, St. Martin, Suriname, Turks & Caicos, U.S.		Caicos, U.S.		
Coastal Development. Photopollution	Y, N (Cur)	Anguilla, Aruba, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Guadeloupe, Guatemala, Martinique, Mexico, Montserrat, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	Y	Mexico U.S.	Y	Venezuela	Y, N (Cur)	Anguilla, Aruba, Belize, Cayman Islands, Colombia, Cuba, Curacao, Guadeloupe, Martinique, Mexico, Montserrat, St. Eustatius, St. Martin, Turks & Caicos, U.S., Venezuela,	Y, N (Cur)	Aruba, Belize, Bonnaire, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Montserrat, Turks & Caicos, U.S.	Y	Anguilla, Aruba, Colombia, Guadeloupe, Guatemala, Martinique, Mexico, St. Martin, St. Eustatius U.S.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Coastal Development. Boat strikes	Y	Anguilla, Aruba, Belize, Bonnaire, Cayman Islands, Colombia, Curacao, Guadeloupe, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Martin, St. Lucia, Turks & Caicos, U.S.	Y	Mexico U.S.	N		Y	Anguilla, Aruba, Bahamas, Belize, Bonnaire, Cayman Islands, Colombia, Curacao, Guadeloupe, Madeira, Martinique, Mexico, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, U.S.	Y	Bahamas, Belize, Cayman Islands, Colombia, Curacao, Madeira, Mexico, Portugal (Mainland), Venezuela U.S.	Y	Anguilla, Colombia, France Atlantic, Guadeloupe, Guatemala, Mexico, Portugal (Mainland), St. Bartholome, St. Lucia, St. Martin, UK-Ireland, Venezuela U.S.

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
Egg predation	Y	Anguilla, Belize, Cayman Islands, Colombia, Cuba, Curacao, Guadeloupe, Guatemala, Martinique, Mexico, Montserrat, St. Martin, St. Lucia, U.S.	Y	Mexico U.S.	Y	French Guiana, Suriname	Y	Belize, Cayman Islands, Cuba, Curacao, Guadeloupe, Martinique, Mexico, Montserrat, St. Martin, Suriname, U.S.	Y	Belize, Cayman Islands, Cuba, Curacao, Mexico, U.S.	Y	Guadeloupe, Guatemala, Martinique, St. Lucia, St. Martin, Suriname, U.S.
Pollution (debris, chemical)	Y	Anguilla, Bonnaire, Cayman Islands, Colombia, Guadeloupe, Guatemala, Martinique, Mexico, St. Eustatius, Turks & Caicos, U.S., Venezuela,	Y	Mexico U.S.	Y	Venezuela	Y	Anguilla, Bonnaire, Cayman Islands, Colombia, Cuba, Guadeloupe, Madeira, Martinique, Mexico, St. Eustatius, Turks & Caicos, U.S., Venezuela	Y	Azores, Bonnaire, Cayman Islands, Colombia, Madeira, Mexico, Turks & Caicos, U.S., Venezuela	Y	Anguilla, Canada, Colombia, France, Guadeloupe, Guatemala, Martinique, Mexico, St. Eustatius, Venezuela U.S.

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
Pathogens	Y	Mexico, St. Eustatius, Turks & Caicos, U.S., Venezuela	Y	U.S.	n/a		Y	Bahamas, Cuba, Guadeloupe, Martinique, Mexico, St. Eustatius, Turks & Caicos, U.S., Venezuela	Y	Canada, Mexico U.S.	Y	Canada,St. Eustatius U.S.
Climate change	Y	Anguilla, Bahamas, Bonnaire, Cayman Islands, Cuba, Curacao, Guatemala, Mexico, Montserrat, St. Bartholom e, St. Eustatius, St. Martin, U.S.	Y	Mexico U.S.	n/a		Y	Anguilla, Bahamas, Bonnaire, Cayman Islands, Cuba, Curacao, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, U.S., Venezuela,	Y	Bahamas, Bonnaire, Cayman Islands, Cuba, Mexico, Montserrat, Turks & Caicos, U.S.	Y	Anguilla, Canada, Colombia, Guatemala, Mexico, St. Eustatius, U.S.,

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Foraging habitat degradation	Y	Anguilla, Colombia, Cuba, Curacao, Guadeloupe, Guatemala, St. Bartholome, St. Eustatius, St. Martin, St. Lucia, Turks & Caicos, Venezuela	Y	U.S.	N	Venezuela	Y	Anguilla, Belize, Bonnaire, Colombia, Cuba, Curacao, Guadeloupe, Madeira, Martinique, Mexico, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, U.S., Venezuela,	Y	Azores, Colombia, Curacao, Madeira, Portugal (Mainland), Turks & Caicos, U.S., Venezuela,	Y	France Atlantic, Guatemala, St. Bartholome, St. Lucia, St. Martin, Venezuela, U.S.
Other	Y (see text)	Belize, Cayman Islands, Colombia, Cuba, St. Bartholome, St. Martin, U.S.	Y (see text)	U.S.	Y	Suriname	Y (see text)	Belize, Cayman Islands, Cuba, St. Bartholome, St. Martin, Suriname, U.S., Venezuela.	Y (see text)	Belize, Cayman Islands, Cuba, U.S.	Y (see text)	St. Bartholome, St. Martin, Suriname, U.S.
Long-term projects (>5yrs)												

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Monitoring at nesting sites (period: range of years)	Y (1988-ongoing) Y (1979-present, U.S.)	Anguilla, Aruba, Belize, Cayman Islands, Colombia, Cuba, Curacao, Mexico, St. Bartholom e, Montserrat, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos, U.S.	Y (1977-ongoing) Y (1986-present, U.S.)	Mexico U.S.	Y (1968-ongoing)	Suriname	Y (1983-ongoing Cuba; 1979-ongoing Venezuela); 1988-on going Mexico, St. Eustatius) Yes (1979-present, U.S.), (1968-ongoing, Suriname)	Anguilla, Aruba, Belize, Cayman Islands, Cuba, Curacao, Mexico, Montserrat, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, Suriname, U.S., Venezuela.	Y (1983-ongoing Cuba) (1988-ongoing Mexico) Yes (1979-Present, U.S.)	Aruba, Cayman Islands, Cuba, Curacao, Mexico, Montserrat, U.S.	Y (1999-ongoing St. Eustatius) Y (1979-present, U.S.) Y (1968-ongoing, Suriname)	Anguilla, Aruba, Colombia, St. Bartholome, St. Eustatius, St. Martin, Suriname, U.S.
Number of index nesting sites	75	Anguilla, Belize, Colombia, Cuba, Curacao, Martinique, Mexico, St. Bartholom e, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos	6	Mexico	>=3		79	Anguilla, Belize, Cuba, Curacao, Martinique, Mexico, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	23 78 (U.S.)	Cuba, Curacao, Mexico, U.S.	9	Colombia, Martinique, St. Bartholome, St. Eustatius, St. Martin

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
Monitoring at foraging sites (period: range of years)	Y (1992-2006 Cuba; 2000-ongoing Venezuela; 1992- 2017 Mexico, Guatemala, St. Eustatius) Y (2003-2012, U.S.)	Anguilla, Belize, Colombia, Cuba, Curacao, Mexico, St. Eustatius, St. Lucia, Turks & Caicos, U.S., Venezuela,	N Y (1995-2009; 1991-2013, U.S.)	Mexico, Portugal (Mainland), U.S.	N	Venezuela	Y (2001-on going; Bahamas 1974-2020) Y (1995-2009; 1982-2006; 1991-2010; 2003-2012, U.S.)	Anguilla, Bahamas, Belize, Colombia, Cuba, Curacao, Mexico, Portugal (Mainland), St. Eustatius, Turks & Caicos, U.S.	Y (2000-ongoing Venezuela; 1988-ongoing Mexico) Y (1995-2009; 2000-2011; 2011-2012; 1982-2006; 2003-2012, U.S.)	Azores, Madeira, Mexico, Portugal (Mainland), Venezuela U.S.	Y (2000-ongoing Venezuela) Y (2001-present, Can)	Canada, French Atlantic, Portugal (Mainland), Venezuela.
Conservation												
Protection under national law	Y	Anguilla, Aruba, Bahamas, Belize, Cayman Islands, Colombia, Cuba, Curacao, Guadeloupe, Guatemala, Martinique, Mexico,	Y	Mexico, UK-Ireland, U.S.	Y	Suriname, Venezuela	Y	Anguilla, Aruba, Bahamas, Belize, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Montserrat, St. Bartholome, St. Eustatius,	Y	Aruba, Bahamas, Belize, Canada, Cayman Islands, Colombia, Cuba, Curacao, Mexico, Montserrat, Turks & Caicos, UK-	Y	Anguilla, Aruba, Bahamas, Belize, Canada, Colombia, Cuba, France Atlantic, Guatemala, Mexico, St. Bartholome, St. Eustatius, St. Lucia, St. Martin,

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
		Montserrat, St. Bartholom e, St. Eustatius, St. Martin, Turks & Caicos, U.S Venezuela.						St. Martin, Suriname, Turks & Caicos, U.S., Venezuela.		Ireland, U.S., Venezuela,		Suriname, UK-Ireland, U.S., Venezuela,
Number of protected nesting sites (habitat preservation) (% nests)	>80%, 39% (Ang)	Anguilla, Cayman Islands, Cuba, Guatemala, Mexico, St. Bartholom e, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	50	Mexico	15%		80-100%; 16(85.5%) (St. Eustatius), 17% (Ang)	Anguilla, Cayman Islands, Cuba, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	80-100%	Cayman Islands, Cuba, Venezuela	7, 1 (St. Eus.100 %); 1 (Venezuel a); 3 (Gua)	Guatemala, St. Bartholome, St. Eustatius, St. Martin, Venezuela
Number of Marine Areas with mitigation of threats	14	Cayman Islands, Cuba, St. Bartholom e, St. Eustatius,	0	Mexico	0		13	Cayman Islands, Cuba, St. Bartholome, St. Eustatius, St. Martin	12 4 (Can)	Canada, Cayman Islands, Cuba, Venezuela.	7 4 (Can)	Canada, St. Bartholome, St. Eustatius, St. Lucia, St. Martin, Venezuela.

	E. imbricata	**Country Chapters**	*L. kempii*	**Country Chapters**	*L. olivacea*	**Country Chapters**	*C. mydas*	**Country Chapters**	*C. caretta*	**Country Chapters**	*D. coriacea*	**Country Chapters**
		St. Martin, Venezuela										
N of long-term conservation projects (period: range of years)	11 (1988-ongoing), >1(2014-ongoing, Curacao)	Belize, Cayman Islands, Cuba, Curacao, Mexico, St. Bartholom e, St. Eustatius, St. Lucia, St. Martin, Turks & Caicos, Venezuela	1 (1975-2011)	Mexico	1 (2009-2023)	Venezuel a	>10 (1990-ongoing Mexico, St. Eustatius); 9 (1983-ongoing Cuba; 1979-ongoing Venezuela); 1 (Cur, 2014-ongoing), 3 (Bel)	Belize, Cayman Islands, Cuba, Curacao, Mexico, St. Bartholome, St. Eustatius, St. Martin, Turks & Caicos, Venezuela	5 (1983-ongoing); 10 (1990-ongoing Mexico), >1 (Cur), 3 (Bel)	Belize, Cayman Islands, Cuba, Curacao, Mexico, Venezuela	>6 (1988-ongoing France Atlantic); St. Eustatius, Venezuel a) 1 (1997-present, Can)	Canada, France Atlantic, Grenada, St. Bartholome, St. Eustatius, St. Martin, Venezuela.
In-situ nest protection (egg cages)	Y	Cayman Islands, Mexico	Y	Mexico	N		Y	Belize, Cayman Islands, Mexico, U.S.	Y	Belize, Cayman Islands, Mexico, U.S.	n/a; N (St. Eustatius) Y (U.S.)	Cuba, France Atlantic, Mexico, St. Bartholome, St. Eustatius, St. Martin, U.S., Venezuela.

	E. imbricata	**Country Chapters**	***L. kempii***	**Country Chapters**	***L. olivacea***	**Country Chapters**	***C. mydas***	**Country Chapters**	***C. caretta***	**Country Chapters**	***D. coriacea***	**Country Chapters**
Hatcheries	Y	Cuba, Guatemala, Mexico	Y	Mexico, U.S.	Y	Suriname	Y	Cayman Islands, Cuba, Mexico, Suriname	Y	Cuba, Mexico, U.S.	Y (Col, Gua); n/a; N (St. Eustatius)	Colombia, Cuba, France Atlantic, Guatemala, St. Bartholome, St. Eustatius, St. Martin, Suriname, Venezuela
Head-starting	Y	Colombia, Cuba	N Y (U.S.)	Mexico U.S.	N	French Guiana	Y	Cayman Islands, Colombia, Mexico	Y Colombia), N	Colombia, Cuba, Mexico, U.S., Venezuela	N	France Atlantic, St. Bartholome, St. Eustatius, St. Martin, Venezuela
By-catch: fishing gear modifications (eg, TED, circle hooks)	Y (Mexico, U.S.)	Cuba, Mexico, St. Bartholom e, St. Martin, Venezuela, U.S.	Y	Mexico, Portugal (Mainland), U.S.	Y	Suriname, Venezuel a	Y	Colombia, Mexico, Portugal (Mainland), Suriname, U.S.	Y	Azores, Canada, Colombia, Mexico, Portugal (Mainland), U.S.	Y	Mexico, Portugal (Mainland), Suriname, U.S.
By-catch: onboard best practices	Y	Cuba, Mexico, U.S.	Y	Mexico, Portugal (Mainland), UK-Ireland, U.S.	Y	Venezuel a	Y	Cuba, Mexico, Portugal (Mainland), U.S., Venezuela.	Y	Azores, Canada, Cuba, Portugal (Mainland), UK-Ireland,	Y	France Atlantic, Portugal (Mainland), St. Eustatius, UK-Ireland, U.S., Venezuela.

	E. imbricata	Country Chapters	*L. kempii*	Country Chapters	*L. olivacea*	Country Chapters	*C. mydas*	Country Chapters	*C. caretta*	Country Chapters	*D. coriacea*	Country Chapters
										U.S., Venezuela,		
By-catch: spatio-temporal closures/reduction	Y	Cayman Islands, Cuba, Mexico	Y	Mexico	Y	Suriname	Y	Cayman Islands, Cuba, Suriname, Mexico	Y	Canada, Cayman Islands, Cuba, Mexico.	Y	Canada, Mexico, Suriname
Other	Y (see text)	Cayman Islands, Cuba, St. Bartholome, St. Lucia, St. Martin, Venezuela	N	Mexico	N		Y (see text)	Cayman Islands, Cuba, St. Bartholome, St. Martin, Venezuela	Y (see text)	Cayman Islands, Cuba	Y (see text)	St. Bartholome, St. Martin

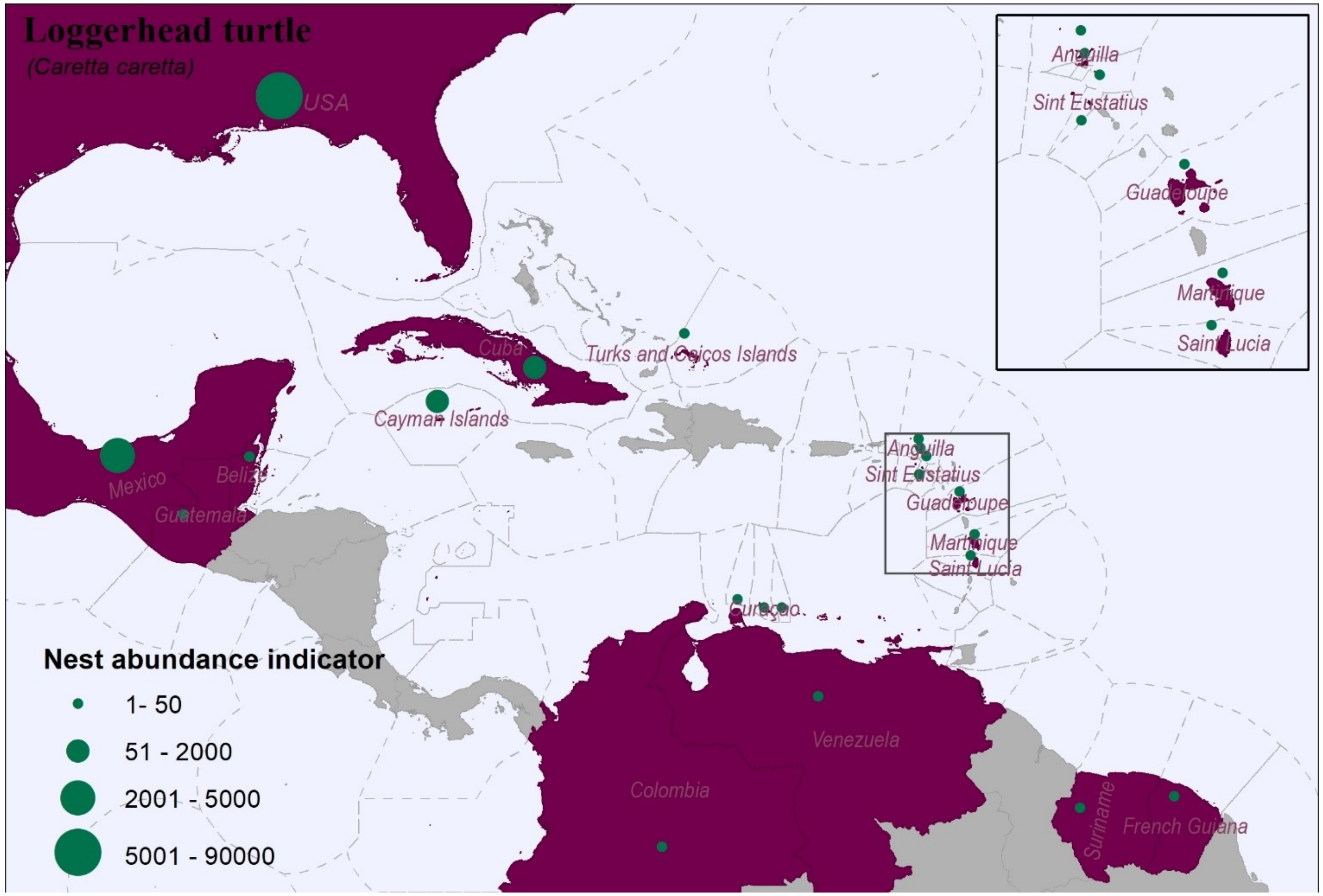

Figure 1. Categorized spatial distribution of the sum of reported average nests per year for loggerhead turtles (*Caretta caretta*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

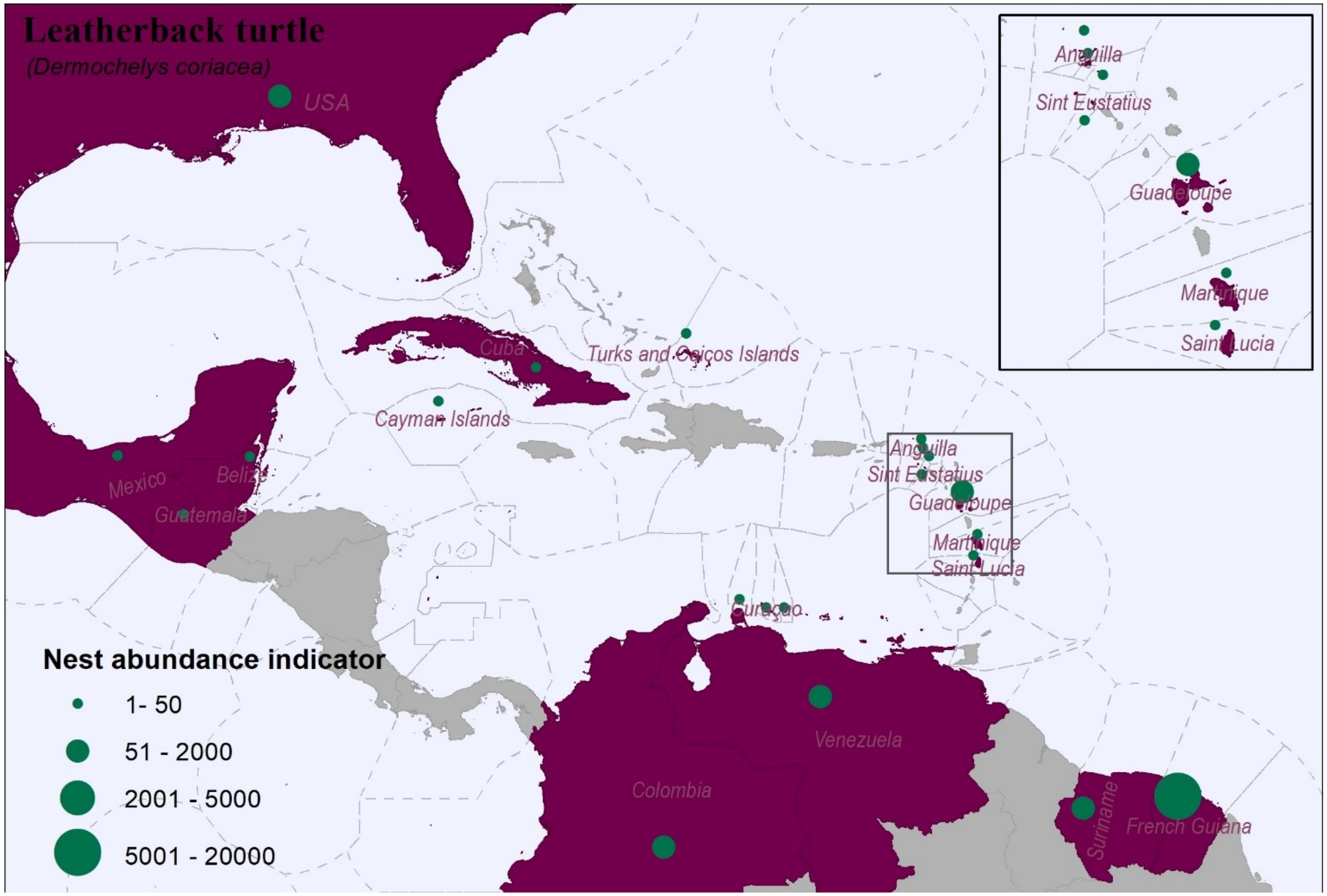

Figure 2. Categorized spatial distribution of the sum of reported average nests per year for leatherback turtles (*Dermochelys coriacea*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

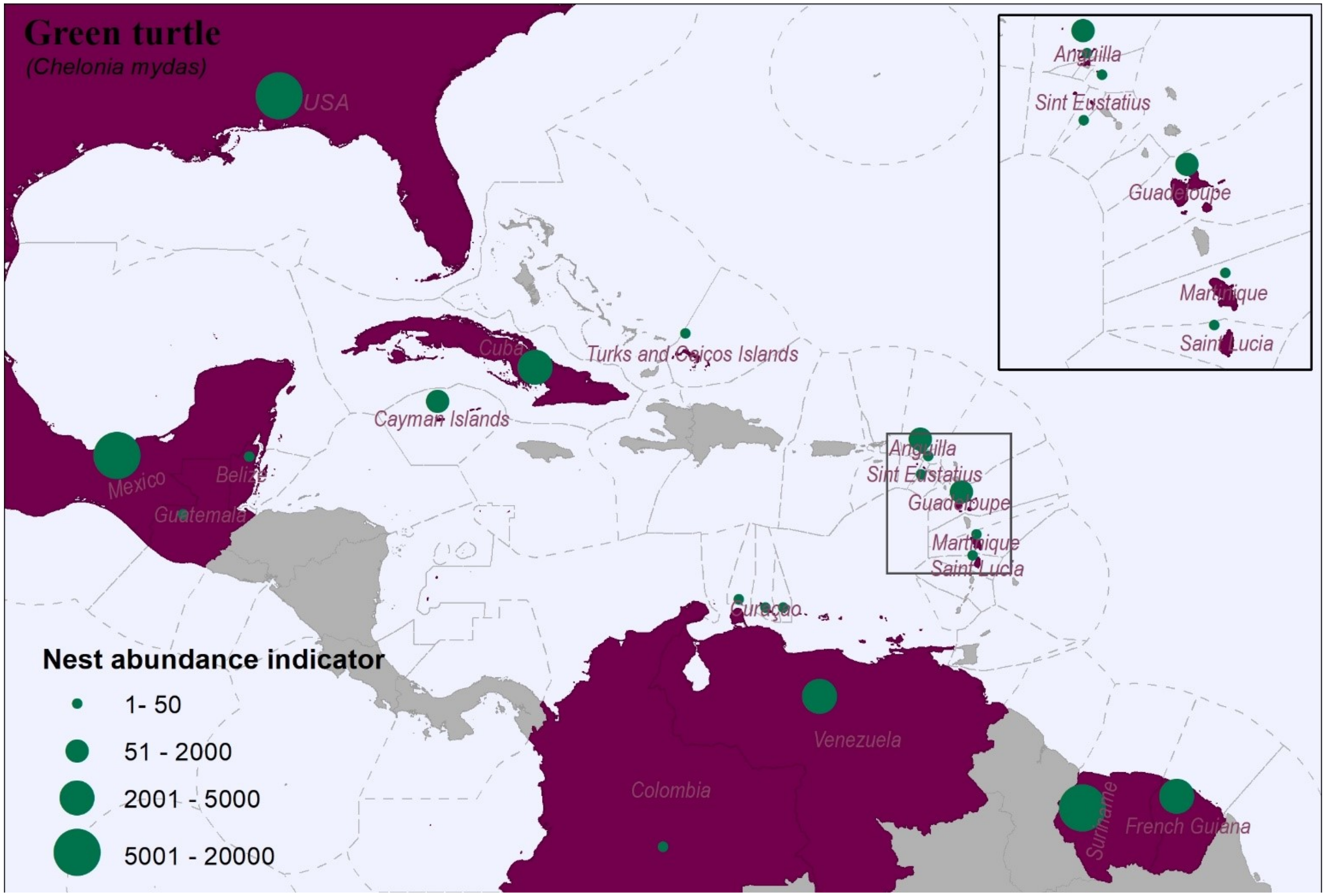

Figure 3. Categorized spatial distribution of the sum of reported average nests per year for green turtles (*Chelonia mydas*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

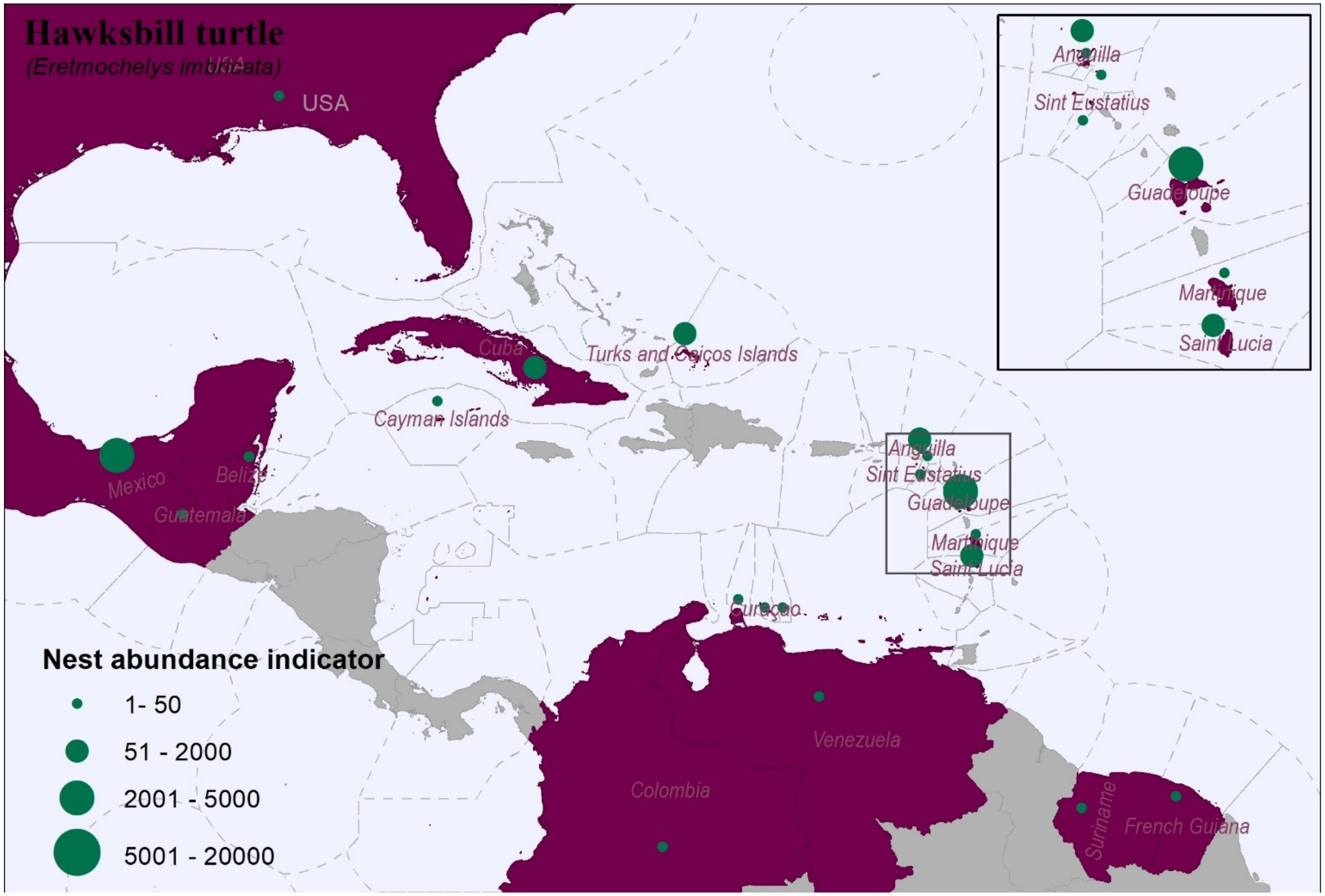

Figure 4. Categorized spatial distribution of the sum of reported average nests per year for hawksbill turtles (*Eretmochelys imbricata*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

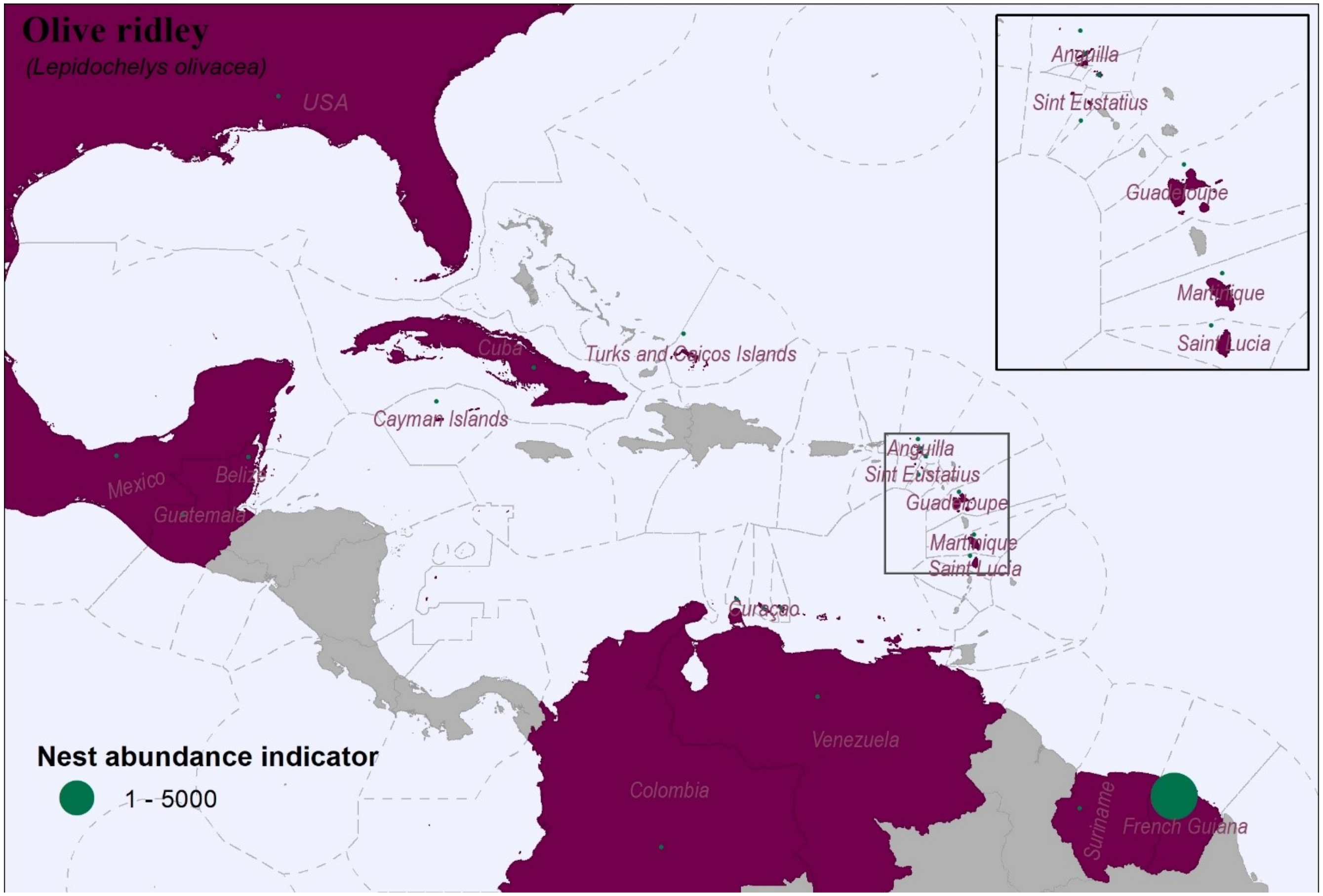

Figure 5. Categorized spatial distribution of the sum of reported average nests per year for olive ridley turtles (*Lepidochelys olivacea*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

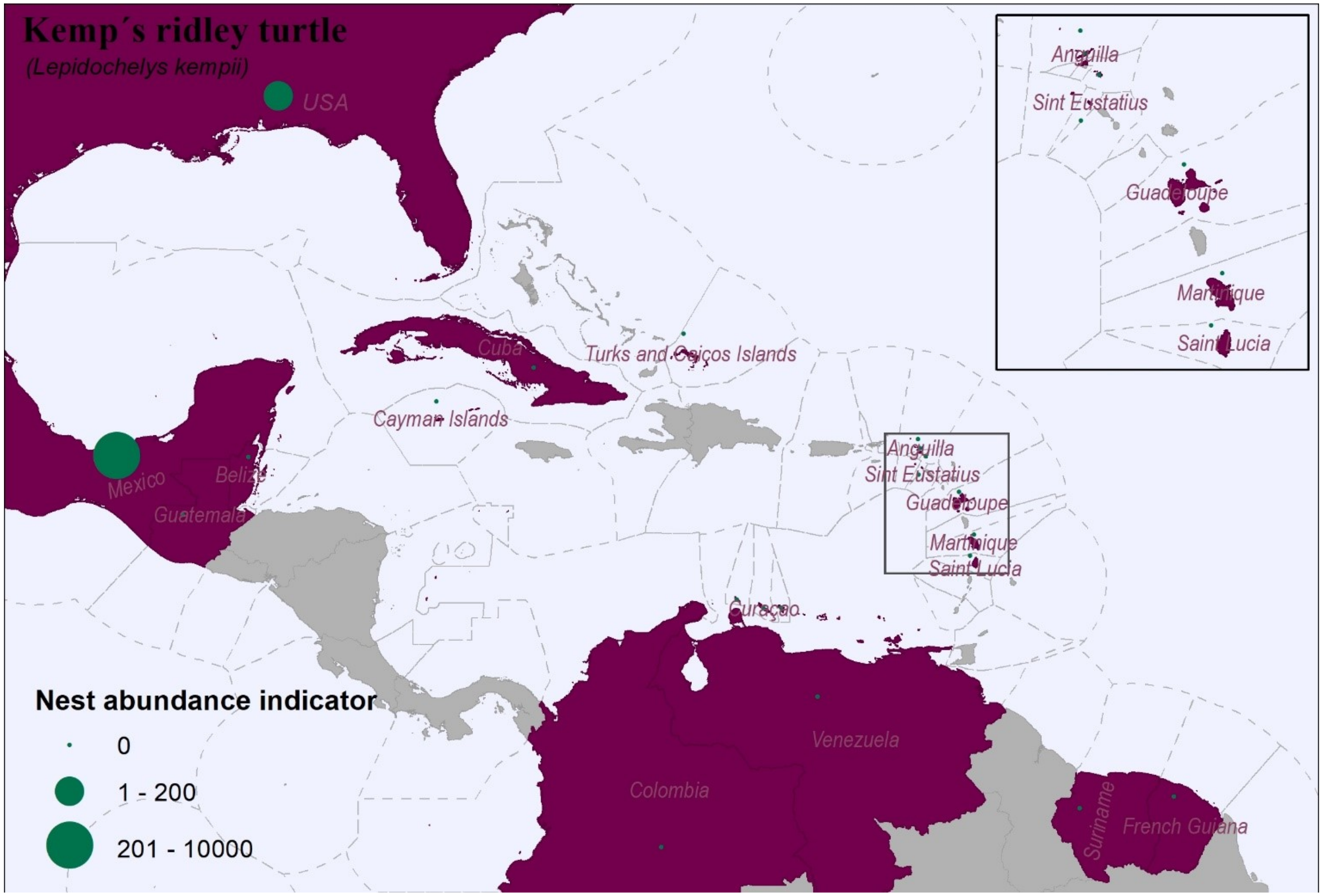

Figure 6. Categorized spatial distribution of the sum of reported average nests per year for Kemp's Ridley turtles (*Lepidochelys kempii*) in each participant country in the Regional Management Unit Northwest Atlantic. Nesting Abundance Indicator placement on this map does not refect physical placement of nesting activities

Anguilla

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1.1. Distribution, abundance, trends.

Please see Table 1.

1.2. Other biological data

Please see Table 1.

Table 1. Biological and conservation information about sea turtle Regional Management Units in Anguilla.

RMU	***C. mydas***	Ref #	***E. imbricata***	Ref #	***D. coriacea***	Ref #
Occurrence						
Nesting sites	Y		Y		Y	
Oceanic foraging areas	Y		Y		U	
Neritic foraging areas	U		U		U	
Key biological data						
Nests/yr: recent average (range of years)	8 (2016-2018)	Table 2	51 (2016-2018)	Table 2	3 (2016-2018)	Table 2
Nests/yr: recent order of magnitude						
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0		0		0	
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	8	Table 2	13	Table 2	3	Table 2
Nests/yr at "major" sites: recent average (range of years)	0		0		0	

Nests/yr at "minor" sites: recent average (range of years)	8 (2016-2018)	Table 2	51 (2016-2018)	Table 2	3 (2016-2018)	Table 2
Total length of nesting sites (km)	4.99	Table 2	6.95	Table 2	3.11	Table 2
Nesting females / yr	10	1	38	1	1.3	1
Nests / female season (N)	U		U		U	
Female remigration interval (yrs) (N)	U		U		U	
Sex ratio: Hatchlings (F / Tot) (N)	U		U		U	
Sex ratio: Immatures (F / Tot) (N)	U		U		U	
Sex ratio: Adults (F / Tot) (N)	U		U		U	
Min adult size, CCL or SCL (cm)	U		U		U	
Age at maturity (yrs)	U		U		U	
Clutch size (n eggs) (N)	91.9 (2016-2018)	Table 2	113.6 (2016-2018)	Table 2	104.4 (2016-2018)	Table 2
Emergence success (hatchlings/egg) (N)	0.89	Table 2	0.84	Table 2	0.68	Table 2
Nesting success (Nests/ Tot emergence tracks) (N)	0.11	Table 2	0.27	Table 2	0.63	Table 2
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	U		U		U	
Recent trends (last 20 yrs) at foraging grounds (range of years)	U		U		U	
Oldest documented abundance: nests/yr (range of years)	U		U		U	
Published studies						
Growth rates	N		N		N	
Genetics	N		N		N	
Stocks defined by genetic markers	Y	1	Y	1	N	1
Remote tracking (satellite or other)	Y	1	Y	1	N	1

Survival rates	N		N		N	
Population dynamics	N		N		N	
Foraging ecology	N		N		N	
Capture-Mark-Recapture	Y	1	Y	1	N	1
Threats						
Bycatch: presence of small scale / artisanal fisheries?	U	2	U	2	U	2
Bycatch: presence of industrial fisheries?	n/a		n/a		n/a	
Bycatch: quantified	U	2	U	2	U	2
Intentional killing of turtles	Y	2	N	2	N	2
Take. Illegal take of turtles	Y	2	N	2	N	2
Take. Permitted/legal take of turtles	n/r		n/r		n/r	
Take. Illegal take of eggs	n/r		n/r		n/r	
Take. Permitted/legal take of eggs	n/r		n/r		n/r	
Coastal Development. Nesting habitat degradation	Y	2	Y	2	Y	2
Coastal Development. Photopollution	Y	2	Y	2	Y	2
Coastal Development. Boat strikes	U	2	U	2	U	2
Egg predation	U	2	Y	2	U	2
Pollution (debris, chemical)	Y	2	Y	2	Y	2
Pathogens	U	2	U	2	U	2
Climate change	Y	2	Y	2	Y	2
Foraging habitat degradation	Y	2	Y	2	U	2

Other						
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (1991-ongoing)	Table 4	Y (1991-ongoing)	Table 4	Y (1991-ongoing)	Table 4
Number of index nesting sites	17	Table 2	17	Table 2	0	
Monitoring at foraging sites (period: range of years)	2 (1999-on-going)	Table 4	2 (1999-on-going)	Table 4	N	
Conservation						
Protection under national law	Y	3,4	Y	3,4	Y	3,4
Number of protected nesting sites (habitat preservation) (% nests)	4 (17%)	3-5	8 (39%)	3-5	4 (40%)	3-5
Number of Marine Areas with mitigation of threats	0		0		0	
N of long-term conservation projects (period: range of years)	0		0		0	
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		N		N	
Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other						

1.3. Threats

1.3.1. Nesting sites (Table 2)

Table 2. Sea turtle nesting beaches in Anguilla.

RMU	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CM-NE ATL				Long	Lat	Long	Lat	Long	Lat					
Blackgardens Bay	Y	0 (2016-2018)	0.3 (2016-2018)	18.236478	63.066189	18.236931	63.065819	18.236644	63.065981	0.06	100		2	D
Captains Bay	Y	2 (2016-2018)	5.7 (2016-2018)	18.262794	62.981006	18.264231	62.979719	18.263331	62.980172	0.11	100		2	D
Crocus Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.217729	63.068517	18.220842	63.066806	18.219375	63.067456	0.42	100		2	D
Deadman's Bay, Scrub Island	Y	unconfirmed	1.7 (2016-2018)	18.293753	62.934978	18.292050	62.934044	18.292942	62.934689	0.21	100		2	D
Elsie Bay	N	0.7 (2016-2018)	0.3 (2016-2018)	18.189017	63.063125	18.188764	63.062883	18.188881	63.062992	0.04	100		2	D
Graftin's Point, Scrub Island	Y	unconfirmed	2.7 (2016-2018)	18.284619	62.956475	18.286347	62.956969	18.285503	62.956650	0.21	100		2	D
Great Bay, Dog Island	Y	unconfirmed	1.7 (2016-2018)	18.274083	63.255828	18.272222	63.251686	18.273461	63.253344	0.55	100		2	D
Limestone Bay	Y	0 (2016-2018)	0.3 (2016-2018)	18.233561	63.070050	18.233753	63.069672	18.233644	63.069794	0.06	100		2	D
Lockrum Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.173197	63.084303	18.173283	63.083819	18.173250	63.084028	0.20	100		2	D
Maundays Bay	N	1.3 (2016-2018)	1 (2016-2018)	18.162472	63.148672	18.164258	63.141864	18.164703	63.146083	0.89	100		2	D

Meads Bay	N	0.7 (2016-2018)	0.3 (2016-2018)	18.179303	63.142628	18.186722	63.134619	18.182239	63.138056	1.37	100		2	D
Merrywing Bay	N	2 (2016-2018)	2 (2016-2018)	18.168928	63.126711	18.172142	63.122850	18.170531	63.124769	0.55	100		2	D
Mimi Bay	Y	1.3 (2016-2018)	3.7 (2016-2018)	18.227931	62.990703	18.229267	62.987939	18.228986	62.989781	0.45	100		2	D
Prickly Pear East	Y	unconfirmed	7.4 (2016-2018)	18.264331	63.173669	18.262797	63.168450	18.265633	63.170911	0.80	100		2	D
Prickly Pear West	Y	unconfirmed	4.3 (2016-2018)	18.267331	63.183442	18.266883	63.182614	18.267092	63.183042	0.10	100		2	D
Savannah Bay, Dog Island	Y	unconfirmed	6.7 (2016-2018)	18.282231	63.247308	18.282872	63.245253	18.280347	63.246492	0.27	100		2	D
Savannah Bay East, Dog Island	Y	unconfirmed	1.3 (2016-2018)	18.282231	63.238053	18.282872	63.236750	18.282558	63.237367	0.16	100		2	D
Savannah Bay/Junks Hole	Y	0 (2016-2018)	0.3 (2016-2018)	18.250689	62.986250	18.243689	62.983456	18.248122	62.987169	1.19	100		2	D
Scrub Bay, Scrub Island	Y	0.7 (2016-2018)	6 (2016-2018)	18.284258	62.956158	18.279628	62.955936	18.291978	62.955906	0.47	100		2	D
Sherricks Bay	Y	0 (2016-2018)	1.7 (2016-2018)	18.162706	63.164675	18.162489	63.161478	18.163100	63.163183	0.37	100		2	D
Shoal Bay East	Y	0.7 (2016-2018)	1.3 (2016-2018)	18.252378	63.037631	18.254531	63.024361	18.254361	63.031789	1.70	100		2	D
Spring Bay, Dog Island	Y	unconfirmed	6.7 (2016-2018)	18.279858	63.260089	18.281211	63.258403	18.280314	63.258997	0.26	100		2	D
Stoney Bay, Dog Island	Y	0.7 (2016-2018)	5.7 (2016-2018)	18.272559	63.250422	18.274408	63.245060	18.273503	63.250.369	0.24	100		2	D
EI-SC ATL														
Auntie Dol Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.204033	63.034225	18.204261	63.033483	18.204200	63.033783	0.08	100		2	D
Blackgardens Bay	Y	10.6 (2016-2018)	26 (2016-2018)	18.236478	63.066189	18.236931	63.065819	18.236644	63.065981	0.06	100		2	D
Captains Bay	Y	0.7 (2016-2018)	5.3 (2016-2018)	18.262794	62.981006	18.264231	62.979719	18.263331	62.980172	0.11	100		2	D

Deadman's Bay, Scrub Island	Y	unconfirmed	5.3 (2016-2018)	18.293753	62.934978	18.292050	62.934044	18.292942	62.934689	0.21	100		2	D
Elsie Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.189017	63.063125	18.188764	63.062883	18.188881	63.062992	0.04	100		2	D
Forest Bay	N	0 (2016-2018)	0.7 (2016-2018)	18.195503	63.047875	18.197589	63.043842	18.197825	63.046608	0.61	100		2	D
Graftin's Point, Scrub Island	Y	unconfirmed	1.3 (2016-2018)	18.284619	62.956475	18.286347	62.956969	18.285503	62.956650	0.21	100		2	D
Great Bay, Dog Island	Y	unconfirmed	4.7 (2016-2018)	18.274083	63.255828	18.272222	63.251686	18.273461	63.253344	0.55	100		2	D
island Harbour	N	0 (2016-2018)	0.3 (2016-2018)	18.258964	63.004783	18.256375	63.001450	18.257411	63.003511	0.32	100		2	D
Katouche Bay	N	0.7 (2016-2018)	0.7 (2016-2018)	18.212097	63.076353	18.212856	63.075208	18.212378	63.075775	0.14	100		2	D
Limestone Bay	Y	1.3 (2016-2018)	3 (2016-2018)	18.233561	63.070050	18.233753	63.069672	18.233644	63.069794	0.06	100		2	D
Lockrum Bay	N	0 (2016-2018)	1 (2016-2018)	18.173197	63.084303	18.173283	63.083819	18.173250	63.084028	0.20	100		2	D
Long Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.190819	63.131283	18.191194	63.125208	18.191583	63.128547	0.75	100		2	D
Maundays Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.162472	63.148672	18.164258	63.141864	18.164703	63.146083	0.89	100		2	D
Meads Bay	N	0.7 (2016-2018)	1.3 (2016-2018)	18.179303	63.142628	18.186722	63.134619	18.182239	63.138056	1.37	100		2	D
Merrywing Bay	N	2 (2016-2018)	2 (2016-2018)	18.168928	63.126711	18.172142	63.122850	18.170531	63.124769	0.55	100		2	D
Mimi Bay	Y	9.3 (2016-2018)	19.7 (2016-2018)	18.227931	62.990703	18.229267	62.987939	18.228986	62.989781	0.45	100		2	D
Prickly Pear East	Y	14.7 (2016-2018)	30.3 (2016-2018)	18.264331	63.173669	18.262797	63.168450	18.265633	63.170911	0.80	100		2	D
Prickly Pear West	Y	1.3 (2016-2018)	12.7 (2016-2018)	18.267331	63.183442	18.266883	63.182614	18.267092	63.183042	0.10	100		2	D
Savannah Bay, Dog Island	Y	unconfirmed	2.3 (2016-2018)	18.282231	63.247308	18.282872	63.245253	18.280347	63.246492	0.27	100		2	D

Savannah Bay East, Dog Island	Y	unconfirmed	2.7 (2016-2018)	18.282231	63.238053	18.282872	63.236750	18.282558	63.237367	0.16	100		2	D
Savannah Bay/Junks Hole	Y	0.3 (2016-2018)	1 (2016-2018)	18.250689	62.986250	18.243689	62.983456	18.248122	62.987169	1.19	100		2	D
Scrub, Scrub Island	Y	1.3 (2016-2018)	11.7 (2016-2018)	18.284258	62.956158	18.279628	62.955936	18.291978	62.955906	0.47	100		2	D
Sherricks Bay	Y	0 (2016-2018)	3.7 (2016-2018)	18.162706	63.164675	18.162489	63.161478	18.163100	63.163183	0.37	100		2	D
Shoal Bay East	Y	3.3 (2016-2018)	3.7 (2016-2018)	18.252378	63.037631	18.254531	63.024361	18.254361	63.031789	1.70	100		2	D
Shoal Bay West	N	0 (2016-2018)	1.3 (2016-2018)	18.163433	63.160525	18.162892	63.153517	18.164728	63.156356	0.91	100		2	D
Sile Bay	N	0 (2016-2018)	0.3 (2016-2018)	18.238358	62.985292	18.239806	63.982889	18.238967	62.983836	0.20	100		2	D
Spring Bay, Dog Island	Y	unconfirmed	9 (2016-2018)	18.279858	63.260089	18.281211	63.258403	18.280314	63.258997	0.26	100		2	D
Stoney Bay, Dog Island	Y	0.3 (2016-2018)	8.3 (2016-2018)	18.272559	63.250422	18.274408	63.245060	18.273503	63.250.369	0.24	100		2	D
DC-NW ATL														
Captains Bay	Y	0.7 (2016-2018)	0.7 (2016-2018)	18.262794	62.981006	18.264231	62.979719	18.263331	62.980172	0.11	100		2	D
Great Bay, Dog Island	Y	unconfirmed	0.3 (2016-2017)	18.274083	63.255828	18.272222	63.251686	18.273461	63.253344	0.55	100		2	D
Meads Bay	N	1.3 (2016-2018)	1.3 (2016-2017)	18.179303	63.142628	18.186722	63.134619	18.182239	63.138056	1.37	100		2	D
Prickly Pear East	Y	unconfirmed	0.3 (2016-2017)	18.264331	63.173669	18.262797	63.168450	18.265633	63.170911	0.80	100		2	D
Savannah Bay, Dog Island	Y	unconfirmed	0.3 (2016-2017)	18.282231	63.238053	18.282872	63.236750	18.282558	63.237367	0.16	100		2	D
Shoal Bay East	Y	1.3 (2016-2018)	1.3 (2016-2018)	18.252378	63.037631	18.254531	63.024361	18.254361	63.031789	1.70	100		2	D
Spring Bay, Dog Island	Y	unconfirmed	0.7 (2016-2018)	18.279858	63.260089	18.281211	63.258403	18.280314	63.258997	0.26	100		2	D

1.4. Conservation

See Table 3.

Table 3. International conventions protecting sea turtles and signed by Anguilla.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention)	Y	Y	To be confirmed	CC, CM, EI, LK, LO, DC	Prohibition of activiities that have adverse affects on species	Sea turtle and sea turtle egg harvesting banned in Anguilla
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Y	Y	To be confirmed	ALL	Listed as endangered (Appendix I); international trade of seat turtles prohibited	Sea turtle and sea turtle egg harvesting banned in Anguilla; international trade prohibited

1.5. Research

See Table 4.

Table 4. Projects and databases on sea turtles in Anguilla.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
T4.1	CM-NE ATL, EI-SC ATL, DC-NW ATL	Anguilla	Caribbean	Saving the sea turtles of Anguilla: combining community action with scientific evidence to drive legislative change	Tracking; Fastloc GPS tag; Nesting female; Foraging juveniles; Policy; Legislation; Caribbean	2016	2019	Fisheries and Marine Resources Unit-Department of Natural Resources	Public	Anguilla National Trust; University of Roehampton		European Commission (BEST 2.0)	Kafi.Gumbs@gov.ai	Farah Mukhida: fm.axatrust@gmail.com; Louise Soanes: ls.axatrust@gmail.com	Y	Nesting sea turtles	Auntie Dol Bay, Blackgardens Bay, Captains Bay, Crocus Bay, Deadmans Bay (Scrub Island), Elsie Bay, Forest Bay, Graftin's Bay (Scrub Island), Great Bay (Dog Island), Island Harbour, Katouche Bay, Limestone Bay, Lockrum Bay, Long Bay, Maunday's Bay, Meads Bay, Merrywing Bay, Mimi Bay, Prickly Pear East, Prickly Pear West, Savannah Bay (Dog Island), Savannah Bay-East (Dog Island), Savannah Bay/Junk's Hole, Scrub Bay (Scrub), Sherricks Bay, Shoal Bay	1991	ongoing	Y	Y	N	n/r	n/r	Y	
T4.2															Y	Foraging sea turtles	Island Harbour, Scrub Island, Crocus Bay-Blackgardens, Isaac Cliff	2002	ongoing	n/r	n/r	Y	Y	Y	Y	

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Aruba

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1.1. Distribution, abundance, trends

1.1.1. Nesting sites

1.1.2. Marine areas

1.2. Other biological data

Four sea turtle species do nest in Aruba in small numbers (See Table 1).

In 1993 Aruba's STRAP was published (1) and the total nest number of all 4 species combined was estimated at less than 30 nest/year

A monitoring program is executed by the Turtugaruba Foundation and data contributed to the SWOT database (7) and Widecast atlas of nesting beaches (5). Nest numbers are fluctuating. (6).

Year-round juveniles and subadults of Hawksbill and Green turtles are present feeding in the coastal waters.

Along the coastline of Aruba there are more beaches that are or could be possibly used for nesting.

These beaches have not been monitored consistently and over a long term to draw conclusions.

1.3. Threats

1.3.1. Nesting sites

1.3.2. Marine areas

Coastal development is the major threat in Aruba. The results of this threat are:

- Degradation of nesting habitat.
- Photo-pollution.
- Collisions with personal watercrafts.

1.4. Conservation

Nests encountered during monitoring are protected in situ, with extensive efforts to facilitate hatchlings natural emergence and sea finding. See Table 3.

1.5. Research

For leatherbacks there is a flipper tag program since 2012.

Most nesting females are remigrants seen and tagged in previous years. The number of recruits is low. This observation is consistent with still ongoing research on nest and beach temperature. Preliminary results suggests that the Aruban leatherback beaches might be relatively cool and favoring male hatchlings. See Table 4.

Table 1. Biological and conservation information about sea turtle Regional Management Units in Aruba.

RMU	*C. caretta*	Ref #	*C. mydas*	Ref #	*D. coriacea*	Ref #	*E. imbricata*	Ref #
Occurrence								
Nesting sites	Y	1,5,7	Y	1,5,7	Y	1,5,7	Y	1,5,7
Pelagic foraging grounds	n/a		n/a		n/a		n/a	
Benthic foraging grounds	n/a		Y	1	n/a		Y	1
Key biological data								
Nests/yr: recent average (range of years)	23 (2011-2020)	6	37 (2011-2020)	6	53 (2006-2020)	6	14 (2011-2020)	6
Nests/yr: recent order of magnitude	13-40	6	14-69 (2011-2020)	6	12-120 (2006-2020)	6	1-19 (2011-2020)	6
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	6	5	10	5	5	5	7	5
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a		n/a	
Total length of nesting sites (km)	6.79	7	5.74	7	6	7	5.94	7
Nesting females / yr	3 till 10		between 3 and 14		between 2 and 20		between 1 and 4	

Nests / female season (N)	5 (23)		between 4 and 8		between 5 and 11		between 1 and 5	
Female remigration interval (yrs) (N)	n/a		n/a		2-5 years		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	90 CCL		98 CCL		140 CCL		87	
Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	117 (N=29)	6	122 (N=57)	6	85(N=19)	6	141 (N=19)	6
Emergence success (hatchlings/egg) (N)	0.827 (N=29)	6	0.816 (N=57)	6	0.572 (N=19)	6	0.615 (N=19)	6
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		n/a	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	stable (2006-2020)	6	stable 2006-2020	4,6	Stable (1998-2020)	3,6	Stable (2012-2020)	6
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a		n/a	
Published studies								
Growth rates	n/a		n/a		n/a		n/a	
Genetics	n/a		n/a		n/a		n/a	
Stocks defined by genetic markers	n/a		n/a		n/a		n/a	
Remote tracking (satellite or other)	n/a		n/a		n/a		n/a	
Survival rates	n/a		n/a		n/a		n/a	
Population dynamics	n/a		n/a		n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a		n/a		n/a	
Capture-Mark-Recapture	n/a		n/a		n/a		n/a	

Threats								
Bycatch: presence of small scale / artisanal fisheries?	n/a		n/a		n/a		n/a	
Bycatch: presence of industrial fisheries?	n/a		n/a		n/a		n/a	
Bycatch: quantified?	n/a		n/a		n/a		n/a	
Take. Intentional killing or exploitation of turtles	n/a		Y		n/a			
Take. Egg poaching	n/a		n/a		n/a		n/a	
Coastal Development. Nesting habitat degradation	Y	1,6	Y	1,6	Y	1,6	Y	1,6
Coastal Development. Photopollution	Y	1,6	Y	1,6	Y	1,6	Y	1,6
Coastal Development. Boat strikes	n/a		Y	6	n/a		Y	6
Egg predation	n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	n/a		n/a		n/a		n/a	
Pathogens	n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a	
Foraging habitat degradation	n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		n/a	
Long-term projects								
Monitoring at nesting sites	Y	6,7	Y	6,7	Y	6,7	Y	6,7
Number of index nesting sites	n/a		n/a		n/a		n/a	
Monitoring at foraging sites	n/a		n/a		n/a		n/a	
Conservation								
Protection under national law	Y	2	Y	2	Y	2	Y	2
Number of protected nesting sites (habitat preservation)	1		1		1		1	
Number of Marine Areas with mitigation of threats	n/a		n/a		n/a		n/a	
Long-term conservation projects (number)	1	6,7	1	6,7	1	6,7	1	6,7
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a		n/a	

Head-starting	n/a		n/a		n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a	
By-catch: onboard best practices	n/a		n/a		n/a		n/a	
By-catch: spatio-temporal closures/reduction	n/a		n/a		n/a		n/a	
Other	Y	6	Y	6	Y	6	Y	6

Table 2. Sea turtle nesting beaches in Aruba.

RMU	**Index site**	**Nests/yr: recent average (range of years)**	**Crawls/yr: recent average (range of years)**	**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
CC-NW-ATL		2020		Long	Lat					
Dos Playa - Boca Prins	N	6		12.506183	-69.918217	0.25	100		Level 1	Daily patrols
Boca Grandi-Grapefield - all sections (4 km)	N	7		12.447078	-69.875428	4.00	100		Level 1	Day patrols 3-5 times per week
Fishermen's Huts	N	6		12.585097	-70.046083	0.85	100		Level 1	Daily patrols
Arashi (all sections)	N	2		12.610942	-70.053767	0.60	100		Level 1	Daily patrols
California	N	0		12.617844	-70.046256	0.80	100		Level 1	Daily patrols
Druif	N	6		12.605808	-70.031722	0.14	100		Level 1	Daily patrols
Andicuri	N	3		12.537589	-69.955881	0.15	100		Level 1	Daily patrols
CM-NW ATL		2020								
Dos Playa - Boca Prins	N	19		12.506183	-69.918217	0.25	100		Level 1	Daily patrols
Boca Grandi-Grapefield - all sections (4 km)	N	11		12.447078	-69.875428	4.00	100		Level 1	Daily patrols
California	N	6		12.617844	-70.046256	0.80	100		Level 1	Daily patrols
Druif	N	4		12.605808	-70.031722	0.14	100		Level 1	Daily patrols

Pos di Noord	N	5		12.573415	-70.002606	0.1	100		Level 1	Day patrols 3-5 times per week
Andicuri	N	1		12.537589	-69.955881	0.15	100		Level 2	Daily patrols
Daimari - Boca Ketu	N	12		12.527244	-69.935456	0.30	100		Level 1	Daily patrols
DC-NW ATL		2020								
Dos Playa - Boca Prins	N	12		12.506183	-69.918217	0.25	100		Level 1	Daily patrols
Boca Grandi-Grapefield - all sections (4 km)	N	0		12.447078	-69.875428	4.00	100		Level 1	Day patrols 3-5 times per week
Eagle	N	10		12.545	-70.061306	3.00	100		Level 1	Nightly patrols
Palm	N	3		12.574	-70.045889	1.20	100		Level 2	Other
Arashi (all sections)	N	7		12.610942	-70.053767	0.60	100		Level 1	Daily patrols
Andicuri	N	3		12.537589	-69.955881	0.15	100		Level 1	Daily patrols
EI-NW-ATL		2020								
Dos Playa - Boca Prins	N	0		12.506183	-69.918217	0.25	100		Level 1	Daily patrols
Boca Grandi-Grapefield - all sections (4 km)	N	6		12.447078	-69.875428	4.00	100		Level 1	Daily patrols
Pos Chiquito	N	5		12.462849	-69.96749	0.05	100		Level 1	Daily patrols
Arashi (all sections)	N	3		12.610942	-70.053767	0.60	100		Level 1	Daily patrols
California	N	5		12.617844	-70.046256	0.80	100		Level 1	Daily patrols
Druif	N	0		12.605808	-70.031722	0.14	100		Level 1	Daily patrols
Pos di Noord	N	0		12.573415	-70.002606	0.1	100		Level 1	Day patrols 3-5 times per week

Table 3. International conventions protecting sea turtles and signed by Aruba.

International Conventions	Signed	Binding		Compliance measured and reported	Species
Cartagena Convention	y	y		n/a	
Protocol concerning Specially Protected Areas and Wildlife (SPAW)	y	y		n/a	All
Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region	y	y		n/a	
Protocol Concerning Pollution from Land-based Sources and Activities	y			n/a	
Convention on Biological Diversity (CBD)	y	y		n/a	All
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	y	y		n/a	All
Convention oon Migratory Species (CMS)	y	y		n/a	All
Inter-American Convention for the Protection and Consrvation of Sea Turtles (IAC)	n/a			n/a	All
MARPOL 73/78 (Annex I/II)			approval	n/a	
MARPOL 73/78 (Annex III)	y			n/a	
MARPOL 73/78 (Annex IV)	n			n/a	
MARPOL 73/78 (Annex V)	y			n/a	
Convention on Wetlands of International Importance (RAMSAR)	y	y		n/a	
UN convention on Law of the Sea (UNCLOS)	y	y		n/a	
Western Hemisphere Convention	n			n/a	
World Heritage Convention	y	y		n/a	

Table 4. Projects and databases on sea turtles in Aruba.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private
T4.1	CM-WIO	France	Europa, Juand de Nova, Glorieuse, Tromelin	Tracking green in the mozambique Channel	Tracking; Fastloc GPS tag; Nesting female; western Indian Ocean	2010	2013	YY	Public
Database available	**Name of Database**	**Beginning of the time series**	**End of the time series**	**Track information**	**Nest information**	**Flipper tagging**	**Tags in STTI-ACCSTR?**	**PIT tagging**	**Remote tracking**
Y	DB-Turtle	1958	2016	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N

Figure 1. Aruba nesting sites (see Table 2).

Azores

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1 RMU: Loggerhead turtle (*Caretta caretta*) – Northwest Atlantic

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Loggerhead turtles are not known to nest in the Azores

1.1.2 Marine areas

Pelagic foraging grounds in Azorean waters for juvenile loggerhead turtles from the Northwestern Atlantic (NWA) subpopulation are located all across the archipelago. Occurrence of this species in the Azores comprises the majority of their pelagic juvenile lifecycle stage (6.5 to 11.5 years) (Bjorndal et al. 2000) with sizes between 8 and 80 cm CCL.

1.2 Other biological data (See Table 1)

1.2.1 Sex ratios (immatures and adults)

n/a

1.2.2 Minimum adult size and age at sexual maturity

n/a

1.2.3 Recent trends at foraging sites

The most recent estimate of abundance for the Azores (2017) is 5187 (2,170-12,399 95%CI; 46%CV; Area = 32804 km2; Design-based) obtained from a ship based census (oceanic census of MISTIC SEAS II).

The trend in relative abundance over the period 2001-2015, based on standardized visual transects on opportunistic platforms (POPA – Programa de Observação das Pescas dos Açores) closely tracked the nest production in SE-USA rookeries in Florida and displayed a long-term stable trend (trend: 17.8%; -39%-139% 95%BCI; Area = 198401 km2; Vandeperre et al. 2019), in accordance with the stable trend in nest counts from the Peninsular Florida Recovery Unit (Anonymous, 2019).

More recent estimates are not available.

1.2.4 Published studies

Please see Referenes.

1.3 Threats

Several threats were identified to impact loggerhead turtles in the Azores, in particular by-catch in pelagic longline fisheries and interaction with marine debris.

Regarding incidental by-catch, the COSTA project (COnsolidating Sea Turtle conservation in the Azores) observer program for the Portuguese fleet has collected data showing that by-catch varied by area/season/main target species. Overall, at-haul back mortality was 22% with an additional 11% of the turtles being released in weak condition. No information is currently available to estimate the evolution of the threat, i.e. fishing pressure, over time.

Regarding marine debris, juvenile oceanic-stage sea turtles are particularly vulnerable to the increasing quantity of plastic coming into the oceans. In Pham et al. (2017), 24 gastrointestinal tracts of juvenile loggerheads were analyzed and the results demonstrate that plastic pollution acts as another stressor for this critical life stage of loggerhead sea turtles. 83% of the individuals were found to have ingested marine debris composed exclusively of plastic items, with large micro plastics (1-5mm) representing 25% of the total number of debris and found in 58% of the individuals sampled.

Entanglement of loggerhead turtles in marine debris is occasionally observed in the Azores, mostly in fishing gear. An indicator of entanglement is currently being defined in the framework of the INDICIT II project (https://indicit-europa.eu/).

1.4 Conservation

Loggerhead turtles and their habitats are protected in the Azores by European and Portuguese law (Table 2).

1.5 Research

COSTA project (COnsolidating Sea Turtle conservation in the Azores - costaproject.org) – Monitoring programs for loggerhead sea turtles; fishing observer program on the Portuguese surface longline fleet in the North-East Atlantic; Sea Turtle Tagging Program; Bio-logging studies on loggerhead sea turtles.

LIFE IP Azores Natura – Restructuring of stranding program and satellite tracking study of loggerheads (https://www.lifeazoresnatura.eu/).

LIFE IP CLIMAZ – Predictive modelling of sea turtle distribution for management applications.

INDICIT I & II – Implementation of the indicator of marine litter on sea turtles and biota in regional sea conventions and marine strategy framework directive areas (https://indicit-europa.eu/).

MISTIC SEAS I & II - Macaronesia Islands Standard Indicators and Criteria: Reaching Common Grounds on Monitoring Marine Biodiversity in Macaronesia (https://misticseas3.com/en/page/mistic-seas-ii).

See Table 3.

2. RMU: Green turtle (Chelonia mydas) – Northwest Atlantic

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Green turtles are not known to nest in the Azores.

2.1.2 Marine areas

Occurrence of green turtles in the Azores is generally associated with island shelves across the archipelago.

2.2 Other biological data

2.2.1 Sex ratios (immatures and adults)

n/a

2.2.2 Minimum adult size and age at sexual maturity

n/a

2.2.3 Recent trends at foraging sites

n/a

2.2.4 Published studies

n/a

2.3 Threats

Unknown.

2.4 Conservation

Green turtles and their habitats are protected in the Azores by European and Portuguese law (Table 2).

2.5 Research

LIFE IP Azores Natura – Characterization of the distribution and occurrence of green turtles in the Azores (https://www.lifeazoresnatura.eu/). See Table 3.

3 RMU: Dermochelys coriacea

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

Leatherback turtles are not known to nest in the Azores.

3.1.2 Marine areas

Foraging grounds in Azorean waters for leatherback turtles are not fully studied and identified. Occurrence of leatherbacks in the area is relatively rare.

3.2 Other biological data

3.2.1 Sex ratios (immature and adults)

n/a

3.2.2 Minimum adult size and age at sexual maturity

n/a

3.2.3 Recent trends at foraging sites

n/a

3.2.4 Published studies

n/a

3.3 Threats

The main threat to leatherback sea turtles is incidental by-catch in the pelagic longline fishery. The COSTA project (COnsolidating Sea Turtle conservation in the Azores) observer program for the Portuguese fleet has collected data on 789 fishing sets in the period 2015-2019. The bycatch of 29 individuals was recorded, mainly in international waters between the Azores and the Iberian Peninsula. Leatherback sea turtles were mostly entangled in the line and were released in the water, apparently in good condition. No information is currently available to estimate the evolution of the threat over time-

No data of other threats is available. In the period 2009-2019, 11 individuals were recorded by the stranding network (RACA – Rede de Arrojamentos de Cetáceos dos Açores), but the cause of death was unknown.

3.4 Conservation

Leatherback turtles and their habitats are protected by European and Portuguese law (Table 2).

3.5 Research

COSTA project (COnsolidating Sea Turtle conservation in the Azores - costaproject.org) – Observer program on the Portuguese surface longline fleet in the North-East Atlantic.

LIFE IP CLIMAZ – Predictive modelling of sea turtle distribution for management applications. See Table 3.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Azores.

RMU	*C. caretta* NW ATL
Occurrence	
Nesting sites	N
Oceanic foraging areas	Y
Neritic foraging areas	N
Key biological data	
Nests/yr: recent average (range of years)	n/a
Nests/yr: recent order of magnitude	n/a
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/a
Nests/yr at "major" sites: recent average (range of years)	n/a
Nests/yr at "minor" sites: recent average (range of years)	n/a
Total length of nesting sites (km)	n/a
Nesting females / yr	n/a
Nests / female season (N)	n/a
Female remigration interval (yrs) (N)	n/a
Sex ratio: Hatchlings (F / Tot) (N)	n/a
Sex ratio: Immatures (F / Tot) (N)	n/a
Sex ratio: Adults (F / Tot) (N)	n/a
Min adult size, CCL or SCL (cm)	n/a
Age at maturity (yrs)	n/a
Clutch size (n eggs) (N)	n/a
Emergence success (hatchlings/egg) (N)	n/a
Nesting success (Nests/ Tot emergence tracks) (N)	n/a
Trends	
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a
Recent trends (last 20 yrs) at foraging grounds (range of years)	Stable (iii)
Oldest documented abundance: nests/yr (range of years)	n/a
Published studies	
Growth rates	Y
Genetics	Y
Stocks defined by genetic markers	Y
Remote tracking (satellite or other)	Y
Survival rates	Y
Population dynamics	Y
Foraging ecology	Y
Capture-Mark-Recapture	N
Threats	

Bycatch: presence of small scale / artisanal fisheries?	N
Bycatch: presence of industrial fisheries?	Y (PLL, DLL)
Bycatch: quantified?	Y
Intentional killing of turtles	N
Take. Illegal take of turtles	N
Take. Permitted/legal take of turtles	N
Take. Illegal take of eggs	N
Take. Permitted/legal take of eggs	N
Coastal Development. Nesting habitat degradation	N
Coastal Development. Photopollution	N
Coastal Development. Boat strikes	N
Egg predation	N
Pollution (debris, chemical)	Y
Pathogens	N
Climate change	N
Foraging habitat degradation	Y
Other	N
Long-term projects (>5yrs)	
Monitoring at nesting sites (period: range of years)	N
Number of index nesting sites	N
Monitoring at foraging sites (period: range of years)	Y (20Y)
Conservation	
Protection under national law	Y
Number of protected nesting sites (habitat preservation) (% nests)	N
Number of Marine Areas with mitigation of threats	n/a
N of long-term conservation projects (period: range of years)	>1 (2015-ongoing)
In-situ nest protection (eg cages)	n/a
Hatcheries	n/a
Head-starting	n/a
By-catch: fishing gear modifications (eg, TED, circle hooks)	Wire leaders (PLL)
By-catch: onboard best practices	Y (voluntary, ongoing)
By-catch: spatio-temporal closures/reduction	N
Other	N

Table 2. International conventions protecting sea turtles and signed by Azores.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992)	Y	Y	Y	*C. caretta*	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992)
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binfind and non-binding	Y	Y	Y	*C. caretta*	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. CMS has a specific resolution on bycatch datailing various actions needed to reduce bycatch of migratory species that will include marine turtles (UNEP/CMS/Resolution 9.18 on Bycatch)

Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	*C. caretta*	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species.
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	Y	Y	Y	*C. caretta*	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival	All seven species listed in Appendix I of CITES
UNFSA: United Nations Fish Stock Agreement. Known formally as the Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.	Y	Y	Y	*C. caretta*	A legal regime for the long-term conservation and sustainable use of straddling and highly migratory fish stocks (i.e. addressing problems related to the management of high seas fish stocks).	Ratified by 81 states and the European Union. Mentions a range of problems, including those related to unselective fishing gear. Elaborates on the fundamental principle that countries should, inter alia, cooperate to ensure conservation. Most shrimp are trawled within EEZs, though in those instances where tropical shrimp may be caught outside of EEZs, or where there are straddling stocks (i.e stocks that migrate through, or occur in, more than one EEZ), UNFSA will have a bearing on the EU's involvement in such cases.

Regional Fisheries Management Organisations (RFMOs) and Regional Fisheries Bodies (RFBs).	Y	Y	Y	*C. caretta*	The EU is party to numerous RFMOs and RFBs that although not classed as global agreements are considered as binding multilateral agreements.	The main relevance has to do with the EU's Common Fisheries Policy (CFP) - the framework that establishes the rules that govern how the shared fish stocks within European Union water are managed. The CFP now includes na external dimension establishing the standards by which EU vesses should adhere to when fishing outside of EU waters. The relevance of the CFP to this is detailed in section 6.1
The Convention for the protection of the marine environment of the North-East Atlantic (the OSPAR Convention) (1992).	Y	Y	Y	*C. caretta*	To protect and conserve marine ecosystems and biological diversity of the North-East Atlantic	This species is considered threatened and/or declining wherever the species is present in OSPAR regions (Cc: OSPAR Regions IV and V).
Marine Strategy Framework Directive (2008).	Y	Y	Y	*C. caretta*	This Directive leads European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	This species of marine turtles is considered as an indicator of MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 3. Projects and databases on sea turtles in Azores.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Current Sponsors	Primary Contact (name and Email)
T4.1	NW ATL	Portugal	Faial, Azores	COSTA	Conservation project	2015	ongoing	IMAR/Okeanos - University of the Azores	Public	ACCSTR, DRAM	ACCSTR/ USFWS/Regional Government	Frederic Vandeperre (frederic.vandeperre@gmail.com)
T4.2	NW ATL	Portugal	Faial, Azores	POPA	Observer program		ongoing	IMAR - Instituto do Mar	Private	Okeanos - University of the Azores	Regional Government	Miguel Machete (miguel.ag.machete@uac.pt
T4.3	NW ATL	Portugal	Faial, Azores	RACA	Stranding program		ongoing	DRAM - Regional Directorate of Sea Affairs	Public	Okeanos - University of the Azores	Regional Government	Marco Santos (marco.ar.santos@azores.gov.pt)
T4.4	NW ATL	Portugal	Faial, Azores	Marine Turtle Tagging Program	Tagging	1969	ongoing	IMAR/Okeanos - University of the Azores	Public	ACCSTR	ACCSTR/ USFWS/Regional Government	Frederic Vandeperre (frederic.vandeperre@gmail.com)

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging
T4.1	Y	Longline fisheries data base		2015	ongoing					
T4.2	Y	Popa observer database - visula sightings		2001	ongoing					
T4.3	Y	Azores Stranding Database		2007	ongoing					

T4.4	Y	Tagging database		1969	ongoing			Y	Y	Y

Bahamas

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1. RMU: Loggerhead turtle (*Caretta caretta*) – Northwest Atlantic

1.1. Distribution, abundance, trends.

1.1.1. Nesting sites

There is no formal nesting observation program for turtles in The Bahamas and the country is not currently a major nesting ground for turtles. Loggerhead turtles are observed mating during the spring and summer months and nests have been recorded in areas including the Cay Sal Bank and Great Bahama Bank (30,40,52). More recently, any observations reported by the public, including residents and tourists, to various in-country NGO's (including the Bahamas National Trust (BNT), Friends of the Environment (FotE), Cape Eleuthera Institute (CEI)) and between 2016 -2020 the Bahamas Sea Turtle Network (BSTN) documented these reports. Details include date, location, and species if identifiable from photos of the track. Loggerhead nests have been the most common reported across several islands.

1.1.2. Marine areas

Loggerhead turtles are the second most abundant species of turtle found across The Bahamas. Juveniles to sub-adults can be found in shallow nearshore habitats throughout the archipelago at low densities (2). Adult female loggerheads from nesting beaches (25,64,68,69) and males from neritic waters (70) in the southern United States have been satellite-tracked migrating to residence and foraging areas in The Bahamas.

1.2. Other biological data

Please see Table 1.

1.3. Threats

There are considerable threats to sea turtle nesting throughout The Bahamas. They differ depending on location. In developed areas such as Grand Bahama and Abaco, house and street lights near the beaches can distract the nesting females and hatchlings. In remote or uninhabited islands, the principal problems are marine debris and illegal harvest. Some members of the older generations still eat turtle eggs.

1.3.1. Nesting sites

The principal threats to nesting and successful emergence:

- Houses built too close to the beach (there are laws against this which are sometimes disregarded).
- Construction of sea walls.
- Street and house lighting.
- Illegal harvest of eggs.
- Illegal harvest of mature and nesting females.
- Degradation of dunes and beaches by hurricanes and building construction.
- Plastics and other marine debris on many ocean beaches.
- Climate change impacts including increased sand temperature.

1.3.2. Marine areas

Threats to turtles in foraging habitats seem to be increasing. There are significantly more fast outboard boats, habitat degradation caused by hurricanes, construction and refuse.

The principal threats to turtles in foraging areas:

- Continued illegal harvest.
- Increased traffic of fast boats in critical areas causing boat strikes, noise disturbance, and scarring of seagrass beds.
- Bycatch in hook and line fishing and entanglement in discarded fishing line.
- Increased plastic in the sea.

1.4. Conservation

Loggerhead turtles are protected in The Bahamas by the Fisheries Resources (Jurisdiction and Conservation) Act 1977, since 2009 (37). Enforcement of fisheries regulations however are a challenge with inadequate resources to cover such a large marine area and so many islands. A conservation priority should be implementing regulations on boating speeds, both for pleasure craft and commercial traffic. In offshore environments in the summer months mating turtle pairs are vulnerable, but also close to shore and in harbours where turtles may be foraging.

The BSTN was established in 2016, in collaboration with the Bahamas Department of Marine Resources, ACCSTR, FIRE, CEI, FotE, Bahamas Reef Environment Educational Foundation (BREEF) and the BNT. The network's aim was to create a place to report turtle nesting, illegal take, injuries, stranding, fibropapilloma disease, and observations of sea turtles in The Bahamas. FotE and the BNT have been essential in documenting turtle nesting observations in the Abacos and Grand Bahama, and communicating with local communities, increasing hatchling survival, and installing nesting season signs. This group and initiative were terminated in 2021 upon the request of the Department of Environmental Protection and Planning and all further reports should be referred to the Department of Marine Resources.

All groups and projects mentioned in other RMU's record data on any loggerheads captured in their tagging efforts. See Table 3.

1.5. Research

Nesting observations compiled from reports to the BSTN once published will provide an updated description of known nesting distribution of loggerhead turtles across the archipelago. A knowledge gap exists on juvenile loggerheads that recruit onto the shallow banks of certain islands and research efforts should be focused here. See Table 4.

2. RMU: Green turtle (*Chelonia mydas*) – Northwest Atlantic

2.1. Distribution, abundance, trends

2.1.1. Nesting sites

There is no formal nesting observation program for turtles in The Bahamas and the country is not a major nesting ground for turtles. Green turtle nests, however, have been recorded (31,40). More recently, any observations reported by the public, including residents and tourists, to various in-country NGO's (including the Bahamas National Trust (BNT), Friends of the Environment (FotE), Cape Eleuthera Institute (CEI)) and between 2016 -2020 the Bahamas Sea Turtle Network (BSTN) documented these reports. Details include date, location, and species if identifiable from photos of the track. Green turtle nests are the second most common observed after loggerheads but make up a much smaller portion.

2.1.2. Marine areas

Green turtles are the most abundant sea turtle species in The Bahamas. Juveniles forage in coastal seagrass meadows throughout the archipelago. Tagging efforts for capture-mark-recapture started as early as 1970 and provide robust estimates of growth rates (2,6,13,14,20,35,46) and survival probabilities (1) of the local population. Research off Abaco found that juvenile green turtles are most abundant in tidal creeks despite abundant forage (seagrass) in more open areas (33). This distribution may be driven by high nutrient content found in the seagrasses growing in the tidal creeks and the risk of predation by tiger sharks in open areas. Other previous and on-going areas of study include diet/foraging (4,11,18,22,24,33,56), grazing impacts (5,16,28), distribution (33,21,60), genetics (3,17,44), stable isotopes (12,19,55), and blood chemistry (23,61).

2.2. Other biological data

Please see Table 1.

2.3. Threats

There are considerable threats to sea turtle nesting throughout The Bahamas. They differ depending on location. In developed areas such as Grand Bahama and Abaco, house and street lights near the beaches can distract the nesting females and hatchlings. In remote or uninhabited islands, the principal problems are marine debris and illegal harvest. Some members of the older generations still eat turtle eggs.

2.3.1. Nesting sites

The principal threats to nesting and successful emergence:

- Houses built too close to the beach (there are laws against this which are sometimes disregarded).
- Construction of sea walls.
- Street and house lighting.
- Illegal harvest of eggs.
- Illegal harvest of mature and nesting females.
- Degradation of dunes and beaches by hurricanes and building construction.
- Plastics and other marine debris on many ocean beaches.
- Climate change impacts including increased sand temperature.

2.3.2. Marine areas

Threats to turtles in foraging habitats seem to be increasing. There are significantly more fast outboard boats, and Fibropapilloma disease seems to be spreading.

There is habitat degradation caused by hurricanes, boat traffic, construction and refuse.

The principal threats to turtles in foraging areas:

- Continued illegal harvest.
- Increased traffic of fast boats in critical areas causing boat strikes, noise disturbance, and scarring of seagrass beds.
- FP ise spreading in some areas.
- Bycatch in hook and line fishing and entanglement in discarded fishing line.
- Increased plastic in the sea.

2.4. Conservation

Green turtles are protected in The Bahamas by the Fisheries Resources (Jurisdiction and Conservation) Act 1977, since 2009 (37). Enforcement of fisheries regulations however are a challenge with inadequate resources to cover such a large marine area and so many islands. A conservation priority should be implementing regulations on boating speeds, both for pleasure craft and commercial traffic. In offshore environments in the summer months mating turtle pairs are vulnerable, but also close to shore and in harbours where turtles may be foraging.

Following the creation of the BNT in 1959, concern began to be expressed for sea turtles. Dr. Archie Carr had initiated a program for sea turtle research, the protection of their nesting grounds and their reintroduction to former nesting grounds. One of the regions where this research was being conducted was at Union Creek, north of the Inagua National Park, The Bahamas. Three hundred turtles were sent to Union Creek in 1959 in an effort to restore the area. Dr. G. Carleton Ray approached the Trust's Executive Committee with the idea of the Union Creek Reserve being a part of the BNT, the result of which was the establishment of the Union Creek Reserve in 1963.

Dr. Archie Carr was a mentor to Dr. Karen Bjorndal and Dr. Alan Bolten, Special Advisors to the Trust's Council. Dr. Bjorndal has been studying sea turtles at Union Creek since 1974 while pursuing her Ph.D. and returned every year with her partner Dr. Alan Bolten. Now Directors of the Archie Carr Center for Sea Turtle Research (ACCSTR) at the University of Florida, they have assessed a wide range of topics including digestion, nutritional ecology, foraging behaviour, growth rates, survival and emigration probabilities, source rookeries, and genetic diversity. This study has been very productive, yielding many "firsts" in building our understanding of sea turtle biology over their foraging grounds and away from the nesting beach.

Family Island Research and Education (FIRE) has been operating since 2006. Working in close cooperation with the ACCSTR and the BNT, the program studies turtles in their foraging areas throughout the Bahamas archipelago using visual surveys and tag/recapture to study growth rates, site fidelity, and movements. Fibropapilloma disease is also documented and has led to serious concern about the spread of the FP virus. Representing the BNT, FIRE conducts outreach in Family Island (out-island) schools, giving presentations about sea turtles and marine conservation, and taking local students out on the water whenever school schedules permit. The program also carries selected students on several 1-3 week research cruises each year. FIRE has also worked with The Bahamas Department of Marine Resources to conduct a series of fisheries enforcement workshops for enforcement personnel in the Family Islands. These workshops are designed to inform enforcement personnel from a variety of agencies such as Fisheries, Police, Customs, Immigration, Defense Force, and Local Government and to promote greater cooperation amongst these agencies.

In 2012 CEI established its Sea Turtle Research and Conservation program, with the goal of investigating juvenile green sea turtle foraging ground ecology. It's long-term mark-recapture program in local tidal mangrove creeks is in its tenth year, facilitating studies on growth rates, residency period, grazing behaviour, movements, energetics, and photo-identification amongst others. The program has also facilitated community outreach initiatives including school-visits, field research experiences, and turtle-focused summer camps.

From 2014 to 2018, FotE offered a sea turtle field course to Bahamians and visitors led by Florida International University researchers. The course consisted of classroom instruction on sea turtle biology, species identification, threats, conservation, and current research followed by field time where participants assisted with sea turtle capture and tagging. During the same time, researchers often gave presentations at local primary schools and summer camps.

The BSTN was established in 2016, in collaboration with the Bahamas Department of Marine Resources, ACCSTR, FIRE, CEI, Bahamas Reef Environment Educational Foundation, FotE, and the BNT. The network's aim was to create a place to report turtle nesting, illegal take, injuries, stranding, fibropapilloma and observations of sea turtles in The Bahamas. FotE and the BNT have been essential in documenting turtle nesting observations in the Abacos and Grand Bahama, and communicating with local communities, increasing hatchling survival, and installing nesting season signs. This group and initiative were terminated in 2021 upon the request of the Department of Environmental Protection and Planning and all further reports should be referred to the Department of Marine Resources. See Table 3.

2.5. Research

The green turtle is the most studied turtle in The Bahamas with most of the research focused on in-water distribution and habitat use through long-term capture-mark-recapture studies. Recent data on population abundance is needed to determine population trends, as well as studies investigating the spread of the fibropapilloma disease and its impact on green turtles in The Bahamas. Studies on the grazing impacts of an increasing green turtle foraging population are needed especially in light of seagrass ecosystem services, local priorities (e.g., fish and conch habitat), and disturbance by major hurricanes. Nesting observations compiled from reports to the BSTN once published will provide an updated description of known nesting distribution of green turtles across the archipelago. See Table 4.

3. RMU: Hawksbill turtle (*Eretmochelys imbricata*) – Northwest Atlantic

3.1. Distribution, abundance, trends

3.1.1. Nesting sites

There is no formal nesting observation program for turtles in The Bahamas and the area is not a significant nesting ground for Hawksbills. Any observations reported by the public, including residents and tourists, to various in-country NGO's (including the Bahamas National Trust (BNT), Friends of the Environment (FotE), Cape Eleuthera Institute (CEI)) and between 2016 -2020 the Bahamas Sea Turtle Network (BSTN) documented these reports. Details include date, location, and species if identifiable from photos of the track. No Hawksbill turtle nests have been reported during this period to the Bahamas Sea Turtle Network, however there have been reports previously (40).

3.1.2. Marine areas

Hawksbills are found in hard-bottomed habitats and seagrass pastures across the archipelago (2,10). Since little hawksbill nesting is occurring in The Bahamas, it follows that recruitment to local foraging areas is also low (32,57).

3.2. Other biological data

Please see Table 1.

3.3. Threats

There are considerable threats to sea turtle nesting throughout The Bahamas. They differ depending on location. In developed areas such as Grand Bahama and Abaco, house and street lights near the beaches can distract the nesting females and hatchlings. In remote or uninhabited islands, the principal problems are marine debris and illegal harvest. Some members of the older generations still eat turtle eggs.

3.3.1. Nesting sites

The principal threats to nesting and successful emergence:

- Houses built too close to the beach (there are laws against this which are sometimes disregarded).
- Construction of sea walls.
- Street and house lighting.
- Illegal harvest of eggs.
- Illegal harvest of mature and nesting females.
- Degradation of dunes and beaches by hurricanes and building construction.
- Plastics and other marine debris on many ocean beaches.
- Climate change impacts including increased sand temperature.

3.3.2. Marine areas

Threats to turtles in foraging habitats seem to be increasing. There is habitat degradation caused by hurricanes, boat traffic, construction and refuse.

The principal threats to turtles in foraging areas:

- Continued illegal harvest.
- Increased traffic of fast boats in critical areas causing boat strikes, noise disturbance, and scarring of seagrass beds.
- Bycatch in hook and line fishing and entanglement in discarded fishing line.
- Increased plastic in the sea.

3.4. Conservation

Hawksbills were the first species of sea turtle to be protected in The Bahamas in 1986, including their eggs by the Fisheries Resources (Jurisdiction and Conservation) Act 1977 (37). Enforcement of fisheries regulations, however, are a challenge with inadequate resources to cover such a large marine area and so many islands. A conservation priority should be implementing regulations on boating speeds, both for pleasure craft and commercial traffic. In offshore environments in the summer months mating turtle pairs are vulnerable, but also close to shore and in harbours where turtles may be foraging.

The Bahama Sea Turtle Network was established in 2016, in collaboration with the Bahamas Department of Marine Resources, ACCSTR, FIRE, CEI, Bahamas Reef

Environment Educational Foundation, FotE, and the BNT. The network's aim was to create a place to report turtle nesting, illegal take, injuries, stranding, fibropapilloma and observations of sea turtles in The Bahamas. This group and initiative were terminated in 2021 upon the request of the Department of Environmental Protection and Planning and all further reports should be referred to the Department of Marine Resources.

All groups and projects mentioned in other RMU's record data on any hawksbills captured in their tagging efforts. See Table 3.

3.5. Research

Because hawksbill turtles are less abundant than green turtles, they have not been the focus of many studies. Concerted efforts to estimate population size and distribution are costly but needed to accurately assess their status. Remote nesting grounds should be revisited and more frequently surveyed during nesting season. See Table 4.

4. RMU: Leatherback turtle (*Dermochelys coriacea*) – Northwest Atlantic

4.1. Distribution, abundance, trends

4.1.1. Nesting sites

There is no formal nesting observation program for turtles in The Bahamas and the country is not a major nesting ground for turtles. Leatherback nests, however, have been recorded (31,40). More recently, any observations reported by the public, including residents and tourists, to various in-country NGO's (including the Bahamas National Trust (BNT), Friends of the Environment (FotE), Cape Eleuthera Institute (CEI)) and between 2016 -2020 the Bahamas Sea Turtle Network (BSTN) documented these reports. Details include date, location, and species if identifiable from photos of the track. No leatherback nests have been reported during this period.

4.1.2. Marine areas

Out of 20 leatherbacks fitted with satellite tags off Massachusetts, USA (~41°N, 70°W) from August 2007 to September 2009, one was tracked close to land in The Bahamas during its southern migration (67).

4.2. Other biological data

n/a

4.3. Threats

There are considerable threats to sea turtle nesting throughout The Bahamas. They differ depending on location. In developed areas such as Grand Bahama and Abaco, house and street lights near the beaches can distract the nesting females and hatchlings. In remote or uninhabited islands, the principal problems are marine debris and illegal harvest. Some members of the older generations still eat turtle eggs.

4.3.1. Nesting sites

The principal threats to nesting and successful emergence:

- Houses built too close to the beach (there are laws against this which are sometimes disregarded).
- Construction of sea walls.
- Street and house lighting.
- Illegal harvest of eggs.
- Illegal harvest of mature and nesting females.
- Degradation of dunes and beaches by hurricanes and building construction.
- Plastics and other marine debris on many ocean beaches.
- Climate change impacts including increased sand temperature.

4.3.2. Marine areas

Threats to turtles in foraging habitats seem to be increasing. There is habitat degradation caused by hurricanes, boat traffic, construction and refuse.

The principal threats to turtles in foraging areas:

- Continued illegal harvest.
- Increased traffic of fast boats in critical areas causing boat strikes, noise disturbance.
- Bycatch in hook and line fishing and entanglement in discarded fishing line.
- Increased plastic in the sea.

4.4. Conservation

Leatherback turtles are protected in The Bahamas by the Fisheries Resources (Jurisdiction and Conservation) Act 1977, since 2009 (37). Enforcement of fisheries regulations however are a challenge with inadequate resources to cover such a large marine area and so many islands. A conservation priority should be implementing regulations on boating speeds, both for pleasure craft and commercial traffic. In offshore environments in the summer months mating turtle pairs are vulnerable, but also close to shore and in harbours where turtles may be foraging.

The BSTN was established in 2016, in collaboration with the Bahamas Department of Marine Resources, ACCSTR, FIRE, CEI, BREEF, FotE, and the BNT. The network's aim was to create a place to report turtle nesting, illegal take, injuries, stranding, fibropapilloma and observations of sea turtles in The Bahamas. This group and initiative were terminated in 2021 upon the request of the Department of Environmental Protection and Planning and all further reports should be referred to the Department of Marine Resources. See Table 3.

4.5. Research

n/a

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Table 1. Biological and conservation information about sea turtle Regional Management Units in The Bahamas.

RMU	*C. caretta*	Ref #	*C. mydas*	Ref #	*E. imbricata*	Ref #	*D. coriacea*	Ref #
Occurrence								
Nesting sites	Y	30,52, 40	Y	40,31	Y	40	Y	40,31
Oceanic foraging areas	U		Y	48,53	U		Y	67
Neritic foraging areas	Y	2,25,64,68, 69, 70	Y	1,2,7,22,23, 33,34	Y	2,10,32,57	N	
Key biological data								
Nests/yr: recent average (range of years)	n/a	40	n/a	40	U	40	U	40
Nests/yr: recent order of magnitude	n/a		n/a		U		U	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		U		U	
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/a		n/a		U		U	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		U		U	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		U		U	
Total length of nesting sites (km)	n/a		n/a		U		U	
Nesting females / yr	U		U		U		U	
Nests / female season (N)	U		U		U		U	

Female remigration interval (yrs) (N)	U		U		U		U	
Sex ratio: Hatchlings (F / Tot) (N)	U		U		U		U	
Sex ratio: Immatures (F / Tot) (N)	U		65/111	6	U		U	
Sex ratio: Adults (F / Tot) (N)	U		U		U		U	
Min adult size, CCL or SCL (cm)	U		U		U		U	
Age at maturity (yrs)	U		U		U		U	
Clutch size (n eggs) (N)	131 (2)	52						
Emergence success (hatchlings/egg) (N)	93% (7)	52						
Nesting success (Nests/ Tot emergence tracks) (N)	21/79	52						
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	U		U		U		U	
Recent trends (last 20 yrs) at foraging grounds (range of years)	U		Stable	7	U		n/r	
Oldest documented abundance: nests/yr (range of years)	Y	30, 31	Y	31	Y	31	Y	31
Published studies								
Growth rates	Y	15,20,46	Y	2,6,13,14,20,35,41,42	Y	10,20,49	N	
Genetics (KB)	N		Y	3,17,43,44	N		N	
Stocks defined by genetic markers	Y	8,47	Y	44	Y	32,57	N	

Remote tracking (satellite or other)	Y	25,29,54,55,58,62,64,65,66,68,69,70	Y	12,21	Y	63	Y	67
Survival rates	N		Y	1	N		N	
Population dynamics	Y	39	Y	6,7	N		N	
Foraging ecology	Y	31,40,62,65	Y	4,5,11,12,16,18,19,21,28,33,40,45,50,56,61	Y	10,31,32,40	N	
Capture-Mark-Recapture	Y	58	Y	7,9,13,35,58,59	Y	10,38,51	N	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	N		N		N		N	
Bycatch: presence of industrial fisheries?	N		N		N		N	
Bycatch: quantified?	N		N		N		N	
Intentional killing of turtles	Y	31	Y	31	Y	31	N	
Take. Illegal take of turtles	Y	26,31	Y	26,31	Y	26,31	N	
Take. Permitted/legal take of turtles	N		N		N		N	
Take. Illegal take of eggs	N		N		N		N	
Take. Permitted/legal take of eggs	N		N		N		N	
Coastal Development. Nesting habitat degradation	Y	31	Y	31	Y	31	N	

Coastal Development. Photopollution	N		N		N		N	
Coastal Development. Boat strikes	Y		Y		N		N	
Egg predation	N		N		N		N	
Pollution (debris, chemical)	N		N		N		N	
Pathogens	N		Y	PS	N		N	
Climate change	Y	20	Y	20,50	Y	20	N	
Foraging habitat degradation	N		N		N		N	
Other	Y	31	Y	24,31	Y	31	Y	31
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	N		N		N		N	
Number of index nesting sites	N		N		N		N	
Monitoring at foraging sites (period: range of years)	N		45 yrs: 1974-2020		N		N	
Conservation								
Protection under national law	Y	27,36,37	Y	27,36,37	Y	27,36,37	Y	27,36,37
Number of protected nesting sites (habitat preservation) (% nests)	U		U		U		U	
Number of Marine Areas with mitigation of threats	U		U		U		U	

N of long-term conservation projects (period: range of years)	N		4: 1974-2021		N		N	
In-situ nest protection (eg cages)	N		N		N		N	
Hatcheries	N		N		N		N	
Head-starting	N		N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N		N	
By-catch: onboard best practices	N		N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N		N	
Other	N		N		N		N	

Table 2. Sea turtle nesting beaches in The Bahamas. (Blank).

There are no published nesting beaches at this time.

Table 3. International conventions protecting sea turtles and signed by The Bahamas.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on Biological Diversity	Y			All	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Articles 7 through 11 describe how biodiversity should be conserved and include: identification and monitoring, in-situ monitoring, ex-situ monitoring, sustainable use of components of biological diversity, incentive measures, research and training, public education and awareness, and impact assessment and minimizing adverse impacts.
Wildlife Conservation and Trade Act, CITES	Y			All	This Act allows the Department of Agriculture (the managing authority) to assume responsibility for implementing CITES in The Bahamas. Included among the implementation duties are: the coordination of implementation and enforcement legislation relating to conservation of species, the establishment of a scientific authority to advise on the import and monitor the export of species and the appointment of a national advisory committee to advise the Minister responsible for agriculture on matters relating to the Act and the implementation of CITES.	In December 2004, the Wildlife Conservation and Trade Act (2004) was passed by Parliament to implement CITES in The Bahamas. CITES permits are required to transport turtle specimens, or parts of turtles. The listing in CITES also is attached to a species, and if listed on Appendix I, as are sea turtles, warrant additional protection and monitoring.

Ramsar Convention	Y		Last report in 2015	All	The Convention on Wetlands is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	The convention entered into force in The Bahamas on 7 June 1997 and has developed a draft policy on wetlands that seeks to balance conservation and development efforts and promote greater public awareness. The Bahamas currently has 1 site (The Inagua National Park, Ramsar Site No 892) which hosts foraging grounds for a significant population of juvenile green sea turtles.

Table 4. Projects and databases on sea turtles in The Bahamas.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	CM-NW ATL, CC-NW ATL, EI-NW ATL	The Bahamas	Wider Caribbean	Cape Eleuthera Institute Sea Turtle Ecology and Conservation Program	Tracking; juveniles; tagging; rates	2012	Ongoing	Y	Private	ACCSTR		Cape Eleuthera Foundation, Earthwatch Institute	Annabelle Brooks, annabellebrooks@ceibahamas.org	Nick Higgs, nickhiggs@ceibahamas.org
T4.2	CM-NW ATL, CC-	The Bahamas	Wider Caribbean	Factors Affecting Green Turtle Foraging Ecology Across Multiple	Foraging; Habitat use; tagging	2013	Ongoing	Y	Public		https://digitalcommons.fiu.edu/c		Elizabeth Whitman, ewhitman@f	

	NW ATL, EI-NW ATL			Spatial Scales							gi/viewcontent.cgi?article=5210&context=etd		iu.edu	
T4.3	CM-NW ATL, CC-NW ATL, EI-NW ATL	The Bahamas	Wider Caribbean	Family Island Research & Education	Tracking; juveniles; tagging	2006	Ongoing	N	Private	ACCSTR			Stephen Connett, lonetagger@outlook.com	
T4.4	CM-NW ATL, CC-NW ATL, EI-NW ATL	The Bahamas	Wider Caribbean	ACCSTR	Tracking; juveniles; tagging; rates	1974	Ongoing	Y	Private				Karen Bjorndal, bjorndal@ufl.edu	

Database available	**Name of Database**	**Names of sites included (matching Table B, if appropriate)**	**Beginning of the time series**	**End of the time series**	**Track information**	**Nest information**	**Flipper tagging**	**Tags in STTI-ACCSTR?**	**PIT tagging**	**Remote tracking**	**Ref #**

N		Eleuthera	2012	Ongoing	n/a	n/a	Y	Y	N	N	T4.1
N		Abaco	2013	Ongoing	n/a	n/a	Y	Y	N	N	T4.2
N		The Bahamas	2001	Ongoing	n/a	n/a	Y	Y	N	N	T4.3
N		The Bahamas	1974	Ongoing	n/a	n/a	Y	Y	N	N	T4.4

Belize

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1. RMU Northwest Atlantic

1.1. Distribution, abundance, trends

Hawksbill, green and loggerhead turtles are commonly observed foraging throughout Belize and nest on offshore coral isles and along the mainland coast. Leatherback sighting are rare and have no known nesting sites in Belize. Ridley turtles do not nest in Belize. Table 2.1 summarizes known information on occurrence, key biological data, trends, published studies, long term projects and conservation efforts. Much of the key biological data and trends are currently not available since data has not been organized into a central database or published. We hope in a subsequent publication to be able to provide specific details.

2.1.1. Nesting Sites

Belize is a small country nestled in the Western Caribbean and features about 100 km of nesting beach along the mainland shore, and hundreds of offshore islands that support turtle nesting. The nesting beaches in the northern portion of the country support primarily green and loggerhead turtles, while the mainland beaches and offshore cayes are visited primarily by hawksbills, but also support loggerhead and green turtles. There are no known nesting sites visited used by leatherback turtles in Belize.

Identification of turtle nesting sites in Belize dates back to 1982 (1), but the first comprehensive report remains the WIDECAST Belize Sea Turtle Recovery Action Plan (10) that published a list of 52 nesting sites and included information on site use by species, abundance of nests/crawls, threats, survey dates and references. In 2007 WIDECAST published an "An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region" (15) which listed 33 nesting beaches, and the 2019 revised edition (16) published 63 nesting beach sites. In 2020 there were 5 additional sites added, for a total of 68 nesting beaches outlined in Figure 1. The reason for listing all known nesting sites is to ensure sites will be monitored when resources become available. It is likely that some traditional nesting sites listed in early publications may no longer support nesting due to erosion and lack of suitable soft sand to construct a nest. When surveys are completed the reason sites are no longer viable nesting sites, will be documented. New nesting sites, primarily along the mainland shores, have been identified. Members of the Belize Sea Turtle Conservation Network have formed a subcommittee to identify resource needs and to raise funds to conduct nationwide nesting beach monitoring to measure nesting activity.

There are currently two index nesting sites in Belize: Ambergris Caye and Gales Point (Table 2.2). The Ambergris Caye Turtle Program is supported by the Hol Chan and Bacalar Chico Marine Reserves which are under management of the Belize Fisheries Department. Gales Point is adjacent to the Gales Point Wildlife Sanctuary, and the Gales Point Wildlife Sanctuary Community Management Committee and community volunteers conduct monitoring at the nesting beach.

Ambergris Caye is a 40 km peninsula in the northernmost part of Belize that extends southward from the Yucatan coast, Mexico. The entire length of Ambergris Caye is reported to be a traditional nesting site. but due to increased tourism development, turtles nest primarily along the unpopulated shores of northern Ambergris Caye, but occasional nesting occurs in the community. The Ambergris Caye index site refers to an assembly of five nesting areas that cover about 13 km and include Rocky Point, Basil Jones, Robles, Punta Azul and Palmero (6, 10). Green and loggerhead turtles are the most common turtles nesting here, but a few hawksbill nests have been recorded.

The Gales Point nesting beach was discovered in 1990 by Smith (7, 8, 9) when conducting nationwide nesting beach surveys. The Gales Point index nesting site extends southward, roughly 8 km from the Bar River Mouth to an area known as White Ridge. This nesting site is used primarily by hawksbills (69%); however, loggerheads (15%) and green turtles (12%) also utilize this nesting beach (17-25). A comparison of the data available from IAC Annual Reports (21-25) for the two nesting index sites is presented in Figure 2.1.

Given the importance of the numerous offshore islands for nesting turtles, including some islands as index nesting sites, should be considered. Offshore islands like Half Moon Caye, Lighthouse Reef Atoll; Calabash Caye, Turneffe Islands Atoll; and Carrie Bow Caye and Hunting Caye inside the Belize Barrier Reef, have resident staff that could complete daily logs of turtle activity. Many of the small offshore islands are privately owned. The management and staff of Ranguana Caye, who operate an exclusive resort on the island, have become actively involved in monitoring nesting turtles and record and submit data forms. Between 2016 and 2019 the average number of hawksbill nests is 16 (Table 2.3). To recruit additional community members to monitor turtle activity at nesting sites outside of protected areas the BSTCN are planning a nationwide outreach program geared towards people living on offshore islands and coastal areas where turtles nest to Adopt a Beach and submit regular reports.

The number of nesting female turtles that currently nest in Belize is uncertain. Between 1978 and 1982, Miller (3) and Gillett (5) reported there were 31 hawksbills, 19 green, and 40 loggerhead turtles nesting annually. In 1991 Smith et al

(10) estimated there were about 22-25 hawksbills nesting at Gales Point, and in 2006 Walker and Walker (30) estimated there were 20 nesting hawksbills. On Ranguana Caye between 2016 and 2019, it is estimated there are an average of 4 hawksbill turtles nest each year at Ranguana Caye, so possibly as many as 12 turtles using this site (Table 2.3). The total number of nests at all nesting sites need to be documented so we can more accurately estimate the number of turtles nesting in Belize.

2.1.2. Marine Areas

Foraging Grounds

Hawksbill, green and loggerhead turtles forage throughout the shallow lagoons inside the Belize Barrier Reef and offshore atolls. Leatherback turtles are occasionally seen in the deep ocean, along the outer forereef by scuba divers, and also inside the Belize Barrier Reef in the Victoria Channel close to mainland nesting sites. In 2011 Belize confirmed its first sighting of an olive ridley turtle that stranded in discarded fishing gear. There do appear to be some areas that attract many turtles that have been identified through fish market surveys and satellite telemetry.

During fish market surveys conducted in 2000-2001 (11), fishermen reported an area southwest of Belize City, near Robinson Point, where turtles were abundant. Robinson Point is characterized by vast seagrass meadows and patch reefs adjacent to an ancient riverbed that leads to the Caribbean Sea. There are other areas throughout Belize where traditional turtle fishermen once harvested turtle that are possibly important foraging areas. Searle (12) studied the in-water population at Robinson point and recommended that the area from Robinson Point to Gales Point be considered as a special protected area for the conservation of migrating and inter-nesting sea turtles.

Over the past twenty years there have been 53 turtles tagged in satellite telemetry studies that have migrated though Belize. The turtles migrating to Belize were tagged in Costa Rica, Cayman Islands, Jamaica, Honduras and Mexico. Turtle tagged in Belize have migrated to other areas in Belize's territorial waters, Mexico, Cuba, Honduras, Nicaragua and Columbia. Migration of 47 of these turtles are illustrated in Figure 2.3 and summarized below:

- 2000 - The first turtle tagged in Belize was a nesting hawksbill found at the Gales Point index site who migrated to South Water Caye Marine Reserve.
- 2000 - First turtle tracked to Belize was a green turtle tagged by the Sea Turtle Conservancy at Tortuguero, Costa Rica, which migrated to Robinson Point in a little over one month.
- 2003 and 2005 three additional turtles tagged by the Cayman Islands Department of Environment migrated to Belize, and one of these turtles migrated to Robinson Point.

• 2007 Pronatura tagged a hawksbill after nesting on Isla Holbox, Mexico, which migrated to a foraging area near the Port Honduras Marine Reserve.

• 2011 Marymount University and Hawksbill Hope launched a satellite telemetry program at the Gales Point nesting index site, and also provided satellite tags to other members of the Belize Sea Turtle Conservation Network, tagging 30 turtles in less than a decade. The interesting zone of turtles tagged at Gales Point also utilize the Robinson Point foraging area.

• 2012 - ProTECTOR tagged a hawksbill on Utila, Honduras which migrated to Robinson Point.

• 2014 and 2017 the Wildlife Conservation Society used satellite telemetry to monitor juvenile hawksbills at Glover's Reef Atoll.

• 2014, 2017, 2019 – Three Tour de Turtles participants travel through Belize.

The map data suggests that hawksbill foraging habitat extends from Robinson Point to the Port Honduras Marine Reserve, and at Glover's Reef, however this may be due to more hawksbills being tagged at Gales Point and Glovers. Green turtles forage in northern Belize at the Bacalar Chico Marine Reserve and between Robinson Point and Colson Point. The loggerhead turtles that were tagged included one nesting female and others were in-water captures or rehabilitated turtles, and are shown foraging inside the Belize Barrier Reef in the northern portion of the country. It should be noted that throughout Belize loggerheads have become accustomed to rendezvousing with commercial fishing sailboats, where they feed on discarded lobster carcasses and harvested queen conch. There are also two tourism sites where loggerheads are attracted to scraps of conch guts and lobster carcasses, one site is located in Hol Chan Marine Reserve and the other in the Gladden Spit and Silk Cayes Marine Reserve. The foraging map includes two loggerheads that forage around commercial fishing sailboats. The only olive ridley tagged was the first one recorded in Belize when it stranded in discarded fishing gear. Detailed analysis of the migration paths and activities of the turtles migrating through Belize is currently being compiled.

Migratory Corridors

Turtles travelling between Belize and Mexico or Costa Rica, use migratory corridors that parallel the coast. When crossing the Cayman Trough, between the southern part of Belize and the Bay Islands, Honduras, turtles do not appear to have a regular route. Sightings of leatherback turtles in the Victoria Channel suggest that this species may use this deep-water channel when travelling inside the Belize Barrier Reef.

Mating Areas

In April and May curious male loggerhead turtles scrutinize divers while scuba diving on the reef drop-off. Reports of solitary male green and male hawksbill turtles are rare. Loggerhead and green turtles have been observed mating off the beach on northern Ambergris Caye. Loggerheads have also. been observed mating off the beach of Turneffe and Lighthouse Atolls and near the barrier reef. Green turtles have also been observed mating inside the main barrier reef west of St George's Caye, and in the deep Caribbean Sea between the Belize Barrier Reef east of Gallow's Point and Turneffe Atoll. Observations of mating hawksbill turtles is rare.

Strandings

The Belize Sea Turtle Conservation Network members respond to reports of stranded sea turtles and utilize a stranding form to document incidents. Boat strikes and shark attacks are common causes of stranded sea turtles. Incidents of fibropapilloma remains low, but within the past couple of years there have been three cases found in dead stranded green turtles and one live stranded green that was released. There are two turtle rehabilitation facilities in Belize, one on Ambergris Caye at the office of the Hol Chan Marine Reserve, and one on St George's Caye at ECOMAR's research center. It is hoped that once the database is functional the stranding details can be recorded and reported.

2.2. Other biological data

An early study of mitochondrial DNA in 1996 by Bowen et al (13) and Bass (31) remain the only published reports of DNA studies on sea turtles in Belize. Bass (13) identified three haplotypes unique to Belize and one haplotype in common with Mona Island, Puerto Rico and the Virgin Islands. Bass (31) reported that the Gales Point nesting site was genetically isolated in terms of maternal lineages and represented a distinct stock.

There was a more recent collaborative effort established and samples were submitted, but the report was not available, or the results were inconclusive. The BSTCN was approached by an international researcher that proposed testing DNA from turtle egg shells, but this program did not occur. Tissue samples have been collected for DNA analysis from turtles that were stranded, nesting and captured during in-water surveys, but resources are needed to have the samples tested. We hope to establish a collaborative program with researchers currently studying DNA.

In 2019 ECOMAR, in partnership with SUNY Cortland and the Belize Fisheries Department, launched the first eDNA study in Belize examining sea turtle DNA in sea water collected near the Belize Barrier Reef where green and loggerhead turtles are known to frequent. It is hoped that the eDNA study can be expanded to the Robinson Point foraging sites and Gales Point interesting zone.

2.3. Threats

2.3.1. Nesting sites

The primary threats to nesting sites include natural predators, erosion, coastal development, plastic debris and poaching. Along mainland nesting beaches adjacent to forests live skunks, racoons and coatimundis that will completely destroy a nest if it is not protected (8, 9, 14, 30). Walker and Walker (30) reports in 2006 there were 65 nests laid. A total of 32 nests were protected and 33 were completely destroyed by predators. At Gales Point, nests must be protected from natural predators, if the hatchlings are to have a chance to succeed. Success in 2006 was reported to be 65% (30).

Some nesting sites on the Snake Cayes in Port Honduras Marine Reserve experience seasonal erosion resulting in early nests being eroded. In these locations nests should be relocated. On many of the small offshore islands, suitable nesting habitat is also becoming degraded and or disappearing completely. Smith (6) reported that more than 24 crawls were made on one caye resulted in only 1 successful nest and on another island 34 false crawls were observed with no nests. Today, residents on the small cayes also report similar observations. As turtles attempt to nest they are unable to penetrate the hard ground and dig through washed up conch shells and coral rubble. Protection of suitable nesting beach becomes even more evident.

Coastal development is becoming an increasing threat to nesting sites throughout Belize. Traditional, bright lights in beach front lighting are resulting in disorientation and death of hatchlings. In a new coastal development at Sittee Point there were as many as 32 dead hatchlings found around one home in 2019, and at other homes there were between 3 and 25 dead hatchlings. In early 2020 ECOMAR reached out property owners to provide alternative lighting options that would still provide security but would not attract hatchlings. Ongoing outreach is being conducted within the community as many property owners are invested in the hatchling's success. Partners are collaborating on a report that will highlight success of adopting turtle friendly lighting. The data from Sittee Point will be uploaded into the Turtle Database so trends can also be monitored nationwide.

Seawalls are being erected in nesting sites. Prior to the construction of seawalls permission must be granted by the Department of Environment. At a recent meeting of the BSTCN, the Fisheries Department representative reported that a map of nesting sites can be shared with DOE so they will know where turtles nest and would reconsider permitting construction of seawalls at nesting sites.

There are also two largescale developments being proposed near the Gales Point index nesting site. An industrial port for the exportation of limestone is being planned for the White Ridge property, the southern end of the Gales Point index site. Turtles are known to nest south of White Ridge past Mullins River, but due to lack of resources the number of turtles that nest here is not known. A new cruise ship port is being planned along the coast north of the Gales Point index site that includes the construction of a peninsula jutting into the sea at 90 degree angle from the shoreline, which will result in the accumulation of sand in the northern section. The capture of the sand from the Sibun River, which is north of the Gales Point index site and proposed development, could have a severe impact on the nesting index site, which is already suffering from coastal erosion.

Plastic pollution is also a threat to turtles at nesting sites. Hatchlings have been rescued from plastic debris outside the nest and inside. One ranger at Ambergris Caye found a hatchling wedged inside a conical funnel with sand tightly packed around the hatchling. Beach cleanups are conducted by park managers and volunteer groups but trying to keep up with the incoming wave of plastic, is an ongoing battle.

Poaching of nesting turtles was reported to be a threat by Carr, Perkins and Moll (1, 2, 4), and Smith et al (10). Since legislation of the Fishery Regulations in 1977, subsequent revisions in 1993, and complete protection in 2002, take of nesting turtles has subsided considerably. However, in 2019 a nesting hawksbill turtle and her eggs were reported to have been taken at a traditional nesting site in 2019. Poaching of eggs has traditionally not been a problem in Belize, like it is in neighboring Latin America countries, but recent reports indicate the influx of construction workers in coastal tourism development sites is resulting in increased evidence of human poaching of turtle nests.

2.3.2. Marine areas

The primary threats to turtles in marine areas are illegal take, boat strikes, shark attacks, discarded fishing gear, gill nets, traditional turtle nets, fibropapilloma and crude oil. Illegal take, boat strikes, and gill nets and traditional turtle nets, result in fatalities. These instances of threats need to be uploaded into the BSTCN database so reports can be generated, and trends monitored over time. A summary of recent events is summarized below.

- Green and loggerhead turtles are targeted by fishers. Two loggerhead turtle heads recently found inside the Belize Barrier Reef east of Belize City prompted a release by the Belize Fisheries Department reminding the public all turtles are protected. Illegal in-water take of a green and loggerhead turtle south of Punta Gorda was also documented, and a restaurant in southern Belize offered turtle on the menu. Juvenile green turtles have been observed carried around Corozal and Belize City and offered for sale.

- Green and loggerheads have been victims to boat strikes near Ambergris Caye and Belize City. These two areas have the greatest amount of boat traffic. Ambergris Caye supports Belize's largest overnight tourism industry. Daily water taxi service from Belize City to Caye Caulker and Ambergris Caye are operated by two businesses that run approximately 6 round-trips daily.

- In 2015 and 2017 two loggerhead turtles were rescued and rehabilitated after surviving shark attacks near Caye Chapel. Loggerhead turtles with missing flippers have been reported from Hopkins in 2019 and Punta Gorda in 2020.
- Discarded fishing gear captures have resulted in the only olive ridley turtles observed in Belize. There have been at least 3 olive ridley turtles which stranded in northern Belize near Ambergris Caye, the first one in 2011. A juvenile green turtle was found dead in discarded fishing gear off Belize City.
- Gill nets have been confirmed catching adult green turtles. Traditional turtle nets have also been documented in use recently.
- There have been a few reports of green turtles with fibropapilloma (FP). One juvenile green turtle found dead in discarded fishing gear off Belize City had FP. Adult green turtles with FP were found dead off Dangriga, Hopkins and Punta Gorda.
- While there are no offshore oil wells in Belize, in 2012 a juvenile green turtle was found covered in crude oil off Ambergris Caye.

2.4. Conservation

Since 1993 hawksbill turtles have been protected in Belize, in 2002 all turtles became protected, and in February 2020 Belize passed the Belize Fisheries Resource Act (34), which has resulted in an increase in fines from BZ$1000 (US$500) per piece to a fine of BZ$50,000 (US$25,000) and penalty of BZ$2000 (US$1000) per piece. The applicable sections are presented below.

Section 90 states:

Unless otherwise stipulated under this act, contravention of any section of this Act is an offence punishable on summary conviction by a fine of fifty thousand dollar or imprisonment for two years, or both fine and imprisonment.

Section 88 states:

(1) No person shall fish or have in his possession prescribed in the Schedule to this Act (the Schedule includes hawksbill, green, loggerhead and leatherback turtles).

(2) The Schedule of this Act may be amended by the Minister by Order published in the Gazette.

(3) Not withstanding Subsection (1), the Fisheries Administrator may authorize in writing the possession of any listed species for research, traditional or cultural use only.

Since 2002, when the Fisheries Regulations protected all sea turtles, it was possible to apply to harvest a turtle for cultural use, but reportedly the number of requests was only a few during the past 18 years.

Belize is a signatory to international conventions whose mandate includes the protection and conservation of sea turtles. Table 2.4 summarizes the list of conventions and implications for sea turtle protection including how compliance is measured and reported, conservation actions, and relevance to sea turtles.

Governmental or NGO programs

The Belize Fisheries Department (BFD) is the government agency legally responsible for fisheries management, management of marine reserves and the issuing of marine research permits. Sea turtles come under the jurisdiction of the Fisheries Department and are the focal point for the IAC – Interamerican Convention for the Protection and Conservation of Sea Turtles. The Belize Fisheries Department directly manages Bacalar Chico Marine Reserve, South Water Caye Marine Reserve, Sapodilla Cayes Marine Reserve and Glover's Reef Marine Reserve and conducts monitoring of nesting sites within the protected areas.

There are other organizations involved in sea turtle conservation, many are members of the Belize Sea Turtle Conservation Network (BSTCN). Some members are managers of marine protected areas (MPAs) and/or conduct scientific research. The Mission of the BSTCN is "To improve the conservation status of marine turtles in Belize through research, monitoring, protection, political lobbying, planning, training and public awareness." The goals of the Turtle Network are to:

1. To standardize outreach, conservation, monitoring and research programs with the aim of unifying criteria and activities for the management of the sea turtles nationwide.

2. To have more involvement in decision making at the political level, in management, enforcement and approved cultural use of marine turtles.

3. Encourage community to participation in the conservation of marine turtles.

The Network is currently comprised of 11 organizations including:

1. Belize Audubon Society
2. Belize Fisheries Department
3. Coastal Zone Management Authority & Institute
4. ECOMAR
5. Hol Chan Marine Reserve
6. Mar Alliance

7. Southern Environmental Association
8. Toledo Institute for Development & Environment
9. Turneffe Atoll Sustainability Association
10. University of Belize Environmental Research Institute
11. Wildlife Conservation Society

A summary of the organizations involved in monitoring sea turtles are outlined in Table 4 and briefly described below.

Belize Audubon Society (BAS)

A non-profit, non-governmental, membership organization dedicated to the sustainable management of Belize's natural resources in order to maintain a balance between people and the environment. BAS is responsible for the management of Half Moon Caye and Blue Hole Natural Monuments on Lighthouse Reef Atoll. BAS conducts monitoring of nesting sites at Lighthouse Reef Atoll on Sandbore Caye, Northern Two Cayes, Long Caye and Half Moon Caye Natural Monument.

Coastal Zone Management Authority & Institute (CZMAI)

A semi-autonomous statutory body responsible for research, monitoring and formulation of policy to support the allocation, sustainable use and planned development of Belize's coastal and marine resources, established under the Ministry of Agriculture and Fisheries. CZMAI manages the Goff's Caye Management Area which is a traditional nesting site.

Environmental Conservation Organization - ECOMAR

A non-profit, non-governmental organization formed in 1995 promoting "Conservation through Education" and focusing on the marine environment. Since 2009 ECOMAR has operated the St George's Caye Research Station and Field School and facilitates university and student research groups to document cultural heritage and biodiversity within the St George's Caye Historical Landmark Site. In 2015 the research station began rehabilitating sea turtles and is working on developing a sea turtle education center. ECOMAR coordinates the Belize Turtle Watch program engaging stakeholders throughout coastal Belize to monitor sea turtle activity, and has coordinated in-water turtle monitoring projects at Gallow's Point and Robinson Point, and in 2011 the nationwide in-water monitoring project in collaboration with the Belize Fisheries Department and other members of the Belize Sea Turtle Conservation Network. In 2020 ECOMAR began collaborating with Turtle Network members to identify resources to conduct nationwide nesting beach monitoring.

Gales Point Wildlife Sanctuary Management Committee

A community-based organization that has been leading the interest in community management of Gales Point Wildlife Sanctuary since its establishment in 1996. Members of the Committee and the community conduct monitoring at the Gales Point index nesting site since 1990.

Marymount University/Hawksbill Hope

Marymount University Study Abroad Belize Program has been bringing student groups to Belize since 2007. In Belize they support the Gales Point Wildlife Sanctuary Management Committee. Hawksbill Hope, Inc was founded in 2009 to aid in the conservation of Belize's natural resources, specifically hawksbill turtles and the Gales Point community that monitors the index nesting site. Initial efforts have provided support to monitoring nesting beaches and collecting data on endangered sea turtles. Hawksbill Hope, through individual contributions and grant funding, has also been able to satellite tag sea turtles throughout Belize each year since 2011.

Hol Chan Marine Reserve

A marine protected area in northern Belize established to protect a portion of the Belize Barrier reef complex in its natural state, to preserve areas of critical habitat, provide and area for recreation and tourism services while preserving the value of the area for sustainable fisheries. Hol Chan Marine Reserve supports the Ambergris Caye Marine Turtle Program, launched in 2007, and is a collaborative effort between Hol Chan Marine Reserve and Bacalar Chico National Park and Marine Reserve to monitor nesting sites on Ambergris Caye.

Mar Alliance

A dynamic international non-governmental organization that designs and conducts collaborative grassroots research and conservation action on threatened marine megafauna such as sharks, rays, turtles and large finfish. Working with fishers and other key stakeholders of the sea, we generate essential data on megafauna populations, behavior and ecology to enable fact-based conservation and management, often in the context of established or proposed marine protected areas. Through our work with fishers we promote the use of sustainable fishing methods and create economic income diversification initiatives to decrease pressures on fisheries and improve good stewardship and management practices. Mar Alliance has conducted in-water sea turtle surveys at Lighthouse Reef Atoll using acoustic telemetry.

Southern Environmental Association (SEA)

Formerly Friends of Nature and TASTE, is a non-profit, non-governmental organization that represents the coastal communities of Hopkins, Sittee River, Seine Bight, Placencia, Independence, Monkey River, Punta Negra and Punta Gorda, and aims to protect their natural resources by developing their human resources. SEA has co-management agreements with the Belize Fisheries Department to manage the

Gladden Spit & Silk Cayes Marine Reserve and the Sapodilla Caye Marine Reserve and with the Forest Department for Laughing Bird Caye National Park. SEA conducts monitoring of nesting sites within the protected areas and also monitors turtle nesting activity along the mainland coast from Hopkins to Placencia.

Toledo Institute for Development and Environment (TIDE)

A non-profit, non-governmental organization established as a grassroots initiative to address the needs of the Toledo District. TIDE has a co-management agreement with the Fisheries Department and Forest Department and is responsible for the management of the Port Honduras Marine Reserve, Paynes Creek National Park and private lands. TIDE conducts monitoring of nesting sites within park boundaries.

Turneffe Atoll Sustainability Association (TASA)

A Belizean non-profit organization formed in 2012 by Turneffe stakeholders. TASA was officially designated to co-manage the Turneffe Atoll Marine Reserve (TAMR) along with the Fisheries Department in 2013. TASA is committed to providing high quality management of the TAMR under five management programs: Natural Resource Management, Science, Education and Outreach, Infrastructure and Administration. TASA monitors nesting sites within the Turneffe Islands Atoll.

Wildlife Conservation Society (WCS)

Is a non-profit international conservation organization qualified under Section 501(c)(3) of the United States Internal Revenue Code and also registered in Belize committed to saving wildlife and wild lands around the world. WCS is supporting a wide range of marine ecosystem monitoring activities in Belize. WCS has an ongoing in-water turtle monitoring project at Glover's Reef Atoll had has place satellite tags on 7 turtles captured during the surveys. WCS in collaboration with the Belize Fisheries Department has launched the SMART data collection system used in protected areas and are adapting to record turtle nesting activity.

Conservation priorities

To improve our knowledge of sea turtles and provide for their improved protection and conservation, the following conservation priorities are presented for consideration by decision makers.

- Expand the Gales Point Wildlife Sanctuary
- Outreach Campaign on Revised Fisheries Resource Act
- Review foraging data and consider expanding boundaries of marine reserves to encompass areas used by migrating sea turtles

Expand the Gales Point Wildlife Sanctuary

The Gales Point nesting site is located adjacent an undeveloped natural littoral forest with numerous natural predators including racoons, skunks and coatimundi, that completely destroy the nests if they are not quickly protected with mesh cages. There is only one road that provides access to a portion of the beach, and only two small resorts located along the beach. Increased patrols, nest protection and presence on the nesting site will result in greater levels of recruitment. Expansion of the Gales Point Wildlife Sanctuary to include the Gales Point nesting site and inter-nesting zone will afford additional protection through increased access to resources available for protected area management. To fully protect Belize's most important hawksbill nesting site resources must be identified to support program management, as outlined in the Belize Sea Turtle Recovery Action Plan.

Outreach Campaign on Revised Fisheries Resource Act

With the passing of new legislation in 2020, the new regulations and fines should be broadcasted widely. Resources should be identified and earmarked for this activity. Many members of the Belize Sea Turtle Conservation Network conduct boat to boat interviews with fishers in the protected areas they manage. Outreach and awareness of the new fishery regulations, and $50,000 fine, should be disseminated during these interviews. In 2019 Searle (35) conducted a nationwide survey of hawksbill turtle products available for sale in markets throughout Belize and documented hawksbill products for sale in two communities. Additional outreach should be conducted to market vendors to make them aware of the increase in fines. This strict penalty may curb the sale of hawksbill products in Belize.

Review foraging data and consider expanding boundaries of marine reserves to encompass areas used by migrating sea turtles

With the advent of satellite telemetry, sea turtle foraging areas can be clearly identified. Inclusion of areas used by multiple turtles, or multiple turtle species, would provide and additional layer of protection since patrols are regularly conducted by park managers. The expanded area does not need to be a conservation zone, it can be designated as a general use zone.

2.5. Research

There exist several key knowledge gaps and unpublished data that could be valuable tools to assess sea turtle populations useful in planning future studies. The areas are:

- Nesting beach monitoring
- Tagging surveys
- Unpublished data
- Database
- Satellite telemetry

- In-water surveys
- DNA studies

The key knowledge gap is a lack of nesting beach data. The Belize Sea Turtle Recovery Action Plan published a summary of turtle nesting activity on beaches throughout Belize with data collected between 1989-1991. The BSTCN should work diligently towards identifying resources for members to conduct nationwide surveys at all nesting sites for 3-5 years to populate the database and identify trends. At nesting sites where there exists 24/7 presence, i.e. Ranguana Caye, a daily log of nesting activity should be kept. Some sites may have infrequent nests, but the log will be important to establishing the importance of the small islands to nesting turtles throughout Belize. The sites where there is 24/7 presence include islands where protected area managers have ranger stations, where the Belize Coast Guard or Port Authority have bases, or there exists resorts already involved in monitoring turtle activity. The following is a list of possible nesting sites where a daily turtle activity log could be maintained. Other sites, where there is 24/7 presence, should be identified and included.

- Mauger Caye
- Calabash Caye
- Sandbore Caye
- Half Moon Caye
- Long Caye (Glovers)
- Twin Cayes
- Little Water Caye
- Laughing Bird Caye
- Ranguana Caye
- Hunting Caye

Due to isolation of nesting beaches and lack of resources, no long term flipper tagging studies of nesting turtles has been completed. There has been limited tagging of turtles during in-water programs including Belize City when turtles were saved from being sold at markets, during in-water surveys at Ambergris Caye, Caye Caulker, Turneffe Islands Atoll, Robinson Point, South Water Caye and Glovers Reef Atoll. The limited instances where turtles have been tagged have yielded valuable results showcasing links between countries, which reveal the benefit of tagging programs. Tag inventory should be incorporated into the turtle database so reports can be generated. The following are details of known recaptures.

• 2001 - Green turtle that was purchased from a fishermen, tagged and released, was observed nesting in Costa Rica.

• 2007 - Hawksbill turtle tagged during in water surveys at Robinson Point was recaptured in Nicaragua in 2013.

• 2011 – Hawksbill turtle tagged during nationwide in-water survey at South Water Caye Marine Reserve was recaptured in Nicaragua in 2017.

• 2013 - Loggerhead turtle that was captured during in water surveys June 13 at Turneffe and was observed nesting near Xel Ha, Yucatan, Mexico July 29.

In 2017 Forman-Castillo (26) compiled historical data and available current data and produced the Belize Marine Turtle Report. The annual publication of data collected each year should be a priority of the BSTCN. However, a lack of resources – financial support and a functional database – has been a constraint to accessing and publishing data. There are several sources of data that should be organized for publication and include the following:

1. Data collected by ECOMAR through the Belize Turtle Watch Program summarizing reports of nesting and hatching, and mating turtles.

2. Turtle data referenced in monthly and annual reports by protected area managers.

3. Records of stranded and rehabilitated turtles from BSTCN members.

4. Records of illegal take and permissions granted for cultural use.

5. Nesting beach data from Ambergris Caye index nesting beach that has been monitored since 2009.

6. Nesting beach data from Gales Point index nesting beach has been monitored sporadically since 1990.

7. Tag inventory of all flipper tags, pit tags, acoustic tags and satellite tags.

8. Nesting beach data from 2020 onward.

The University of Belize's Environmental Resource Institute, a member of the Belize Sea Turtle Conservation Network, has created a database to be the repository for all turtle data. However, the database has had accessibility issues and has some missing fields that need to be incorporated by the database manager to make the database fully functional. We hope to have the database operative in 2020.

ECOMAR has collected tracking data for 47 of the 53 turtles that were part of satellite telemetry studies that migrated through Belize. The data reveal a complex set of data on migration routes and foraging areas. ECOMAR and Marymount University and other partners are currently collaborating on reports summarizing data.

In-water studies have been completed by WCS at Glover's Reef (27, 32, 33), Mar Alliance at Lighthouse Reef Atoll (28, 29) by ECOMAR at Gallow's Point and Robinson Point, and as a united effort by members of the Belize Sea Turtle Conservation Network throughout Belize in 2011. In-water studies should also continue to document trends.

DNA studies have been discussed at BSTCN meetings and members are seeking to collaborate with partners that have capability to test and incorporate into ongoing studies. There were some samples sent for analysis around 2010, but the results were not made available or may have been inconclusive. Analysis of tissue from nesting turtles, in-water captures and stranded sea turtles need to be analysed and compared to regional data.

The list of conservation priorities and research needs highlights additional activities that need to addressed during the next decade. Members of the Belize Sea Turtle Conservation will continue to work together to protect and conserve sea turtles in Belize.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Belize.

RMU	*C. caretta*	Ref #	*C. mydas*	Ref #	*D. coriacea*	Ref #	*E. imbricata*	Ref #
Occurrence								
Nesting sites	Y		Y		N		Y	
Pelagic foraging grounds	N		N		Y - A		N	
Benthic foraging grounds	Y - A		Y - B		N		Y - B	
Key biological data								
Nests/yr: recent average (range of years)	n/a		n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a		n/a	
Nests / female season	n/a		n/a		n/a		n/a	
Female remigration interval (yrs)	n/a		n/a		n/a		n/a	
Sex ratio: hatchlings (F / Tot)	n/a		n/a		n/a		n/a	
Sex ratio: juveniles (F / Tot)	n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot)	n/a		n/a		n/a		n/a	

Min adult size, CCL or SCL (cm)	n/a		n/a		n/a		n/a	
Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs)	n/a		n/a		n/a		n/a	
Emergence success (hatchlings/egg)	n/a		n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks)	n/a		n/a		n/a		n/a	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	50+ (1989-1991)	6-10	50+ (1989-1991)	6-10	n/a		125 -160 (1989-1991)	6-10
Published studies								
Growth rates	N		N		N		N	
Genetics	N		N		N		N	
Stocks defined by genetic markers	N		N		N		N	
Remote tracking (satellite or other)	Y	13	Y	13	N		Y	13
Survival rates	N		N		N		N	
Population dynamics	N		N		N		N	
Foraging ecology (diet or isotopes)	N		N		N		N	
Capture-Mark-Recapture	Y		Y		N		Y	
Threats								
Bycatch: small scale / artisanal	n/a		n/a		n/a		n/a	

Bycatch: industrial	n/a		n/a		n/a		n/a	
Bycatch: quantified?	n/a		n/a		n/a		n/a	
Intentional killing or exploitation of turtles	Y		Y		n/a		Y	
Egg poaching	Y		Y		n/a		Y	
Egg predation	Y		Y		n/a		Y	
Photopollution	Y		Y		n/a		Y	
Boat strikes	Y		Y		n/a		Y	
Nesting habitat degradation	Y		Y		n/a		Y	
Foraging habitat degradation	n/a		n/a		n/a		n/a	
Other	Y		Y		n/a		Y	
Long-term projects								
Monitoring at nesting sites	Y		Y		n/a		Y	
Number of index nesting sites	2	17-25	2	17-25	n/a	17-25	2	17-25
Monitoring at foraging sites	Y		Y		n/a		Y	
Conservation								
Protection under national law	Y	34	Y	34	Y	34	Y	34
Number of protected nesting sites (habitat preservation)	n/a		n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	n/a		n/a		n/a		n/a	
Long-term conservation projects (number)	4		4		n/a		4	
In-situ nest protection (eg cages)	1		1		n/a		1	
Hatcheries	0		0		n/a		0	
Head-starting	0		0		n/a		0	

By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a	
By-catch: onboard best practices	n/a		n/a		n/a		n/a	
By-catch: spatio-temporal closures/reduction	n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		n/a	

Table 2. Sea turtle nesting beaches in Belize.

Nesting site	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #
CC				Long	Lat	Long	Lat	Long	Lat			
Ambergris Caye	Y	21-51:38 (2012-2016)	UNK	n/a	n/a	n/a	n/a	18.114095	-87.84795	2.5	n/a	21-25
Gales Point	Y	13-20:15 (2012-2016)	UNK	17.14222	-88.30388	17.23027	-88.30388	17.2036095	-88.3049575	14	n/a	21-25
CM												
Ambergris Caye	Y	15-70:41(2012-2016)	UNK	n/a	n/a	n/a	n/a	18.114095	-87.84795	2.5	n/a	21-25
Gales Point	Y	11-15:12 (2012-2016)	UNK	17.14222	-88.30388	17.23027	-88.30388	17.2036095	-88.3049575	14	n/a	21-25
EI												
Ambergris Caye	Y	0-4:2 (2012-2016)	UNK	n/a	n/a	n/a	n/a	18.114095	-87.84795	2.5	n/a	21-25
Gales Point	Y	54-84:69 (2012-2016)	UNK	17.14222	-88.30388	17.23027	-88.30388	17.2036095	-88.3049575	14	n/a	21-25

Table 2.1. Summary of nests reported for Ranguana Caye between 2016 and 2019.

YEAR	NUMBER OF NESTS	NUMBER OF HATCHING EVENTS	COMMENTS
2016	11	16	All reported to be hawksbill
2017	11	9	2 nests laid in Dec, all reported to be hawksbill
2018	n/a	n/a	n/a
2019	11	20	All reported to be hawksbill

Table 3. International conventions protecting sea turtles and signed by Belize**.**

Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora 1975 (Signed 1986)				
Y	permits are issued by Fisheries Department for export of protected species, but annual reports are not available on CITES for viewing	ALL	an international agreement between governments whose aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Species are categorized into Appendices and various levels of endangered based on available data.	CITES permits are required to transport turtle specimens, or parts of turtles. The listing in CITES also is attached to a species, and if listed on Appendix I, as are sea turtles, usually warrant additional protection and monitoring.
CBD - Convention on Biological Diversity 1992 (Signed 1992)				
Y	reports submitted	ALL	to conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Articles 7 through 11 descibe how biodiversity should be conserved and include: identification and monitoring, in-situ monitoring, ex-situ monitoring, sustainable use of components of biologocal diversity, incentive measures, research and training, public education and awareness, and impact assessment and minimizing adverse impacts.

IAC - Inter-American Convention for the Protection and Conservation of Sea Turtles 2001 (Signed 1998)				
Y	reports submitted, available for viewing on IAC website	ALL	Intergovernmental treaty which provides the legal framework for countries in the American Continent to take actions in benefit of these species.	The importance of this Convention is the protection bestowed to sea turtles in the habitats where the different stages of their lives transpire. Included in the measures mandated by the text per se of the Convention, is the following: The capture, retention or incidental capture of sea turtles is forbidden, as well as domestic commerce with their eggs, parts or products. The compliance of that established by the CITES Convention in regard to international trade of sea turtles, their eggs, parts or products (like hawksbill shell). The restriction of human activities that may adversely affect sea turtles during their reproduction, incubation and migration stages. Their protection and conservation, habitat restoration and those sites established and designated as protected areas, as pertinent. To support research directed to experimental reproduction, breeding and re-introduction. The promotion of environmental education and the dissemination of information, with the objective to foster the participation of governmental institutions, NGOs and the public at large. The reduction to the possible minimum of capturing, wounding or incidental capturing of sea turtles during fishing activities, as well as the development, improvement and utilization of fishing gear, devices and appropriate techniques, including the Turtle Excluder Devices (known as TEDs).

Ramsar - Convention on Wetlands 1975 (Signed 1998)				
Y	?	ALL	conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world	includes coastal areas and could be used to protect sea turtle foraging grounds less than 6 meters deep
Cartagena - Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region 1986 (Signed 1999)				
Y	?	ALL	countries who are Contracting Parties to the Convention are required to: protect and preserve rare or fragile ecosystems and habitats of depleted, threatened or endangered species; and develop technical and other guidelines for the planning and environmental impact assessments of important development projects.	In collaboration with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), the following activities have been given priority during the biennium: Support the elaboration of Sea Turtle Recovery Action Plans (STRAPs) in countries that do not have plans. Support existing STRAPs through the implementation of national priority actions, in particular the provision of training as it relates to educators (teacher training), law enforcement officers, veterinarians and first responders. Collaborate further with the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) on STRAP development and other sea turtle activities in the Workplan to ensure that work is not duplicated. Continue to promote standard guidelines and criteria for Index Site monitoring at sea turtle foraging grounds in the WCR and provide training for nesting beach and in-water population monitoring.

MARPOL - International Convention for the Prevention of Pollution from Ships 1983 (Signed 2007)				
Y	reports submitted	ALL	international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes	protect sea turtles from threats of oil pollution

Table 4. Projects and databases on sea turtles in Belize.

Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration	Reports / Information material
Gales Point	Gales Point Sea Turtle Project	nesting female, satellite telemetry	1990	n/a	Gales Point Wildlife Sanctuary Management Committee	Public	Belize Fisheries Department	Y
Nationwide	Nesting Beach Monitoring	nesting female	2000	n/a	Belize Fisheries Department	Public	Belize Audubon Society, Southern Environmental Association, Port Honduras Marine Reserve	Y
Nationwide	Belize Turtle Watch Program	nesting female, inwater, satellite telemetry	2007	n/a	ECOMAR	Public	Belize Fisheries Department, private coastal property owners and residents and visitors	Y
Ambergris Caye	Ambergris Caye Turtle Program	nesting female, inwater, satellite telemetry	2007	n/a	Hol Chan Marine Reserve & Bacalar Chico Marine Reserve	Public	Belize Fisheries Department	Y
Glovers Atoll Marine Reserve	Glover's Atoll in-Water Turtle Monitoring Program	inwater, satellite telemetry	2007	n/a	Wildlife Conservation Society	Public	Belize Fisheries Department	Y
Gales Point	Marymount University/ Hawksbill Hope	nesting female, satellite telemetry	2007	n/a	Marymount University	Public	Belize Fisheries Department, Gales Point Turtle Project	Y
Lighthouse Reef Atoll	Hawksbill turtle tracking at Lighthouse Reef Atoll, Western Caribbean - MarAlliance	inwater, acoustic tagging, satellite telemetry	2009	2016	Mar Alliance	Public	Belize Fisheries Department, Wildlife Conservation Society, Belize Audubon Society	Y

Current Sponsors	Primary Contact (name and Email)	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information
PACT, Hawksbill Hope	Kevin Andrewin <kevinandrewin@gmail.com>	N	n/a	n/a	n/a	n/a	n/a
Belize Fisheries Department, Belize Audubon Society, Southern Environmental Association, Port Honduras Marine Reserve	Alicia Eck-Nunez <alicia.nunez@fisheries.gov.bz> Adriel Castaneda <adriel.castaneda@fisheries.gov.bz>	N	n/a	n/a	n/a	n/a	n/a
ECOMAR	Linda Searle <linda@ecomarbelize.org>	N	n/a	n/a	n/a	n/a	n/a
Hol Chan Marine Reserve	Kirah Forman <kirahforman@yahoo.com>	N	n/a	n/a	n/a	n/a	n/a
Wildlife Conservation Society	Nicole Auil <nauilgomez@wcs.org>	N	n/a	n/a	n/a	n/a	n/a
Marymount University	Todd Rimkus, PhD <trimkus@marymount.edu>	N	n/a	n/a	n/a	n/a	n/a
Mar Alliance, Wildlife Conservation Society, British Chelonia Group	Rachel Graham <rachel@maralliance.org>	N	n/a	n/a	n/a	n/a	n/a

Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
n/a	N	N	y	Y	6-10,14
n/a	Y	N	Y	Y	n/a
n/a	Y	Y	Y	Y	n/a
n/a	Y	N	N	Y	n/a
n/a	Y	N	N	Y	27, 32
n/a	N	N	y	Y	n/a
n/a	Y	N	N	Y	28,29

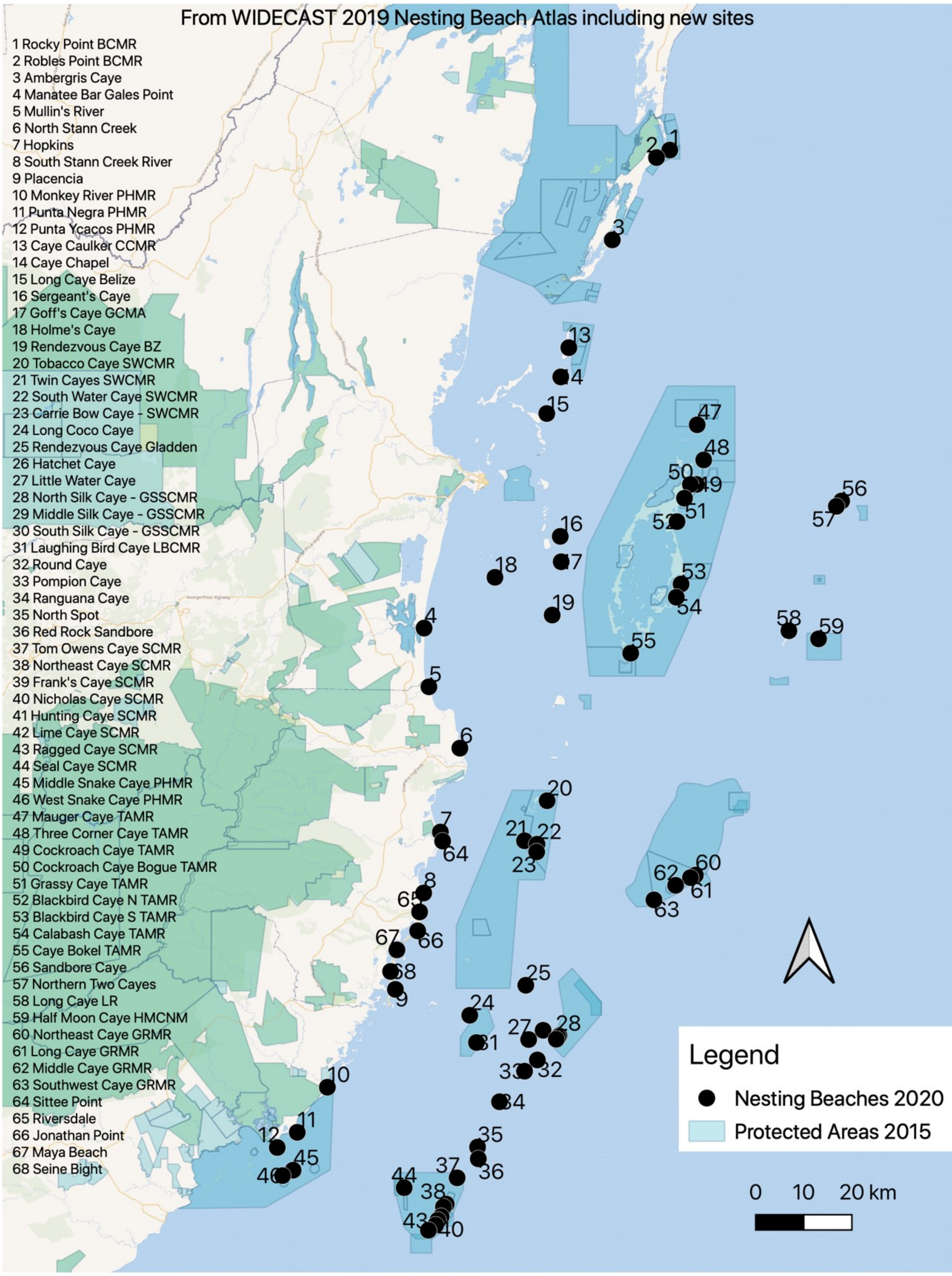

Figure 1. Sea turtle nesting sites in Belize (adapted from 10, 15, 16).

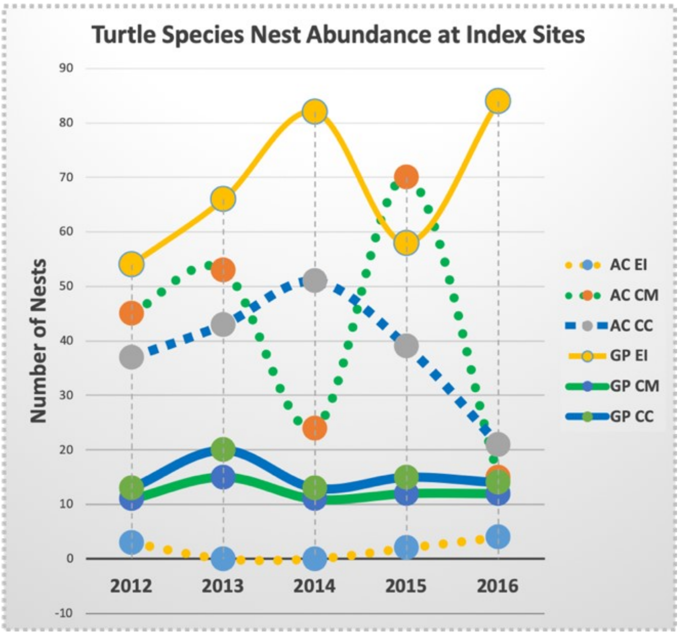

Figure 2. Comparison of turtle species nesting at Ambergris Caye (AC) and Gales Point (GP) nesting index sites between 2012-2016 (21-25).

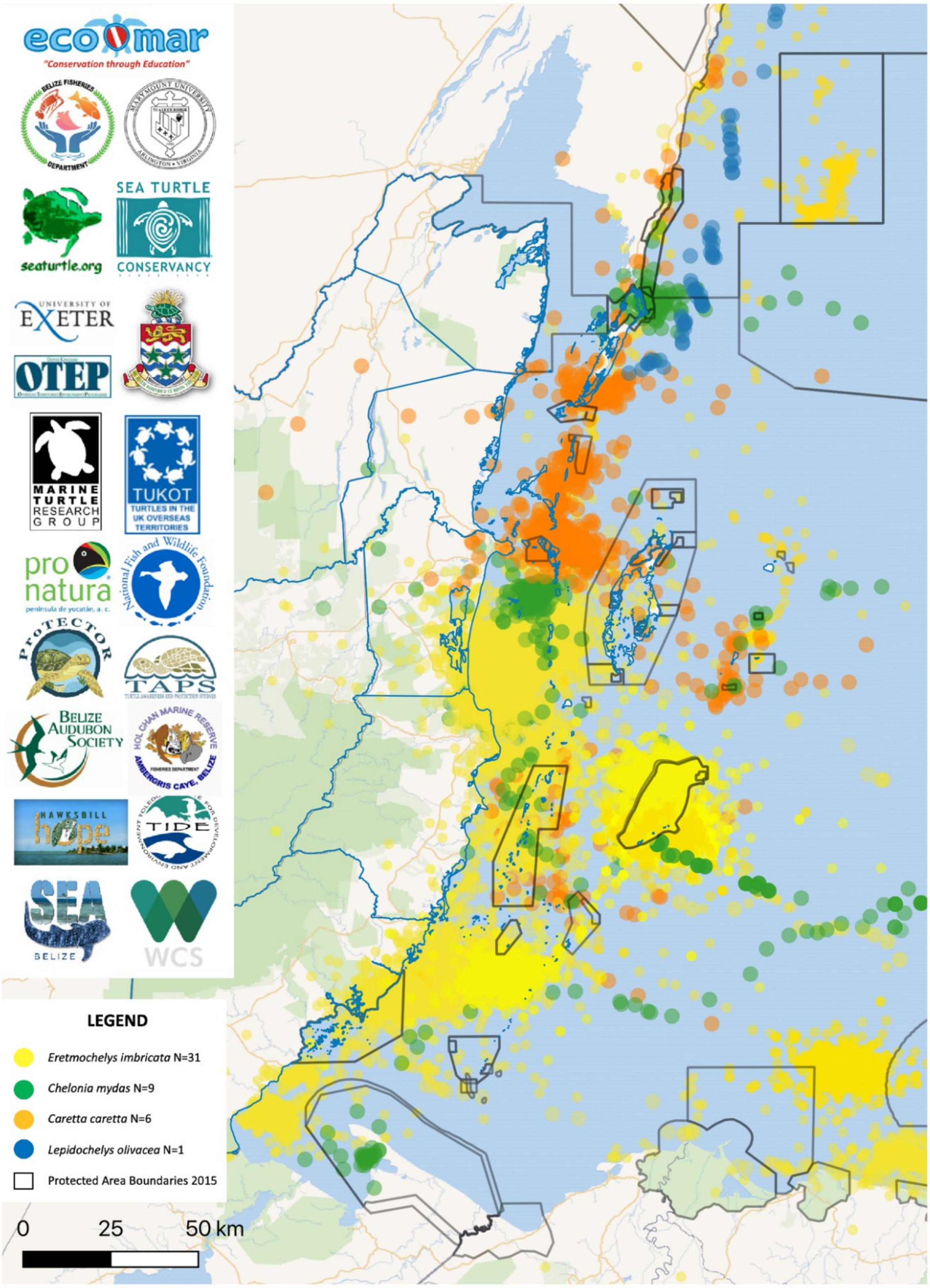

Figure 3. Identification of sea turtle foraging areas in Belize using satellite telemetry.

Bonaire

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1. RMU: Loggerhead turtle (*Caretta caretta*) – Northwest Atlantic

1.1. Distribution, abundance, trends

1.1.1. Nesting sites

Two nesting sites are used by the Northwest Atlantic (NW ATL) subpopulation of which one is an index nesting site. The total length of the Klein Bonaire index nesting site is 2km, and the beaches in the south (comprising Te Amo & Donkey Beach, and Red Beryl-Sweet Dreams) cover approximately 3 km. These beaches are 100 per cent monitored, following monitoring level 1 and protocol B.

1.1.2. Marine areas

Adult loggerhead turtles visit Bonaire during the nesting season. Bonaire does not have a juvenile or subadult loggerhead population year-round.

1.2. Biological data

Nests/year, clutch size and hatch success

The recent average number of nests/year for the 2002-2019 period is 18 for Klein Bonaire and 8 for the nesting beaches in the south of Bonaire. For Klein Bonaire, the only major nesting site, the recent order of magnitude is 9-30 for the period 2003-2020. For loggerheads, mean ± SD clutch size was 127 ± 22 eggs and hatch success 76.7% ± 19.8% (data from 131 nests). See Table 1.

1.2.1. Recent trends at nesting sites

Between 2003 and 2019, we have recorded 316 loggerhead nests on Klein Bonaire. The highest number of nests recorded in one season was 30 (2016). See Table 2.

The annual nesting activity of loggerheads tended upward in 2003-2016, with almost no change in 2017-2019. Despite wide fluctuations in annual nesting activity, there were no overall trends for loggerheads.

1.2.2. Recent trends at foraging sites

Adult loggerhead turtles visit Bonaire during the nesting season. Bonaire does not have a juvenile or subadult loggerhead population year-round.

1.2.3. Published studies

Published studies include research on green and hawksbill turtle abundance and population dynamics at foraging grounds in Bonaire (Rivera-Milán et al, 2019), population recovery changes (Van der Zee et al, 2019), seagrass (Johnson et al, 2019; Christianen et al, 2018), growth rates (Bjorndal et al, 2017; Bjorndal et al, 2016) and post-breeding migration routes (Becking et al, 2016). Unpublished studies include nesting trends for hawksbill and loggerhead turtles (Rivera-Milán et al, unpublished paper) and STCB's research and monitoring reports (2005-2020, www.bonaireturtles.org).

1.2.3.1. Satellite tracking

Becking et al (2016) examined the postbreeding migratory behavior of 5 female loggerhead turtles during the years 2004-2013. The distances swum from Bonaire to the foraging areas ranged from 608 to 1766km for loggerheads. Turtles departed 1−27 days after transmitter application, and then took 14−27 days to reach their foraging grounds. Loggerheads were tracked to offshore banks near Honduras and Nicaragua and to areas close to the islands of Vieques, Puerto Rico, Margarita Island, and Los Roques Archipelago, Venezuela.

1.3. Threats

Since Bonaire does not have a juvenile and sub-adult population of loggerheads, threats are mostly linked to nesting. Terrestrial threats for nesting females include coastal development and associated hazards, such as the degradation of nesting habitat, pollution and photopollution (mainly at nesting sites opposite the Bonaire International Airport). Climate change affects nesting loggerhead turtles in terms of available nesting area, and may also affect the gender balance in hatchlings (ongoing research). In the marine environment, threats mainly include pollution and entanglement (e.g. ghost nets, fishing line).

1.4. Conservation

See Table 3.

1.5. Research.

See Table 4.

2. RMU: Green turtle (*Chelonia mydas*) – Northwestern Atlantic

2.1. Distribution, abundance, trends

2.1.1. Nesting sites

Three nesting sites are used by the Northwest Atlantic (NW ATL) subpopulation of which two are index nesting sites. The total length of the Klein Bonaire index nesting site is 2km, the Playa Chikitu index site in Washington Slagbaai Park is 0.1km and the beaches in the south (comprising Te Amo & Donkey Beach, and Red Beryl-Sweet Dreams) cover approximately 3km. These beaches are 100 per cent monitored, following monitoring level 1 and protocol B.

2.1.2. Marine areas

Bonaire has a juvenile and subadult resident population of green turtles, to be seen year-round along the west coast and in green turtle 'hotspot' Lac Bay.

2.1. Biological data

2.1.1. Nests/year, clutch size and hatch success

The recent average number of nests/year for the 2004-2020 period is 15 for Playa Chikitu, the only major nesting site for green turtles. The recent order of magnitude is 2-29 for the period 2004-2020. For green turtles, mean clutch size was 137 eggs and hatch success 75% (data from 15 nests). Table 1.

2.1.2. Recent trends at nesting sites

Between 2003 and 2019, we have recorded 197 green turtle nests on Playa Chikitu. The highest number of nests recorded in one season was 29 (2013). We have no information on trends for green turtles. Table 2.

2.1.3. Recent trends at foraging sites

For Rivera-Milán et al (2019) we used N-mixture models, conventional distance sampling and the multiple Lincoln-Petersen method to estimate abundance from transect-count and net-capture surveys. Maximum likelihood and Bayesian generalised linear models were used to assess trends in annual abundance in 2003−2018, and a Bayesian state-space logistic model was developed to generate the posterior distributions of population parameters and make abundance predictions for 2019−2030.

Mean ± SE annual abundance was 555 ± 149 green turtles (2.5th and 97.5th percentiles = 337, 943) and there were no trends in western Bonaire and Klein Bonaire in 2003−2018. Mean annual abundance was 348 ± 135 green turtles and there was a positive trend inside Lac Bay, southeast Bonaire, 2003−2018.

2.1.4. Published studies

Published studies include research on green and hawksbill turtle abundance and population dynamics at foraging grounds in Bonaire (Rivera-Milán et al, 2019), population recovery changes (Van der Zee et al, 2019), seagrass (Johnson et al, 2019; Christianen et al, 2018), growth rates (Bjorndal et al, 2017; Bjorndal et al, 2016) and post-breeding migration routes (Becking et al, 2016). Unpublished studies include nesting trends for hawksbill and loggerhead turtles (Rivera-Milán et al, unpublished paper) and STCB's research and monitoring reports (2005-2020, www.bonaireturtles.org).

2.1.4.1. Satellite tracking

Becking et al (2016) examined the postbreeding migratory behavior of 4 female green turtles during the years 2004-2013. The distances swum from Bonaire to the foraging areas ranged from 198 to 3135km for green turtles. Turtles departed 1−62 days after transmitter application, then took 6−49 days to reach their foraging grounds. Two green turtles departed Bonaire on a northwest course, reaching Nicaragua and the waters between Belize and Mexico. One turtle departed Bonaire to the southeast, reaching her foraging grounds at the Los Roques Archipelago, Venezuela, and another turtle swam to the Dominican Republic.

2.2. Threats

Multiple threats affect Bonaire's resident population of green turtles and visiting nesting females. Terrestrial threats include coastal development and associated hazards, such as the degradation of nesting habitat, pollution and photopollution (mainly at nesting sites opposite the Bonaire International Airport). Climate change affects nesting green turtles in terms of available nesting area, and may also affect the gender balance in hatchlings (ongoing research). In addition, although sea turtles are protected by law, green turtles (including their eggs) continue to be captured for consummation incidentally. In the marine environment, threats include strikes with vessels (e.g. boats, (foil)surf boards, jetskis), degradation of foraging habitat (e.g. invasive seagrass), pollution, entanglement (e.g. ghost nets, fishing line) and fibropapillomatosis.

2.2. Conservation

See Table 3.

2.3. Research.

See Table 4.

3. RMU: Hawksbill turtle (*Eretmochelys imbricata*) – Northwestern Atlantic

3.1. Distribution, abundance, trends

3.1.1. Nesting sites

Two nesting sites are used by the Northwest Atlantic (NW ATL) subpopulation of which one is an index nesting site. The total length of the Klein Bonaire index nesting site is 2km, and the beaches in the south (comprising Te Amo & Donkey Beach, and Red Beryl-Sweet Dreams) cover approximately 3km. These beaches are 100 per cent monitored, following monitoring level 1 and protocol B.

3.1.2. Marine areas

Bonaire has a juvenile and subadult resident population of hawksbill turtles, to be seen year-round along the west coast.

3.2. Biological data

3.2.1. Nests/year, clutch size and hatch success

The recent average number of nests/year for the 2004-2020 period is 40 for Klein Bonaire, the only major nesting site for hawksbill turtles. The recent order of magnitude is 21-61 for the period 2003-2020. For hawksbills, mean ± SD hatch success rate was 74.9% ± 28.4% for hawksbills and mean ± SD clutch size was 147 ± 27 (320 nests). See Table 1.

3.2.2. Recent trends at nesting sites

Between 2003 and 2019, we have recorded 672 hawksbill nests on Klein Bonaire. The highest number of nests recorded in one season was 61 (2017).

Hawksbill annual nesting activity tended downward in 2003-2009, upward in 2010-2014, and downward again in 2015-2019. There were no overall trends for hawksbills. See Table 2.

3.2.3. Recent trends at foraging sites

For Rivera-Milán et al (2019) we used N-mixture models, conventional distance sampling and the multiple Lincoln-Petersen method to estimate abundance from transect-count and net-capture surveys. Maximum likelihood and Bayesian generalised linear models were used to assess trends in annual abundance in 2003−2018, and a Bayesian state-space logistic model was developed to generate the posterior distributions of population parameters and make abundance predictions for 2019−2030.

Mean ± SE annual abundance was 70 ± 13 hawksbill turtles and there were no trends in western Bonaire and Klein Bonaire in 2003−2018.

3.2.4. Published studies

Published studies include research on green and hawksbill turtle abundance and population dynamics at foraging grounds in Bonaire (Rivera-Milán et al, 2019), population recovery changes (Van der Zee et al, 2019), seagrass (Johnson et al, 2019; Christianen et al, 2018), growth rates (Bjorndal et al, 2017; Bjorndal et al, 2016) and post-breeding migration routes (Becking et al, 2016). Unpublished studies include nesting trends for hawksbill and loggerhead turtles (Rivera-Milán et al, unpublished paper) and STCB's research and monitoring reports (2005-2020, www.bonaireturtles.org).

Satellite tracking

Becking et al (2016) examined the postbreeding migratory behavior of 2 male and 13 female hawksbill turtles during the years 2004-2013. The distances swum from Bonaire to the foraging areas ranged from 197 to 3135km for hawksbill turtles.

Female hawksbill turtles departed 1−56 days after transmitter application, then took 10−120 days to reach their foraging grounds. Five female hawksbills were tracked to the vicinity of Ser ranilla and Rosalind Banks, and established themselves on foraging grounds within <150 km of each other. Another female was tracked to waters between Mona and Monito Islands, Puerto Rico. The other hawksbills headed to foraging grounds by the Dominican Republic, the Virgin Islands, Jamaica, Colombia, and Venezuela. Another hawksbill departed Klein Bonaire towards the south, beginning in large loops north of Los Roques and Orchila Islands, Venezuela, before reaching her foraging grounds off the west side of the Paraguaná Peninsula, Venezuela; and another turtle swam west and south towards Panamanian waters, making 2 loops before heading north to Banco Gorda in Panama.

3.3. Threats

Multiple threats affect Bonaire's resident population of hawksbill turtles and visiting nesting females. Terrestrial threats include coastal development and associated hazards, such as the degradation of nesting habitat, pollution and photopollution (mainly at nesting sites opposite the Bonaire International Airport). Climate change affects nesting hawksbill turtles in terms of available nesting area, and may also affect the gender balance in hatchlings (ongoing research). In the marine environment, threats include strikes with vessels (e.g. boats, (foil)surf boards, jetskis), degradation of foraging habitat, pollution and entanglement (e.g. ghost nets, fishing line).

3.4. Conservation

See Table 3.

3.5. Research

See Table 4.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Bonaire.

RMU	*C. caretta*	Ref #	*C. mydas*	Ref #	*E. imbricata*	Ref #
Occurrence						
Nesting sites	Y	1, 3, 11-24	Y	1, 11-24	Y	1, 3, 11-24
Oceanic foraging areas	n/a		n/a		n/a	
Neritic foraging areas	Y (limited)	1, '11-24	Y	2	Y	2
Key biological data						
Nests/yr: recent average (range of years)	18 (2002-2019) for Klein Bonaire	1, 3	15 (2004-2020) for Playa Chikitu	1	40 (2002-2019) for Klein Bonaire	1, 3
Nests/yr: recent order of magnitude	9-30 (2003-2020) for Klein Bonaire	1, 11-24	2-29 (2004-2020) for Playa Chikitu	1, 11-24	21-61 (2003-2020) for Klein Bonaire	1, 11-24
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	1 (KB)	1	1 (Chik)	1	1 (KB)	1
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	0		0		0	
Nests/yr at "major" sites: recent average (range of years)	18 (2002-2019)	1, 3	15 (2004-2020)	1	40 (2002-2019)	1, 3
Nests/yr at "minor" sites: recent average (range of years)						
Total length of nesting sites (km)	~5	1	~5.1	1	~5	1

Nesting females / yr	n/a		n/a		n/a	
Nests / female season (N)	n/a		n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	U		U		U	
Sex ratio: Immatures (F / Tot) (N)	U		U		U	
Sex ratio: Adults (F / Tot) (N)	U		U		U	
Min adult size, CCL or SCL (cm)	n/a		n/a		n/a	
Age at maturity (yrs)	U		U		U	
Clutch size (n eggs) (N)	127 (131)	3	137 (15)	1	147 (320)	3
Emergence success (hatchlings/egg) (N)	76.7% (131)	3	75% (15)	1	74.9% (320)	3
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a	
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	Upward 2003-2016, stable 2017-2019	3	n/a		Downward 2003-2009, upward 2010-2014, downward 2015-2019	3
Recent trends (last 20 yrs) at foraging grounds (range of years)	U		Stable (2003-2018), slight increase at Lac Bay (2003-2018)	2	Stable (2003-2018)	2
Oldest documented abundance: nests/yr (range of years)	316 (2003-2019) KB (highest: 30 in 2016)	1	197 (2003-2019) (highest: 29 in 2013)	1	672 (2003-2019) KB (highest: 61 in 2017)	1
Published studies						
Growth rates	N		Y	4, 7	Y	8
Genetics	N		Y	4	Y	10

Stocks defined by genetic markers	N		Y	4	N	
Remote tracking (satellite or other)	Y	9	Y	9	Y	9
Survival rates	N		N		N	
Population dynamics	N		Y	2	Y	2
Foraging ecology	N		Y	5, 6	N	
Capture-Mark-Recapture	N		N		N	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y	1, 11-24	Y	1, 11-24	Y	1, 11-24
Bycatch: presence of industrial fisheries?	N		N		N	
Bycatch: quantified?	Y	1, 11-24	Y	1, 11-24	Y	1, 11-24
Intentional killing of turtles	N		N		N	
Take. Illegal take of turtles	N		Y (but rare)	11-24	N	
Take. Permitted/legal take of turtles	N		N		N	
Take. Illegal take of eggs	Y	22	N		N	
Take. Permitted/legal take of eggs	N		N		N	
Coastal Development. Nesting habitat degradation	Y		N		Y	
Coastal Development. Photopollution	Y	1, 11-24	N		Y	1, 11-24
Coastal Development. Boat strikes	N		Y	1, 11-24	Y	1, 11-24
Egg predation	N		N		N	

Pollution (debris, chemical)	Y	1, 11-24	Y	1, 11-24	Y	1, 11-24
Pathogens	n/a		n/a		n/a	
Climate change	Y	1, 11-24	Y	1, 11-24	Y	1, 11-24
Foraging habitat degradation	n/a		Y (Lac)	5, 6	n/a	
Other						
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (2002-ongoing)	1, 11-24	Y (2002-ongoing)	1, 11-24	Y (2002-ongoing)	1, 11-24
Number of index nesting sites	1	1, 11-24	2	1, 11-24	1	1, 11-24
Monitoring at foraging sites (period: range of years)	Y (2003-ongoing)	2, 11-24	Y (2003-ongoing)	2, 11-24	Y (2003-ongoing)	2, 11-24
Conservation						
Protection under national law	Y	25	Y	25	Y	25
Number of protected nesting sites (habitat preservation) (% nests)	all (100%)	25	all (100%)	25	all (100%)	25
Number of Marine Areas with mitigation of threats	n/r		2 (Marine Reserves)	25	2 (Marine Reserves)	25
N of long-term conservation projects (period: range of years)	1 (1991-ongoing)	1, 11-24	1 (1991-ongoing)	1, 11-24	1 (1991-ongoing)	1, 11-24
In-situ nest protection (eg cages)	Y	1, 11-24	Y	1, 11-24	Y	1, 11-24
Hatcheries	N		N		N	
Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	N		N		N	
By-catch: spatio-temporal closures/reduction	n/r		n/r		n/r	

Other							

Table 2. Sea turtle nesting beaches in Bonaire.

RMU	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CC-NW ATL				Long	Lat	Long	Lat					
Klein Bonaire	Y	18 (2002-2019)		12.16827	-68.3104	12.16	-68.29405	2	100	1, 2, 3, 11-24	1	B
South (Te Amo & Donkey Beach, Red Beryl-Sweet Dreams)	N	8 (2006-2019)		12.13484	-68.2795	12.031	-68.29405	3	100	1, 11-24	1	B
CM-NW ATL												
Klein Bonaire	Y	1 (2003-2020)		12.16827	-68.3104	12.16	-68.29405	2	100	1, 11-24	1	B
Playa Chikitu	Y	15 (2004-2020)		12.28021	-68.3487	12.279	-68.34798	0.1	100	1, 11-24	1	B
South (Te Amo & Donkey Beach, Red Beryl-Sweet Dreams)	N	15 (2018-2020)		12.13484	-68.2795	12.031	-68.29405	3	100	1, 11-24	1	B
EI-NW ATL												

Klein Bonaire	Y	40 (2002-2019) KB		12.16827	-68.3104	12.16	-68.29405	2	100	1, 2, 3, 11-24	1	B
South (Te Amo & Donkey Beach, Red Beryl-Sweet Dreams)	N	8 (2006-2019)		12.13484	-68.2795	12.031	-68.29405	3	100	1, 11-24	1	B

Table 3. International conventions protecting sea turtles and signed by Bonaire.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Inter-American Convention for the protection of sea turtles	Y	Y	Y	CM, CC, EI	Protection, monitoring, tagging, tracking	Protection of sea turtles in the Caribbean
Spaw Protocol	Y	Y	Y	CM, CC, EI	Protection, monitoring, tagging, tracking	Protection of sea turtles in the Caribbean

Table 4. Projects and databases on sea turtles in Bonaire.

#	RMU	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	CM-BON	Caribbean Netherlands	Sea Turtle Conservation Bonaire	Monitoring; tracking; nesting; Caribbean	2002	ongoing	STCB	Public	WIDECAST	www.bonaireturtles.org	WWF-NL, Dutch Ministry of LNV,	Kaj Schut, stcb@bonaireturtles.org	Daan Zeegers, field@bonaireturtles.org

				Netherlands; Bonaire							Stichting DierenLot		
T4.2	EI-BON	Caribbean Netherlands	Sea Turtle Conservation Bonaire	Monitoring; tracking; nesting; Caribbean Netherlands; Bonaire	2002	ongoing	STCB	Public	WIDECAST	www.bonaireturtles.org	WWF-NL, Dutch Ministry of LNV, Stichting DierenLot	Kaj Schut, stcb@bonaireturtles.org	Daan Zeegers, field@bonaireturtles.org
T4.3	CC-BON	Caribbean Netherlands	Sea Turtle Conservation Bonaire	Monitoring; tracking; nesting; Caribbean Netherlands; Bonaire	2002	ongoing	STCB	Public	WIDECAST	www.bonaireturtles.org	WWF-NL, Dutch Ministry of LNV, Stichting DierenLot	Kaj Schut, stcb@bonaireturtles.org	Daan Zeegers, field@bonaireturtles.org
T4.4	CM-BON	Caribbean Netherlands	Sea Turtle Conservation Bonaire	Monitoring; tracking; foraging; Caribbean Netherlands; Bonaire	2003	ongoing	STCB	Public	WIDECAST	www.bonaireturtles.org	WWF-NL, Dutch Ministry of LNV, Stichting DierenLot	Kaj Schut, stcb@bonaireturtles.org	Daan Zeegers, field@bonaireturtles.org
T4.5	EI-BON	Caribbean Netherlands	Sea Turtle Conservation Bonaire	Monitoring; tracking; foraging; Caribbean Netherlands; Bonaire	2003	ongoing	STCB	Public	WIDECAST	www.bonaireturtles.org	WWF-NL, Dutch Ministry of LNV, Stichting DierenLot	Kaj Schut, stcb@bonaireturtles.org	Daan Zeegers, field@bonaireturtles.org

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking
T4.1	Y	STCB nesting data	Klein Bonaire, Playa Chikitu, South	2002	ongoing	N	Y	Y	N	Y	Y
T4.2	Y	STCB nesting data	Klein Bonaire, Playa Chikitu, South	2002	ongoing	N	Y	Y	N	Y	Y
T4.3	Y	STCB nesting data	Klein Bonaire, Playa Chikitu, South	2002	ongoing	N	Y	Y	N	Y	Y
T4.4	Y	STCB survey data	West coast, Klein Bonaire, Lac Bay	2003	ongoing	Y	N	Y	N	Y	N
T4.5	Y	STCB survey data	West coast, Klein Bonaire, Lac Bay	2003	ongoing	Y	N	Y	N	Y	N

Canada

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1 RMU: Loggerhead (*Caretta caretta*) - Northwest Atlantic

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Loggerhead turtles are not known to nest in Canada.

1.1.2 Marine areas

Oceanic foraging grounds in Canadian waters for juvenile and adult loggerhead turtles from the Northwestern Atlantic (NWA) subpopulation are located off the Scotian Shelf, Scotian Slope, Georges Bank and Grand Banks. Occurrence of this species in Canadian waters is seasonal (Table 1; Figure 2).

1.2 Other biological data

1.2.1 Sex ratios (immatures and adults)

n/a

1.2.2 Minimum adult size and age at sexual maturity

Please see Table 3.5.1. Because loggerheads in Canadian waters originate from rookeries in the U.S., we have included values for minimum adult size and age at sexual maturity that were estimated at sites in the U.S.

1.2.3 Recent trends at foraging sites

No population trend analyses have been conducted for loggerhead turtles in foraging areas in Canadian waters.

1.2.4 Published studies

Please see Table 3.5.1.

1.3 Threats

Several threats were identified to impact loggerhead turtles in Canada, particularly those related to bycatch in commercial fisheries and pathogens (Table 3.5.1).

1.4 Conservation

Loggerhead turtles and their habitats are protected in Canada (Table 3.5.3).

1.5 Research

As biological data collected for this species in Atlantic Canada has largely been fishery-dependent, biases may exist. For example, distribution and size class data reflect turtles incidentally-captured in pelagic longline fisheries. Telemetry studies have been initiated to better understand habitat use in Canadian waters.

In addition, existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, may be linked to environmental or individual-level variability, and may vary with population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. Furthermore, precise estimates of survival rates of younger age classes, e.g. hatchling, and pelagic juvenile, are essential to accurately estimate population size and trend.

There have been very few studies of pollution and pathogens in sea turtles within Canadian waters and no studies of biotoxins. Much of the information available for sea turtles studied within adjacent regions, particularly related to various forms of pollution and some potential pathogens, are relevant to Canada as well. Notable exceptions are harmful algal blooms and the tumor-causing disease fibropapillomatosis, which thus far have only been recorded in lower latitudes.

2 RMU: Green turtle (*Chelonia mydas*) - Northwest Atlantic

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Green turtles are not known to nest in Canada.

2.1.2 Marine areas

There are no known foraging grounds for green turtles in Canada. However, there has been one published report of a live green turtle and a live loggerhead-green turtle hybrid turtle in Canadian waters (Ref# 1) (Table 3.5.1).

2.2 Other biological data

2.2.1 Sex ratios (immatures and adults)

n/a

2.2.2 Minimum adult size and age at sexual maturity

n/a

2.2.3 Recent trends at foraging sites

n/a

2.2.4 Published studies

There is one report of a live green turtle and one report of a live loggerhead-green turtle hybrid turtle in Canadian waters (Ref # 1) (Table 3.5.1).

2.3 Threats

n/a

2.4 Conservation

Green turtles and their habitats are protected in Canada (see Table 3.5.3).

2.5 Research

There are multiple unpublished, but confirmed records of green turtles in Atlantic Canada, suggesting potential contiguity with NE USA neritic foraging habitat. We encourage publication of these records.

3 RMU: Leatherback turtle (*Dermochelys coriacea*) - Northwest Atlantic

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

Leatherback turtles are not known to nest in Canada.

3.1.2 Marine areas

Foraging grounds in Canadian waters for juvenile and adult leatherback turtles from the NWA subpopulation are located off the coasts of Nova Scotia, Newfoundland and Labrador, New Brunswick and Prince Edward Island (Table 3.5.1; Figure 3.6.2).

3.2 Other biological data

3.2.1 Sex ratios (immature and adults)

There is one study that reported sex ratios for adult leatherback turtles in Canada (Ref# 17) (Table 3.5.1).

3.2.2 Minimum adult size and age at sexual maturity

Because leatherbacks in Canadian waters originate from multiple rookeries across the NW ATL, we have not included values for minimum adult size and age at sexual maturity.

3.2.3 Recent trends at foraging sites

Trends in foraging areas are presented using the best available data, which suggest a stable trend since 2002. However, we suggest using caution should be exercised when interpreting this trend because it reflects it is based on one published dataset survey effort in a relatively small portion of the species' overall range in Canadian waters (an area identified as high-use habitat for the species), and is based on opportunistic sightings per unit effort (SPUE), so that may be biased by difficulty in accounting for detectability may present a potential bias (Ref# 63).

3.2.4 Published studies

Please see Table 3.5.1.

3.3 Threats

Several threats were identified to impact leatherback turtles in Canada, particularly those related to bycatch in industrial fisheries, pathogens and pollution (Table 3.5.1).

3.4 Conservation

Leatherback turtles and their habitats are protected in Canada (Table 3). Spatial-temporal closures to all fishing, or specific gear types (e.g. bottom dragging) exist in various areas under the Canada Fisheries Act and Canada Oceans Act, however these management instruments were established to broadly manage and protect marine resources and were not specifically designed to reduce sea turtle bycatch (3602, 3603).

3.5 Research

The extent to which this species interacts with various fisheries, and specific gear components, in Atlantic Canadian waters remains unknown. Survivorship rates at the time of release from fishing gear, and post-release, are poorly understood. There is a paucity of studies, in particular mark-recapture studies, to estimate survival rate, age at maturity, remigration interval, and clutch frequency. Furthermore, existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, and may be linked to environmental or individual-level variability, and population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. In addition, special effort should be directed towards precise estimates of survival rates of younger age classes, e.g. hatchling, and pelagic juvenile, as they are essential to accurately estimate population size and trend.

There have been very few studies of pollution and pathogens in sea turtles within Canadian waters and no studies of biotoxins. Much of the information available for sea turtles studied within adjacent regions, particularly related to various forms of pollution and some potential pathogens, are relevant to Canada as well. Notable exceptions are harmful algal blooms and the tumor-causing disease fibropapillomatosis, which thus far have only been recorded in lower latitudes.

4 RMU: Kemp's Ridley turtle (*Lepidochelys kempii)* - Northwest Atlantic

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

Kemp's ridley turtles are not known to nest in Canada.

4.1.2 Marine areas

There are no known foraging grounds for Kemp's ridley turtles in Canada. However, there are a few reports of juvenile Kemp's ridley turtles in Canada, all of which are considered accidental captures/strandings (Ref# 7) (Table 3.5.1).

4.2 Other biological data

4.2.1 Sex ratios (immatures and adults)

n/a

4.2.2 Minimum adult size and age at sexual maturity

n/a

4.2.3 Recent trends at foraging sites

n/a

4.2.4 Published studies

n/a

4.3 Threats

n/a

4.4 Conservation

n/a

4.5 Research

n/a

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Canada. (n/a = Not applicable or available; CC = *Caretta caretta*, CM = *Chelonia mydas*, DC = *Dermochelys coriacea*, LK = *Lepidochelys kempii*).

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Occurrence								
Nesting sites	No	n/a	No	n/a	No	n/a	No	n/a
Oceanic foraging grounds	Juvenile	1-6	Juvenile	1	Juvenile, Adult	7-15, 85	Juvenile	7
Neritic foraging grounds	Yes	16	No	n/a	Adult	85	No	n/a
Key biological data								
Nests/yr: recent average	n/a		n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a		n/a		n/a	
Number of "major" sites	n/a		n/a		n/a		n/a	
Number of "minor" sites	n/a		n/a		n/a		n/a	
Nests/yr at "major" sites: recent average	n/a		n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average	n/a		n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a		n/a	

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Nesting females/yr	n/a		n/a		n/a		n/a	
Nests/female/season (clutch frequency)	n/a		n/a		n/a		n/a	
Female remigration interval (yrs)	n/a		n/a		n/a		n/a	
Sex ratio: Hatchlings	n/a		n/a		n/a		n/a	
Sex ratio: Immatures	n/a		n/a		n/a		n/a	
Sex ratio: Adults (females/total) (Number of individuals)	n/a		n/a		0.65 (80)	17	n/a	
Minimum adult size (cm): minimum observed value (CCL: curved carapace length; SCL: straight carapace length)	SCL: 80.2; CCL: 84.5	18-29	n/a		n/a		n/a	
Age at maturity (yrs): mean, range of estimates	33.6, 12-50.8	18, 21, 24, 30	n/a		n/a		n/a	
Clutch size (number of eggs/nest)	n/a		n/a		n/a		n/a	
Emergence success (hatchlings/egg)	n/a		n/a		n/a		n/a	
Nesting success (nest/crawl)	n/a		n/a		n/a		n/a	

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Trends								
Recent trends (last 20 yrs) at nesting sites	n/a		n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds [ranges of years]	n/a		n/a		Stable [2001-2014]	63	n/a	
Oldest documented abundance (nests/yr)	n/a		n/a		n/a		n/a	
Published studies								
Growth rates	No	n/a	No	n/a	No	n/a	No	n/a
Genetics	Yes	1	Yes	1	Yes	31	No	n/a
Stocks defined by genetic markers	No	n/a	No	n/a	No	n/a	No	n/a
Remote tracking (satellite or other)	Yes	4, 32-38, 86	Yes	87	Yes	8, 13, 39-62	Yes	36
Survival rates	No	n/a	No	n/a	No	n/a	No	n/a
Population dynamics	No	n/a	No	n/a	Yes	63-64, 79, 85, 88	No	n/a

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Foraging ecology (diet or isotopes)	Yes	4	No	n/a	Yes	8, 15, 65-70	No	n/a
Capture-Mark-Recapture	Yes	2, 71	No	n/a	Yes	17, 31	No	n/a
Threats								
Bycatch: presence of small scale / artisanal fisheries?	No	n/a	No	n/a	No	n/a	No	n/a
Bycatch: presence of industrial fisheries? (PLL: Pelagic Longlines; FP: Fish/Crustacean Pots/Traps; OTH: Other, *see text*)	Yes (PLL)	3, 72-73	No	n/a	Y (PLL, FP, OTH)	74-75	No	n/a
Bycatch: quantified? (codes as above)	Yes (PLL)	3, 72	No	n/a	No	n/a	No	n/a
Intentional killing or exploitation of turtles	No	n/a	No	n/a	No	n/a	No	n/a
Take. Illegal take of turtles	No	n/a	No	n/a	No	n/a	No	n/a
Take. Permitted/legal take of turtles	No	n/a	No	n/a	No	n/a	No	n/a
Take. Egg poaching	No	n/a	No	n/a	No	n/a	No	n/a

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Take. Permitted/legal take of eggs	No	n/a	No	n/a	No	n/a	No	n/a
Coastal Development. Nesting habitat degradation	No	n/a	No	n/a	No	n/a	No	n/a
Coastal Development. Photopollution	No	n/a	No	n/a	No	n/a	No	n/a
Coastal Development. Boat strikes	No	n/a	No	n/a	No	n/a	No	n/a
Egg predation	n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	No	n/a	No	n/a	Yes	76	No	n/a
Pathogens	Yes	77	No	n/a	Yes	78	No	n/a
Climate change	Yes	86	No	n/a	Yes	79	No	n/a
Foraging habitat degradation	No	n/a	No	n/a	No	n/a	No	n/a
Other (HAB - harmful algal blooms)	No	n/a	No	n/a	No	n/a	No	n/a
Long-term projects (>5yrs)								
Monitoring at nesting sites	n/a		n/a		n/a		n/a	
Number of index nesting sites	n/a		n/a		n/a		n/a	

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
Monitoring at foraging sites [ranges of years]	No	n/a	No	n/a	Yes [2001-present]	63	No	n/a
Conservation								
Protection under national law	Yes	80	No	n/a	Yes	80	No	n/a
Number of protected nesting sites (habitat preservation)	n/a		n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats (MPA: Marine Protected Area)	>= 4 MPAs	81	No	n/a	>= 4 MPAs	81	No	n/a
N of long-term conservation projects [range of years]	No	n/a	No	n/a	1 [1997-present]	63	No	n/a
In-situ nest protection (e.g., cages)	n/a		n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a		n/a	
Head-starting	n/a		n/a		n/a		n/a	
By-catch: fishing gear modifications (e.g., TED, circle hooks; code as above)	corrodible circle hooks (PLL)	82	No	n/a	No	n/a	No	n/a
By-catch: onboard best practices	Yes	82	No	n/a	No	n/a	No	n/a

RMU	*C. caretta*	Ref#	*C. mydas*	Ref#	*D. coriacea*	Ref#	*L. kempii*	Ref#
By-catch: spatio-temporal closures/reduction	Yes	83-84	No	n/a	Yes	83-84	No	n/a

Table 2. Sea turtle nesting beaches in Canada (blank).

Table 3.5.2. Nesting sites. There are no known nesting sites for sea turtles in Canada.

Table 3. International conventions protecting sea turtles and signed by Canada. (CC = *Caretta caretta*, CM = *Chelonia mydas*, DC = *Dermochelys coriacea*, EI = *Eretmochelys imbricata*, LK = *Lepidochelys kempii*, LO = *Lepidochelys olivacea*).

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES)	Yes	Yes	Yes	CC, CM, EI, LK, DC, LO	Ensures that the international trade in wild animal and plant specimens does not threaten their survival.	All species are listed in Appendix 1.
Convention on Wetlands of International Importance (Ramsar)	Yes	No	No	CC, CM, EI, LK, DC, LO	Halt the worldwide loss of wetlands and ensure their proper, sustainable use and management,	Sea turtles not specifically covered by Ramsar, but as existing and potential Ramsar sites are used by sea turtles for nesting and foraging, Ramsar and the IAC entered into a MOU to collaborate and designate Ramsar sites with an eye towards conservation of all sea turtle species.
Species at Risk Act (SARA)	Yes	Yes	Yes	CC, DC	Aims to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.	Two species are listed in Schedule 1

Table 4. Projects and databases. (blank)

Table 3.5.4. Projects and databases. Left blank only peer reviewed publications and books were included in the 2020 Report.

Figure 1. Nesting sites (blank)

Figure 3.6.1. Nesting sites. There are no known nesting sites for sea turtles in Canada.

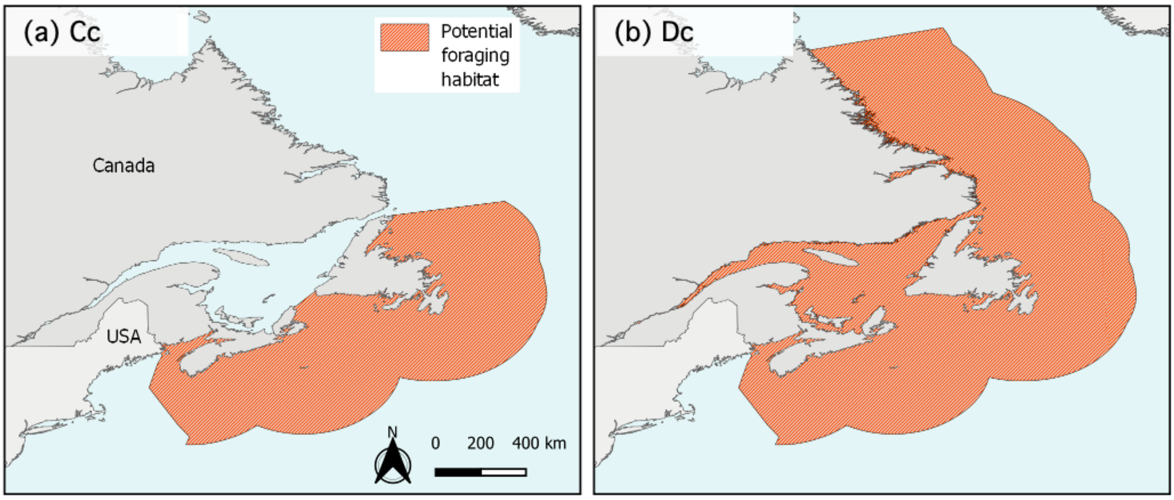

Figure 2. Foraging habitat

Figure 3.6.2. Potential foraging habitat (benthic and/or pelagic) for two species of sea turtles in Canada delimited by EEZ boundaries. Cc = *Caretta caretta*, Dc = *Dermochelys coriacea*.

Cayman Islands

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1. RMU: Green turtle (*Chelonia mydas*) – Northwest Atlantic

1.1. Distribution, abundance, trends

C. mydas nesting sites are present on all three islands (Grand Cayman, Little Cayman and Cayman Brac). Nesting is most abundant on Grand Cayman. For example, in 2019, there were 342 nests in Grand Cayman in comparison to 86 in Little Cayman and only 5 in Cayman Brac [3]. In Grand Cayman, 64% of nesting occurs on the west side of the island [3]. *C. mydas* nesting numbers have significantly increased since monitoring began in 1998. In Grand Cayman, comparing the first 5 years of nest numbers to the most recent 5 years, the increase was 1,126% (from 82 to 1,005 nests). Nest numbers have also increased in Little Cayman where less than 10 nests were recorded each season in 1998, 2000 – 2003, and 86 were recorded in 2019. Nesting numbers remain low in Cayman Brac with a maximum of 7 nests recorded in a season [3]. A captive breeding operation contributed to the nesting population recovery of *C. mydas*, which were listed as locally extinct in the 1980s [9] due to over-exploitation over hundreds of years [1] (although it appears populations did manage to persist at very low levels [8]).

1.1.1. Nesting sites

In Grand Cayman, 67% of green turtle nests were located within 3km of the facility where captive breeding and releasing of *C. mydas* occurs (Cayman Turtle Farm, now Cayman Turtle Centre), though this area only represented 9% of available nesting habitat [3]. Specific nesting sites are not disclosed due to an ongoing threat of illegal take in the Cayman Islands; however, critical habitat maps are available [3,10]. No Specific nesting sites were included in this report.

1.2. Other biological data

Time-depth recorders revealed diurnal foraging and nocturnal resting of C. mydas [5] and a capture, mark, re-capture method in this study indicated that the South Sound of Grand Cayman is an important developmental habitat for small juvenile and subadults and their fidelity to seagrass beds [5]. Data from recaptures of tagged turtles that were headstarted and released as part of a captive breeding programme found that age at maturity could be as young as 15 years [14]. Growth rates of captive re-captures were found to be comparable to wild turtles in the region [14]. Effects of the C. mydas captive breeding and re-introduction programme found loss of genetic variability and increased relatedness in captive stock over time, but no difference in genetic diversity among captive and wild groups [15]. No depensation was identified in reduced Cayman nesting populations [25]. See Table 1.

1.3. Threats

Illegal harvesting is a present threat as green turtle meat is of cultural significance in the Cayman Islands [11,14]. Between 1999 to 2019, 41 C. mydas have been harvested and a further 23 attempts made. The number of turtles harvested each year is likely much higher than those known and reported [3]. A further 19 C. mydas were legally harvested from the wild when a legal turtle fishery operated between 1998 – 2008 [3].

Artificial lighting is a serious threat to sea turtle populations as it causes hatchling misorientation and mortality. It was reported that 11% of nests (all species) in Grand Cayman suffered hatchling misorientation during hatching and 9% of nests had direct interventions applied to them to protect hatchlings from artificial lighting [3]. There is no difference between misorientation rates of C. caretta and C. mydas [3].

As hatching season coincides with the more severe part of hurricane season in the Caribbean, nest inundation is another threat. In Grand Cayman, 5% of nests (from 3590 sea turtle nests of all species) were inundated or completely washed away despite 6% of all nests being relocated to further from the high-water mark. Though the proportion of nest inundation varies year to year based on storm activity, future predictions state that storms and hurricanes will intensify [27] and therefore it is likely nest inundation will increase as an emerging threat in the future [3]. Other threats include human disturbances to nests (including vehicle compaction of sand) and roots growing into eggs (3).

1.3.2. Marine areas

n/a

1.4. Conservation

The Cayman Islands Government Department of Environment has an ongoing sea turtle nest monitoring programme that recruits interns and volunteers to assist with monitoring all nesting beaches between May – November. All sea turtle activity on beaches is recorded so that nest number trends and threats are known. The department also has Conservation Enforcement Officers, who help protect turtles around the three islands [3]. The Cayman Islands Government is currently funding a 'Turtle Friendly Lighting Initiative' to remediate existing beachfront lighting, targeting areas of critical nesting habitat [3]. Furthermore, all sea turtles are listed as a Part 1 Protected Species in the Cayman Islands and are protected at all times [10].

The Cayman Turtle Centre continues to breed and release *C. mydas* hatchlings and yearlings, along with the controversial sale of turtle meat [3,28,29].

Turtle license conditions include: licensed fishermen can take green and loggerheads between 16 - 24 inches CCL. No more than 4 turtles to be taken between December to March. No spear guns or fixed nets to be used, and a licensee must allow the turtle to be inspected by a conservation officer. Although a small number of these licenses still exist, none have been used since restrictions were tightened in 2008 (3).

Under the National Conservation Act (2013) it is an offence to "take" any species of sea turtle (unless licensed) or eggs. "Take" means to collect, hunt, kill, destroy, injure, disturb, harass, harm, wound, capture, molest or impeded in any way (10). See Table 2.

1.5. Research

A number of published studies have been carried out on C. mydas in the Cayman Islands. These include:

- Satellite tracking [17,23].
- Depth recording [5].
- Population genetics [30].
- Headstarting [11,14,30].
- Growth rates [5,8, 13, 14].
- Nesting [1,2,3,8].
- Hatch success and fertilization [25].
- Distribution of juveniles [24].
- Consumption and illegal take [28].

Ongoing data collection for future publications is being carried out.

2. RMU: Loggerhead turtle (*Caretta caretta*) – Northwest Atlantic

2.1. Distribution, abundance, trends

C. caretta nesting sites are present on all three islands (Grand Cayman, Little Cayman and Cayman Brac). Nesting is most abundant on Grand Cayman. For example, in 2019, there were 125 nests in Grand Cayman in comparison to 65 in Little Cayman and 48 in Cayman Brac [3]. In Grand Cayman, 58% of nesting occurs on the south side of the island [3]. *C. caretta* nesting numbers have significantly increased since monitoring began in 1998, but they did not start to increase until 2008 (coinciding with the end of a local traditional turtle fishery [3]. Unlike *C. mydas*, *C. caretta* were never captive bred. In Grand Cayman, comparing the first 5 years of nest numbers to the most recent 5 years, the increase was 487% (from 113 to 663 nests). Nest numbers have also increased in Little Cayman where no nests were recorded in the first monitoring seasons in 1998 and 2000, and less than 6 nests were recorded each season between 2001 – 2003. In 2019, 65 nests were recorded. *C. caretta* are the most abundant species nesting in Cayman Brac, but nest numbers remain low, with a maximum of 55 nests in a season [3].

2.1.1. Nesting sites

Specific nesting sites are not disclosed due to an ongoing threat of illegal take in the Cayman Islands; however, critical habitat maps are available [3,10]. No Specific nesting sites were included in this report.

2.2. Other biological data

Encounters of C. caretta in Cayman waters are rare [24]. Satellite tracking data from 3 adult females suggests oceanic interesting intervals and found they all travelled to Nicaraguan feeding grounds outside of the nesting season [17]. No depensation was identified in reduced Cayman nesting populations [25]. See Table 1.

2.3. Threats

Illegal harvesting is a present threat as turtle meat is of cultural significance in the Cayman Islands [11] Bell et al. 2005). The threat is greatest for *C. mydas*. However, between 1999 to 2019, 5 *C. caretta* have been harvested and a further 3 attempts made. The number of turtles harvested each year is likely much higher than those known and reported [3]. A further 10 *C. caretta* were legally harvested from the wild when a legal turtle fishery operated between 1998 – 2008 [3]. Other threats include human disturbances to nests (including vehicle compaction of sand) and roots growing into eggs (3).

See section 1.3 for details on other threats to all sea turtle species nesting in the Cayman Islands.

2.4. Conservation

See section 1.4 for details.

Turtle license conditions include: licensed fishermen can take green and loggerheads between 16 - 24 inches CCL. No more than 4 turtles to be taken between December to March. No spear guns or fixed nets to be used, and a licensee must allow the turtle to be inspected by a conservation officer. Although a small number of these licenses still exist, none have been used since restrictions were tightened in 2008 (3).

Under the National Conservation Act (2013) it is an offence to "take" any species of sea turtle (unless licensed) or eggs. "Take" means to collect, hunt, kill, destroy, injure, disturb, harass, harm, wound, capture, molest or impeded in any way (10). See Table 2.

2.5. Research

C. caretta are the least studied species that nests in the Cayman Islands due to rare encounters within Cayman waters [24].

- Nesting [1,2,3,8].
- Hatch success and fertilization [25].
- Satellite tracking [17].

Ongoing data collection for research publications is being carried out.

3. RMU: Hawksbill turtle (*Eretmochelys imbricata*) – Northwestern Atlantic

3.1. Distribution, abundance, trends

E. imbricata nesting sites are present, but at critically low numbers across all three islands (Grand Cayman, Little Cayman and Cayman Brac). The greatest number of nests recorded across all three islands in a single season was 13 (in 2017). There are many recent years in Grand Cayman and Cayman Brac where no nesting has occurred. Since 2014, in Little Cayman, between 2 and 12 nests have been recorded each season [3].). Although nesting of E. imbricata is uncommon in the Cayman Islands, there are foraging aggregations of juvenile E. imbricata around the Cayman Islands that are encountered regularly by divers [24].

3.1.1. Nesting sites

See 2.1.1.

3.2. Other biological data

The Cayman Islands *E. imbricata* aggregation demonstrates a broad size distribution (20.5 – 62.6 cm SCL), slow growth rate (3.0 ± 0.9 cm yr^{-1}) and evidence of long-term residence of some individuals [6]. Home range was found to be small but an international tag return indicated a long-range developmental migration [6]. Food types included sponges and jellyfish and commensal feeding relationships were recorded with a gray Pomacanthus arcuatus, French Pomacanthus paru, and queen angelfish Holacanthus ciliaris [6]. Larger E. imbricata preferred deeper waters with body mass directly correlating to maximum diurnal dive depth [4]. Mixed stock analysis found that the Cayman Islands aggregation represents a diverse mixed stock [16]. See Table 1.

3.3. Threats

Illegal harvesting is a present threat as turtle meat is of cultural significance in the Cayman Islands [11,14]. The threat is greatest for *C. mydas*. However, between 1999 to 2019, 8 E. imbricata have been harvested and a further 10 attempts made. The number of turtles harvested each year is likely much higher than those known and reported [3]. A further 10 *E. imbricata* were legally harvested from the wild when a legal turtle fishery operated between 1998 – 2008 [3]. Other threats include human disturbances to nests (including vehicle compaction of sand) and roots growing into eggs (3).

See section 1.3 for further details on threats to all nesting sea turtle species in the Cayman Islands.

3.4. Conservation

See section 1.4.

Turtle license conditions include: licensed fishermen can take green and loggerheads between 16 - 24 inches CCL. No more than 4 turtles to be taken between December to March. No spear guns or fixed nets to be used, and a licensee must allow the turtle to be inspected by a conservation officer. Although a small number of these licenses still exist, none have been used since restrictions were tightened in 2008 (3).

Under the National Conservation Act (2013) it is an offence to "take" any species of sea turtle (unless licensed) or eggs. "Take" means to collect, hunt, kill, destroy, injure, disturb, harass, harm, wound, capture, molest or impeded in any way (10). See Table 2.

3.5. Research

- Nesting [1, 2,3,8].
- Size distributions and growth rates [6].
- Home range [6].
- Depth recording [4].
- Diet and behaviour [6].
- Distribution of juveniles [24].
- International trade [26].
- Dispersal patterns [16].

Ongoing data collection for research publications is being carried out.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in the Cayman Islands.

RMU	***C. caretta***	Ref #	***C. mydas***	Ref #	***E. imbricata***	Ref #	***D. coriacea***	Ref #
Occurrence								
Nesting sites	Y	1,2,3	Y	1,2,3	Y	1,2,3	N	3
Oceanic foraging areas	U	-	U	-	U	-	U	-
Neritic foraging areas	N	7	Y (J)	5,7	Y (J)	4,6,7	N	7
Key biological data								
Nests/yr: recent average (range of years)	249.2 (2015-2019)	3	272.2 (2015-2019)	3	6.8 (2015-2019)	3	0	3
Nests/yr: recent order of magnitude	n/r	-	n/r	-	n/r	-	n/r	-
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a	-	n/a	-	n/a	-	n/r	-
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/a	-	n/a	-	n/a	-	n/r	-
Nests/yr at "major" sites: recent average (range of years)	n/a	-	n/a	-	n/a	-	n/r	-
Nests/yr at "minor" sites: recent average (range of years)	n/a	-	n/a	-	n/a	-	n/r	-

Total length of nesting sites (km)	Across all three islands there is approximately 20km of loggerhead turtle *critical habitat*. Total nesting habitat for all species is approximately 60km.	20, 21	Across all 3 islands there is approximately 13km of green turtle *critical habitat*. Total nesting habitat for all species is approximately 60km	20, 21	Total nesting habitat for all species is approximately 60km across the three islands.	20	n/r	-
Nesting females / yr	U	-	100-150 (estimated total nesting population size)	15, PS	U	-	n/r	-
Nests / female season (N)	U	-	U	-	U	-	n/r	-
Female remigration interval (yrs) (N)	U	-	n/a	-	U	-	n/r	-
Sex ratio: Hatchlings (F / Tot) (N)	U	-	U	-	U	-	n/r	-
Sex ratio: Immatures (F / Tot) (N)	U	-	U	-	U	-	n/r	-
Sex ratio: Adults (F / Tot) (N)	U	-	U	-	U	-	n/r	-
Min adult size, CCL or SCL (cm)	U	-	n/a	-	U	-	n/r	-
Age at maturity (yrs)	U		15-19 yrs for captive bred released turtles	14	U		n/r	-
Clutch size (n eggs) (N)	119 (18)	1	119 (10)	1	154 (2)	1	n/r	-
Emergence success (hatchlings/egg) (N)	n/a	-	n/a	-	n/a	-	n/r	
Nesting success (Nests/Tot emergence tracks) (N)	0.45 (1436)	18, PS	0.5 (2015)	18, PS	U	-	n/r	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	Slight increase (7.3%) from an	3	Increasing (2338.6%) from	3	Hawksbill nest numbers in the	3	n/r	-

	average of 23.3 nests (1999 - 2001) to 25 nests (2005 - 2007), although numbers critically low during this time period. Then increasing by 189.6% from an average of 48 nests (2008 - 2010) to 139 (2017 - 2019). Nesting population size still low but showing signs of recovery.		1999 - 2019 from an average of 7 nests (1999 - 2001) to 233 nests (2017 - 2019). Nesting population size still low but showing signs of recovery.		Cayman Islands remain critically low, with a maximum of 5 nests in one season on Grand Cayman, 12 nests in Little Cayman and 3 in Cayman Brac, and many years with no nests across all islands.			
Recent trends (last 20 yrs) at foraging grounds (range of years)	U		U		U			
Oldest documented abundance: nests/yr (range of years)	43 (1971 - 1991)	8	17 (1971 - 1991)	8	6 (1971 - 1991)	8	1 (1971 - 1991)	8
Published studies								
Growth rates	N		Y	12,13, 8, 14	Y	6	N	
Genetics	N		Y	14, 15	Y	16	N	
Stocks defined by genetic markers	N		Y	14, 15	Y	16		
Remote tracking (satellite or other)	Y	17	Y	17, 23	Y	4	N	

Survival rates	N		N		N		N	
Population dynamics	N		N		N		N	
Foraging ecology	N		N		Y	6	N	
Capture-Mark-Recapture	N		Y	8, 14	Y	6	N	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y	19	Y	19	Y	19		
Bycatch: presence of industrial fisheries?	N	19	N	19	N	19		
Bycatch: quantified?	N		N		N			
Intentional killing of turtles	Y	3	Y	3	Y	3		
Take. Illegal take of turtles	Y (min of 5 taken 1999 - 2019)	3	Y (min. 41 taken 1999 - 2019)	3	Y (min. 8 taken 1999 - 2019)	3, 6		
Take. Permitted/legal take of turtles	Y (10 taken 1999 - 2008)	3	Y (19 taken 1999 - 2008)	3	Y (10 taken 1999 - 2008)	3, 6		
Take. Illegal take of eggs	U	-	Y (5 clutches taken between 2000 - 2003)	1	U			
Take. Permitted/legal take of eggs	N	10	N	10	N	10	N	10
Coastal Development. Nesting habitat degradation	Y	6, 21, 22	Y	6, 21, 22	Y	6, 21, 22		
Coastal Development. Photopollution	Y	3	Y	3	Y	3		
Coastal Development. Boat strikes	Y (1 known)	18	Y (6 known)	18	Y (3 known)	18		
Egg predation	Y	3	Y	3	Y	3		
Pollution (debris, chemical)	Y	3	Y	3	Y	3, 6		

Pathogens	U		U		U			
Climate change	Y	3, PS	Y	3,PS	Y	3,PS		
Foraging habitat degradation	U		U		U			
Other	Y	3	Y	3	Y	3		
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	Y (1998 - present)	3	Y (1998 - present)	3	Y (1998 - present)	3		
Number of index nesting sites	n/r		n/r		n/r			
Monitoring at foraging sites (period: range of years)	n/a		n/a		n/a			
Conservation								
Protection under national law	Y - Sea turtles are listed as Part 1 species under the National Conservation Act	10	Y - Sea turtles are listed as Part 1 species under the National Conservation Act	10	Y - Sea turtles are listed as Part 1 species under the National Conservation Act	10	Y	10
Number of protected nesting sites (habitat preservation) (% nests)	Y - Critical sea turtle nesting habitat is protected	21	Y - Critical sea turtle nesting habitat is protected	21	Y - Critical sea turtle nesting habitat is protected	21	n/r	
Number of Marine Areas with mitigation of threats	54.8% of area from the shelf to the shore is protected to some level. 45.2% include no-take zones for certain species. Turtles are protected in	18	54.8% of area from the shelf to the shore is protected to some level. 45.2% include no-take zones for certain species. Turtles are protected in all of Cayman waters.	18	54.8% of area from the shelf to the shore is protected to some level. 45.2% include no-take zones for certain species. Turtles are protected in	18		

	all of Cayman waters.				all of Cayman waters.			
N of long-term conservation projects (period: range of years)	1 -Cayman Islands Department of Environment (1998 - present)	3	2 - Cayman Turtle Centre (1968 - present) and Cayman Islands Department of Environment (1998 - present)	3	1 (Cayman Islands Department of Environment 1998- present)	3		
In-situ nest protection (eg cages)	Y	3	Y	3	Y	3		
Hatcheries	N		Y	3, 11, 14, 15	N			
Head-starting	N		Y	3, 11, 14, 15	N			
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N			
By-catch: onboard best practices	N		N		N			
By-catch: spatio-temporal closures/reduction	Y (see section 1.4)	10	Y (see section 2.4)	10	Y (see section 3.4)	10		
Other	Y (see section 1.4)	10	Y (see section 2.4)	10	Y (see section 3.4)	10		

Table 2. International conventions protecting sea turtles and signed by the Cayman Islands.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
The Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES) Appendix 1	Y	Y		ALL		Sea turtles are protected under this convention. Trade in specimens of these species is permitted only in exceptional circumstances.
The Convention on the Conservation of Migratory Species of Wild Animals (CMS) Appendix 1	Y	Y		ALL		Sea turtles are protected under this convention by prohibiting take, with restricted scope for exceptions.

Colombia

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General remarks

The distribution, abundance, and conservation status of sea turtles in the Colombian Caribbean have been studied for more than five decades. Historical estimations from field sightings and interviews with fishermen provided information about the high number of nesting females of four species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coriacea*) in the 1960s [35]. More recently, characterizations of environmental and geomorphological factors have been made on beaches, establishing that at least 127 beaches are conducive for sea turtle nesting in the region. Also, assessments of oceanographic and taxonomic features in seagrasses beds and coral reefs have identified potential foraging areas along the coast [5].

However, the current low number of females and consequently effective nesting events on most beaches provide an idea of the critical conservation status of sea turtles in the Colombian Caribbean. There is an urgent need to strengthen data gathering protocols and monitoring programs. Thus, it is necessary to standardize methodologies for the evaluation of the population assemblies present in the feeding grounds and transit corridors of turtles.

1. Distribution, abundance, trends

1.1. Nesting sites

Caretta caretta

Loggerhead turtles are distributed throughout the Colombian Caribbean. Their nesting season runs from April to August, with a peak of nesting in June [21]. Historical reports indicate that this species was once the most abundant in the Colombian Caribbean [33]. The beaches of the Departamento of Magdalena (Mendihuaca, Guachaca, Buritaca, Don Diego and Quintana) between 11 ° 16 'N - 73 ° 51' W and 11 ° 15 'N -73 ° 39' W, congregated approximately 200 nesting females a year in the 1960s [35]. Currently, based on information from a systematic monitoring program by the Turtle and Marine Mammal Conservation Program (ProCTMM) of the Jorge Tadeo Lozano University, we know that no more than five females arrive annually at each of these beaches (Table 4.2).

Another systematic monitoring area is Tayrona National Park. The Territorial Directorate of National Parks in the Caribbean is in charge of monitoring 11 beaches (Boca del Saco, El Medio, Cabo San Juan del Guía, Arrecifes, Cañaveral, Castilletes, La Gumarra, San Felipe, La Piscina, El Medio, and Playa Escondida). Loggerheads nest on eight of these beaches at very low density, despite the fact that the protected area was established in 1969 (Table 2). Another protected area where turtle nesting is monitored is Sierra Nevada de Santa Marta National Park. An average of nine nesting loggerheads annually have been recorded at Quintana Beach, however, we only have data from two years of monitoring.

The Guajira Peninsula is located In the northern part of the country and is populated by the Wayuu ethnic group. Since 2009, Conservation International Colombia, Cerrejón, Fondo Acción, and, the Regional Autonomous Corporation of la Guajira – CORPOGUAJIRA, have worked with the Wayuu people in a novel, community-based conservation project focused on sea turtle nesting monitoring and a bycatch assessment. Although that nesting density is low, this initiative is highly valuable given that it generates economic income mechanisms for the community, such as community ecotourism and the sale of artisanal products [16].

For the insular zone of the Colombian Caribbean, there is no updated information available, although there are records of up to 31 nesting events in the Serrana and Serranilla keys, which belong to the Archipiélago de San Andrés, Providencia, and Santa Catalina (SAPSC) [6]. Currently, annual expeditions led by the Comisión Colombiana del Océano are underway, where multiple NGOs collaborate to update information on the nesting and habitat use of sea turtles in the archipelago.

Dermochelys coriacea

Here, we present the most updated available leatherback nesting data for the Colombian Caribbean. This information comes from five departments (Magdalena, Chocó, Antioquia, Guajira and Córdoba). Historically, sporadic nesting has also been reported in the department of Bolívar. Leatherback nesting season in the area takes place from late February to early June, with nesting peaks in April and May [28].

In the department of Antioquia is located in the Sanctuary of Fauna Acandí, Playón, Playona (SFAPP). The Sanctuary was declared in 2013, largely because of the importance of the area for leatherback turtle nesting. SFAPP and adjacent beaches such as Capitancito and Playeta in Colombia, and Armila in Panama, are recognized as important for the regional conservation of the species, given the high density of nests per year [24]. The data on effective nests reported by Patino-Martinez et al. [24] for the 2006 and 2007 seasons were significantly larger than those collected by the National Parks in 2014. This may be caused by differences in the monitoring; however, at the regional level, the number of nests has declined by approximately 60% (-7.9% annually) in the Northwest Atlantic subpopulation [38].

Work by local community members to monitor of reproductive activities has been of special importance. Since 2000, a group of local researchers—currently called the Fundación Mama Basilia—has led monitoring and education activities. These efforts have been coordinated with the Consejo Comunitario de Comunidades Negras de la Cuenca del Río Tolo y Zona Costera Sur – COCOMASUR, and more recently with the National Natural Parks.

An additional example of communities engaged in sea turtle conservation in the region is the Asociación para la Conservación Ambiental y el Ecoturismo – ACAETUR. This local association conducts a holistic conservation program with the support of the Corporación para el Desarrollo Sostenible del Urabá – CORPOURABA, and the Fundación Conservación Ambiente Colombia. This community organization monitors Bobalito beach, another index nesting beach for leatherbacks in the country (Table 2).

This report also includes information generated by the National Natural Parks on the sporadic nesting of leatherback on 12 beaches in the northern and central Colombian Caribbean (Table 2).

Chelonia mydas

The nesting density of green turtles is the lowest in the Colombian Caribbean. Their nesting season accurs between July and November [22]. Although green turtle nests were reported on multiple beaches in seven departments a few decades ago (Antioquia, San Andres Archipelago, Providencia and Santa Catalina, Atlántico, Bolívar, Córdoba, La Guajira and Sucre), the present report only contains quantitative information on a few nests in the departments of Antioquia, La Guajira, and Magdalena (Table 4.2). We do not present data from Tayrona National Park; however, between 2001 and 2002 there was an average of 16 nests in the park [19].

Eretmochelys imbricata

The hawksbill sea turtle is distributed throughout the Colombian Caribbean and nests at low densities on many beaches. Its nesting activities have been reported in multiple beaches in the departments of La Guajira, Magdalena, Bolívar, Sucre, Córdoba, Antioquia, Chocó, and the Archipiélago de San Andres Providencia and

Santa Catalina [3]. Its nesting season runs from April to November, with two peaks in May and September [3].

The Caribbean islands of Colombia are frequent hawksbill nesting areas. When comparing the data in this report with the information in the literature, we found a significant decrease of nesting females and, consequently, nesting events in these insular areas [6, 9]. Both, in SAPSC and the San Bernardo and Rosario archipelagos, Environmental authorities have led the monitoring processes.

1.1.2. Marine areas

1.2. Other biological data

Caretta caretta

There is anecdotal information, mainly by fishermen, about the use of neritic habitats by *C. caretta* [5, 6, 17] along the continental and insular waters of the Colombian Caribbean. There is no monitoring program to estimate the number of turtles or the size class composition of individuals of this species in the area. Through traditional tagging (Monel tags) and satellite tracking, connectivity between foraging areas in Colombia and other countries in the Caribbean and North Atlantic has been demonstrated [34, ProCTMM unpublish data].

Sea turtles' behaviors at offshore aggregation areas are an unexplored issue in Colombia.

Through observations from opportunity platforms—vessels of drilling, support, research or seismic vessels, and navy ships—Fundación Omacha confirmed the presence of sea turtles from the departments of Magdalena, La Guajira, Sucre, and the Gulf of Uraba. Sightings were taken of four species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coriacea*) [29].

Dermochelys coriacea

There is anecdotal information, mainly from fishermen, on the use of neritic and oceanic habitats by *D. coriacea* throughout the continental zone of the Colombian Caribbean [5, 17]. There is no monitoring program to estimate the number of turtles of this species, but through satellite tracking, connectivity between nesting beaches in Colombia and foraging areas in the North Atlantic has been demonstrated [37].

Sea turtles' behaviors at offshore aggregation areas are an unexplored issue in Colombia.

Through observations from opportunity platforms—vessels of drilling, support, research or seismic vessels, and navy ships—Fundación Omacha confirmed the presence of sea turtles from the departments of Magdalena, La Guajira, Sucre, and the Gulf of Uraba. Sightings were taken of four species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coriacea*) [29].

Chelonia mydas

The Colombian Caribbean is considered an area of great importance as a feeding ground and for the development of green turtles. Seagrasses and macroalgae are distributed across more than 43,000 Ha along the continental coast and the SAPSC [17]. These seagrasses and seaweeds are the main dietary components of juveniles, subadults and adults of green turtles in the Caribbean [42]. The protection of these areas is critical since *C. mydas* can remain in its feeding grounds for more than 20 years before migrating to breeding areas [43].

There is evidence of the use of seagrass beds in the Alta Guajira area. The bycatch mitigation program advanced in that zone includes tagging animals and its preliminary results indicate that juveniles show fidelity to the marine area of Bahía Hondita [16]. In the San Bernardo Archipelago, through in-water census and bycatch assessments, we have information on the use of seagrasses beds by juvenile, subadult, and adult individuals, as well as high fidelity to the feeding grounds [9, 16, 17, 30].

Sea turtles' behaviors at offshore aggregation areas are an unexplored issue in Colombia.

Through observations from opportunity platforms—vessels of drilling, support, research or seismic vessels, and navy ships—Fundación Omacha confirmed the presence of sea turtles from the departments of Magdalena, La Guajira, Sucre, and

the Gulf of Uraba. Sightings were taken of four species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coriacea*) [29].

Eretmochelys imbricata

The total area of live coral coverage in the Colombian Caribbean is estimated at more than 1,000 km^2, of which 75% is located in the SAPSC, 12% in the San Bernardo Islands, 6% in the Rosario Islands, and the Barú Peninsula, and the remaining 7% along the Caribbean coast between La Guajira and the Urabá Gulf [17]. These are the areas where multiple life-stage hawksbill turtles are sighted. In 2002, Ceballos-Fonseca [5] in her analysis of the conservation status of sea turtles in the Colombian Caribbean reported that fishermen in the region expressed their thoughts on the decreased numbers of hawksbills in their traditional foraging and transit areas.

Between 1998 and 2010, 1,249 hawksbill turtles, including juveniles, subadults, and adults, were caught incidentally in the Corales del Rosario Park and Rosario Islands. There is no information on how many of these animals were sacrificed [9]. This is a significant number for a species that is Critically Endangered, so this data highlights the importance of this area for the recovery of the species. As for the SAPSC, occasional sightings are reported near San Andres Island, and in the Serrana, Quitasueño, and Roncador keys [6].

Sea turtles' behaviors at offshore aggregation areas are an unexplored issue in Colombia.

Through observations from opportunity platforms—vessels of drilling, support, research or seismic vessels, and navy ships—Fundación Omacha confirmed the presence of sea turtles from the departments of Magdalena, La Guajira, Sucre, and the Gulf of Uraba. Sightings were taken of four species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, and *Dermochelys coriacea*) [29].

1.3. Threats

1.3.1. Nesting sites

Caretta caretta

According with Paez et al. [21] *C. caretta* is near to the local extinction due to long-term and unsustainable harvesting of eggs and adult females, alterations of nesting beaches, and a lack of systematic governance for the species' protection. Other threats include the are erosion of nesting beaches and sand extraction [5].

Dermochelys coriacea

Leatherback eggs are still consumed in Colombia. There are historical reports of the consumption of this species; however, to date, we do not have updated data on the consumption of leatherback turtles in the area. In 2015, the Red List of Reptiles of Colombia was updated, and in addition to those listed above, the following threats were identified in nesting beaches: habitat loss and degradation, looting of nests by domestic animals, and illegal mining [28].

Chelonia mydas

The main threat that green turtles are facing is the consumption of nesting females and eggs, especially in La Guajira [22], but alterations of the anthropic origin of nesting beaches, (understood as erosion, urbanization, and deregulated tourism), are also having significant impacts on the green turtle's reproductive activities [17, 22].

Eretmochelys imbricata

Turtle meat and eggs are still sold in traditional restaurants in Riohacha [Rguez-Baron, pers. observ.], and hawksbill is one of the most commercialized sea turtles in La Guajira [5]. This is also true near Cartagena, in the Departamento de Bolívar [5]. In Corales del Rosario y San Bernardo Natural Park, the loss of habitat through the construction of homes, docks and spurs, tourist infrastructure, and beach erosion is evident [5, 9, 30].

1.3.2. Marine Areas

Caretta caretta

There is no information available on the effect of loggerheads bycatch in the Colombian Caribbean. It has been determined through interviews with fishermen, that juvenile and adult turtles are consumed when caught incidentally [5], even in protected areas [20]. The presence of organic waste is also considered a threat, although its concentrations and effects on sea turtles have not been characterized and/or quantified [5, 20].

Dermochelys coriacea

In general terms, we do not have quantitative information on the effect of leatherback bycatches in the Colombian Caribbean. It is known through interviews with fishermen that juvenile and adult turtles are caught by artisanal and industrial vessels, by multiple fishing gear [28], even in protected areas [20]. Bycatch in gillnets is estimated to cause the deaths of up to 20 adult females per year in the Urabá Gulf [28].

Chelonia mydas

The bycatch of immature, subadult, and adult individuals in foraging grounds is frequent. Near the coast of the Departamento de Bolívar and the Rosario and San Bernardo Islands, several bycatch events have been reported in different seasons and different years [5]. The types of fishing gears with the greatest number of interactions with green turtles are gillnets and harpoons.

Green turtles are followed by hawksbills as the most commercialized turtles for human consumption in La Guajira [17]. In Bahía Hondita, between May and August 2016, a community working group in collaboration with Conservation International received 40 juveniles and subadults that were caught during fishing operations. Seven of these animals were captured directly; and the others were caught incidentally. Fifteen of these turtles died because of their interactions with fishing gear. The fishing gear that most impacts the population health of green turtles is the lobster traps, which caused death by drowning in 100% of individuals (n = 8). In this area, turtles are also frequently caught by gillnets.

Eretmochelys imbricata

Several threats exist in marine areas, where targeted and incidental catches remain the greatest threat to the hawksbill turtle [3, 30]. The trade of artisanal products made of hawksbill shell has declined thanks to the coordinated work of several organizations and local authorities; however, it continues to be sold illegally in some places in Cartagena. The intake of plastics is an additional new threat in forage areas [3].

1.4. Conservation

In the last five decades in Colombia, various efforts have been made to protect, conserve, and research sea turtles. However, there are no rigorous population assessments for any of the species in Colombia. It is thus necessary to implement information management systems on demographic aspects to determine key information for the implementation of effective management measures in nesting beaches and in development and foraging areas [36].

Colombia has signed several treaties that ensure the management and protection of sea turtles. Among these are the Convention of International Trade in Endangered Species of Wild Fauna and Flora (Appendix I), the Bonn Convention (Appendices I and II), the Specially Protected Areas and Wildlife (Appendix II), and the Convention on Biological Diversity. Therefore, it is necessary to generate mechanisms to strengthen compliance with the guidelines set forth in instruments and initiatives directed at the recovery and conservation of species, such as the National Program for the Conservation of Marine and Continental Turtles [18] and the National Migratory Species Plan [27], which have objectives such as "collecting and producing information related to the populations of migratory species present in Colombia", "Designing, adopting, implementing and administering a specialized system of public information on species migratory," and "Establish[ing] mechanisms and rules that allow the exchange of information between entities and organizations dedicated to the study and conservation of migratory species at the national level."

1.5. Research

Caretta caretta

Most research conducted on loggerheads in the country are genetic studies by the Genetics Molecular Biology and Bioinformatics Lab, at Jorge Tadeo Lozano University [10, 11, 12, 15]. Those studies include the definition of population stocks by genetic markers [10, 12]. The ProCTMM from the same university, by its head-starting project maintains neonates for up to one year, to care for the individuals for later release them to the environment after conducting research on their geometric morphometry, behavior, and genetics. The results of these studies are not yet published.

Dermochelys coriacea

All published research studies on leatherbacks have been conducted in the Urabá Gulf area, particularly in the SFAPP and nearby beaches. Some demographic and reproductive aspects have been characterized, the importance of the area for the conservation of the species has been stimated [24, 39, 40, 41], the effect of climate change on the sex proportion of the offspring has been modeled [25], and the effect of hatchery techniques on the embryonic development has been evaluated[26].

Chelonia mydas

In the northeastern-most part of La Guajira, a study was conducted to assess the submerged aquatic vegetation—seagrasses and macroalgae—with in-water surveys. The quality of those habitats for green turtles was inferred from individual distribution, body condition, and genetic diversity pattern of green turtles in those feeding grounds, and their significance for the Atlantic populations, revealed that resident juveniles come from Costa Rica, Mexico, Aves Island and the U.S. Virgin Islands; other minor contributions were Bioko and Guinnea-Bissau in Africa [32].

In 2002, the physical and biological characterization of foraging areas was conducted alongside annotations on the behavior and use of habitat of green turtles in the San Bernardo archipelago [30]. From the analysis of stomach contents of turtles caught incidentally, the main dietary components of juveniles of green turtles in the area were determined [30].

Eretmochelys imbricata

Currently, an assessment of hawksbill population trends in foraging at the Corales del Rosario and San Bernardo Natural Park, the Santuario of Fauna and Flora Mono Hernández, Isla Fuerte, and the coasts of Bolívar and Sucre is being developed [9]. Data are available on juvenile capture/recapture since 2005 demonstrating the high fidelity of turtles to the area. This contrasts with the results obtained through the satellite tagging of a juvenile (52.6cm CCL) by ProCTMM in the Departamento del Magdalena, which traveled 1,463.66 km in 64 days before reaching Bocas del Toro, Panama [23].

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Colombian Caribbean.

RMU	*E. imbricata*	Ref#	*C. caretta*	Ref#	*D. coriacea*	Ref#	*C. mydas*	Ref#
Occurrence								
Nesting sites	Y	1,2,3,5,6 ,8,9,17,19,20	Y	1,2,4,5,6,8,16, 17,19,20	Y	1,2,4,5,6,8, 17,19,20,24	Y	1,2,4,5,6, 8,16,17,19
Pelagic foraging grounds	Y	29	Y	29, 34	Y	29	Y	29
Benthic foraging grounds	JA	5,6,8,9,17,30	JA	5,6,17	N	n/a	JA	5,6,8,9, 16,17,30
Key biological data								
Nests/yr: recent average (range of years)	Table 4.2		Table 4.2		Table 4.2		Table 4.2	
Nests/yr: recent order of magnitude	Table 4.2		Table 4.2		Table 4.2		Table 4.2	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	1	PS	n/a	n/a	1	24, PS	n/a	n/a
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	Table 4.2		Table 4.2		Table 4.2		Table 4.2	
Nests/yr at "major" sites: recent average (range of years)	Table 4.2		Table 4.2		Table 4.2		Table 4.2	
Nests/yr at "minor" sites: recent average (range of years)	Table 4.2		Table 4.2		Table 4.2		Table 4.2	
Total length of nesting sites (km)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nesting females / yr	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nests / female season (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Female remigration interval (yrs) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Hatchlings (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Immatures (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Adults (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Min adult size, CCL or SCL (cm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Age at maturity (yrs)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Clutch size (n eggs) (N)	138 (148)	9	119.6 (73)	16	n/a	n/a	n/a	n/a

Emergence success (hatchlings/egg) (N)	0.6 (148)	9	50 (73)	16	n/a	n/a	n/a	n/a
Nesting success (Nests/ Tot emergence tracks) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	Table 2		Table 2		Table 2		Table 2	
Recent trends (last 20 yrs) at foraging grounds (range of years)	(1999-2017)	9, see texts	(2003-2016)	16, see text				
Oldest documented abundance: nests/yr (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Published studies								
Growth rates								
Genetics	Y	7,13,31	Y	10,11,12,15	n/a	n/a	Y	32
Stocks defined by genetic markers	Y	31	Y	10,12			Y	32
Remote tracking (satellite or other)	Y	23						
Survival rates								
Population dynamics								
Foraging ecology (diet or isotopes)								
Capture-Mark-Recapture	Y	9,30					Y	9,30
Threats								
Bycatch: presence of small scale / artisanal fisheries?	SN	6,30			SN	28	SN, FP,PLL	6,16,30
Bycatch: presence of industrial fisheries?	n/a	n/a	n/a	n/a	ST, PT, PLL	28	n/a	n/a
Bycatch: quantified?	n/a	n/a	n/a	n/a	n/a	n/a	Y	16
Take. Intentional killing or exploitation of turtles	Y	6	Y	6	Y	28	Y	6
Take. Egg poaching	Y	9	Y	6	Y	28		
Coastal Development. Nesting habitat degradation	Y	6,9,20	Y	6,20	Y	20,28	Y	6

Coastal Development. Photopollution	Y	6	Y	6	Y	20	Y	6
Coastal Development. Boat strikes	Y	6	Y	6	Y	20	Y	6
Egg predation								
Pollution (debris, chemical)	Y	6,30	Y	6	Y	28	Y	6,30
Pathogens								
Climate change	n/a	n/a	n/a	n/a	Y	25	n/a	n/a
Foraging habitat degradation	Y	6	Y	6	n/a	n/a	Y	6,9
Other	Y	see text						
Long-term projects								
Monitoring at nesting sites	Y	9			Y	24		
Number of index nesting sites	1	PS	n/a	n/a	Y	24, PS	n/a	n/a
Monitoring at foraging sites	Y	9					Y	9
Conservation								
Protection under national law	Y	18,27	Y	18,27	Y	18,27	Y	18,27
Number of protected nesting sites (habitat preservation)		6,9		6		28		6
Number of Marine Areas with mitigation of threats		6,9		6		28		6
Long-term conservation projects (number)		9, see text				24, see text		9, see text
In-situ nest protection (eg cages)								
Hatcheries					Y	26		
Head-starting	Y	see text	Y	see text	n/a	n/a	Y	see text
By-catch: fishing gear modifications (eg, TED, circle hooks)			Y	4			Y	14
By-catch: onboard best practices								
By-catch: spatio-temporal closures/reduction								
Other								

Table 2. Sea turtle nesting beaches in the Colombian Caribbean.

*There is not an specific number of nests corresponding each beach of Santuario de Fauna Acandí, Playón, Playona.

RMU	**Index site**	**Nests/yr: recent average (range of years)**	**Western limit**		**Eastern limit**		**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
			Long	Lat	Long	Lat	Long	Lat					
EI-NW-ATL													
Mendihuaca	N	3 (2018)	n/a	n/a	n/a	n/a	-73.55519	11.190577	7	n/a	PS	1	B
La Gumarra	N	1 (2012)	-73.572	11.192	-73.564	11.1954	-73.563552	11.184996	0.603	n/a	PS	1	B
Boca del Saco	N	0.6 (2007-2013)	-73.5844	11.2015	-73.583	11.2003	-73.195582	11.195582	0.671	n/a	PS	1	B
El Medio	N	1 (2012)	-73.5826	11.2001	-73.582	11.2002	-73.589	11.195078	0.308	n/a	PS	1	B
Cabo San Juan del Guia	N	2 (2013)	-73.5795	11.19796	-73.578	11.19705	-73.575178	11.194283	0.289	n/a	PS	1	B
Arrecifes	N	1.2 (2006-2013)	-73.572	11.19199	-73.564	11.1954	-73.56588	11.185748	1.1	n/a	PS	1	B
Cañaveral	N	1.2 (2007-2011)	n/a	n/a	n/a	n/a	-73.55435	11.183295	1	n/a	PS	1	B
La Piscina	N	1 (2013)	n/a	n/a	n/a	n/a	-73.57362	11.192779	0.15	n/a	PS	1	B
Castillete	N	1 (2009)	n/a	n/a	n/a	n/a	-73.5406	11.2100	1.1	n/a	PS	1	B
Playa Escondida	N	1 (2008-2009)	n/a	n/a	n/a	n/a	-73.5524	11.182723	0.1	n/a	PS	1	B
Baru	N	1 (2007-2009)	n/a	n/a	n/a	n/a	-75.39909	10.10154	4.3	n/a	PS	1	B
Playa Blanca	N	7 (2007-2008)	n/a	n/a	n/a	n/a	-75.36447	10.13512	n/a	n/a	PS	1	B
Isla Rosario	N	4 (2008-2010)	n/a	n/a	n/a	n/a	-75.44407	10.14086	1.6	n/a	1, 9	1	B
Punta Gigante	N	3 (2009)	n/a	n/a	n/a	n/a	-75.44801	10.14525	0.1	n/a	1, 9	1	B
Isla Tesoro	N	6.4 (2007-2010)	n/a	n/a	n/a	n/a	-75.44182	10.14043	n/a	n/a	1	1	B
Playa Palitos	N	3 (2010)	n/a	n/a	n/a	n/a	-75.36481	10.15331	0.2	n/a	1, 9	1	B
Isla Fuerte	N	3 (2010)	n/a	n/a	n/a	n/a	-76.11208	9.23213	n/a	n/a	PS	1	B
Playa Salina	N	3 (2010)	n/a	n/a	n/a	n/a	-75.36401	9.53172	n/a	n/a	PS	1	B
Playa Chichiman	N	1 (2010)	n/a	n/a	n/a	n/a	-75.37004	9.50339	n/a	n/a	PS	1	B

Santuario de Fauna Acandi, Playon, Playona*	Y	14 (2014)	n/a	n/a	n/a	n/a	-77.26666	8.53549	n/a	n/a	PS	1	B
Atazcosa	N	1 (2007)	n/a	n/a	n/a	n/a	-74.29394	10.58537	n/a	n/a	PS	1	B
Bobalito	Y	61.3 (2012-2017)	n/a	n/a	n/a	n/a	-76.56524	8.33241	13.5	84	PS	1	B
Punta los Guamachitos	N	1 (2010)	n/a	n/a	n/a	n/a	-73.07307	11.24445			PS	1	B
Isla Tortuguilla	N	10 (2015)	n/a	n/a	n/a	n/a	-76.33932	9.030338	n/a	n/a	1	1	B
Punta los Guamachitos	N	1 (2010)	n/a	n/a	n/a	n/a	-73.07307	11.24445	n/a	n/a	PS	1	B
CC-NW-ATL													
La Gumarra	N	0.8 (2009-2013)	-73.572	11.192	-73.564	11.1954	-73.563552	11.184996	0.603	n/a	PS	1	B
Boca del Saco	N	0.6 (2007-2013)	-73.5844	11.2015	-73.583	11.2003	-73.195582	11.195582	0.671	n/a	PS	1	B
El Medio	N	3 (2012)	-73.5826	11.2001	-73.582	11.2002	-73.589	11.195078	0.308	n/a	PS	1	B
Cabo San Juan del Guia	N	2 (2013)	-73.5795	11.19796	-73.578	11.19705	-73.575178	11.194283	0.289	n/a	PS	1	B
Arrecifes	N	0.75 (2006-2013)	-73.572	11.19199	-73.564	11.1954	-73.56588	11.185748	1.1	n/a	PS	1	B
Cañaveral	N	2.7 (2007-2013)	n/a	n/a	n/a	n/a	-73.55435	11.183295	1	n/a	PS	1	B
Castillete	N	1.3 (2007-2012)	n/a	n/a	n/a	n/a	-73.5406	11.2100	1.1	n/a	PS	1	B
Playa Escondida	N	5 (2007)	n/a	n/a	n/a	n/a	-73.5524	11.182723	0.1	n/a	PS	1	B
Don Diego	N	6 (2014-2018)	n/a	n/a	n/a	n/a	-73.40298	11.151151	7.3	n/a	PS	1	B
Mendihuaca	N	1.5 (2015-2018)	n/a	n/a	n/a	n/a	-73.55519	11.190577	7	n/a	PS	1	B
Quintana	N	9 (2013-2015)	n/a	n/a	n/a	n/a	-73.42162	11.15313	n/a	n/a	PS	1	B
Atazcosa	N	1 (2014)	n/a	n/a	n/a	n/a	-74.29394	10.58537	n/a	n/a	PS	1	B
Punta Gallinas	N	6 (2009-2013)	n/a	n/a	n/a	n/a	-71.67761	12.45351	n/a	n/a	16	1	B
Bahia Hondita	N	5.5 (2009-2016)	-71.4312	12.26105	-71.421	12.26288	n/a	n/a	4	n/a	4, 16	1	B
DC-NW-ATL													
La Gumarra	N	1.75 (2006-2013)	-73.572	11.192	-73.564	11.1954	-73.563552	11.184996	0.603	n/a	PS	1	B
Boca del Saco	N	1 (2009)	-73.5844	11.2015	-73.583	11.2003	-73.195582	11.195582	0.671	n/a	PS	1	B

El Medio	N	1 (2012)	-73.5826	11.2001	-73.582	11.2002	-73.589	11.195078	0.308	n/a	PS	1	B
Arrecifes	N	1.5 (2006-2010)	-73.572	11.19199	-73.564	11.1954	-73.56588	11.185748	1.1	n/a	PS	1	B
San Felipe	N	1 (2006)	-73.5643	11.18739	-73.563	11.18709	-73.562345	11.184386	0.168	n/a	PS	1	B
Cañaveral	N	3 (2008-2013)	n/a	n/a	n/a	n/a	-73.55435	11.183295	1	n/a	PS	1	B
Castillete	N	2.5 (2006-2007)	n/a	n/a	n/a	n/a	-73.5406	11.2100	1.1	n/a	PS	1	B
Mendihuaca	N	3.5 (2015-2018)	n/a	n/a	n/a	n/a	-73.55519	11.190577	7	n/a	PS	1	B
Quintana	N	2 (2014)	n/a	n/a	n/a	n/a	-73.42162	11.15313	n/a	n/a	PS	1	B
Don Diego	N	5 (2017)	n/a	n/a	n/a	n/a	-73.40298	11.151151	7.3	n/a	PS	1	B
Santuario de Fauna Acandi, Playon, Playona*	Y	187.8 (2006-2014)	n/a	n/a	n/a	n/a	-77.26666	8.53549	n/a	n/a	PS	1	B
Capitancito	N	45 (2006-2007)	-77.1818	8.3503	-77.183	8.3513	n/a	n/a	0.7	n/a	24	1	B
Acandi	Y	1071 (2006-2007)	-77.1518	8.2926	-77.163	8.3009	n/a	n/a	2.4	n/a	24	1	B
Playona	Y	1482.5 (2006-2007)	-77.0959	8.2557	-77.146	8.2816	n/a	n/a	12	n/a	24	1	B
Playeta	N	25 (2006-2007)	-77.0813	8.2452	-77.086	8.2506	n/a	n/a	1.5	n/a	24	1	B
Pueblo Nuevo	N	10 (2006)	-76.5309	8.3601	-76.562	8.3307	n/a	n/a	8	n/a	24	1	B
Atazcosa	N	2 (2015)	n/a	n/a	n/a	n/a	-74.29394	10.58537		n/a	PS	1	B
Moñitos	N	2 (2013)	n/a	n/a	n/a	n/a	-76.13137	9.24657		n/a	PS	1	B
Bobalito	Y	112.7 (2012-2017)	n/a	n/a	n/a	n/a	-76.56524	8.33241	13.5	84	PS	1	B
Bahia Hondita	N	6 (2009)	-71.4312	12.26105	-71.421	12.26288	n/a	n/a	4	n/a	4	1	B
CM-NW-ATL													
Quintana	N	1 (2015)	n/a	n/a	n/a	n/a	-73.42162	11.15313		n/a	PS	1	B
Atazcosa	N	1 (2015)	n/a	n/a	n/a	n/a	-74.29394	10.58537		n/a	PS	1	B
Bobalito	Y	6.2 (2012-2017)	n/a	n/a	n/a	n/a	-76.56524	8.33241	13.5	84	PS	1	B
Punta Gallinas	N	2 (2013)	n/a	n/a	n/a	n/a	-71.67761	12.45351	n/a	n/a	PS, 4	1	B

Table 3. International conventions protecting sea turtles and signed by Colombia.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity	Y		Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
Ramsar Convention	Y		Y		It is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Based on a MOU between IAC and Ramsar of the Parties to both Conventions in order to identify and strngthen conservation and wise use of Ramsar Sites (https://www.ramsar.org/sites/default/files/documents/library/mou_seaturtlescon-vention_eng_8-7-12.pdf).

Table 3.1. Organizations and agencies related with sea turtle research and conservation in the Colombian Caribbean.

Government Agencies
Ministerio de Ambiente y Desarrollo Sostenible
Instituto de Investigaciones Marinas y Costeras
Parques Nacionales Naturales de Colombia
Corporación para el Desarrollo sostenible del Urabá
Corporación Autónoma Regional de Sucre
Corporación Autónoma Regional del Atlántico
Corporación Autónoma Regional de los Valles del Sinú y del San Jorge
Corporación Autónoma Regional de la Guajira
Corporación Autónoma Regional del Magdalena
Corporación para el Desarrollo Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina
Community groups
Fundación Mamá Basilia
Consejo Comunitario Cocomasur
Asociación para la Conservación Ambiental y el Ecoturismo ACAETUR
NGOs
JUSTSEA Foundation
World Wildlife Fund Colombia
Conservación Internacional Colombia
Fundación Tortugas del Mar
Fundación Conservación Ambiente Colombia
Fundación Omacha
Fundación Tortugas Marinas de Santa Marta
Fundación Natura
Asociación para la Conservación de las Especies en Vías de Extinción
Fundación Coriacea
Universities
Universidad Jorge Tadeo Lozano
Universidad de Antioquia
Universidad de los Andes
Universidad Javeriana
Universidad de la Guajira

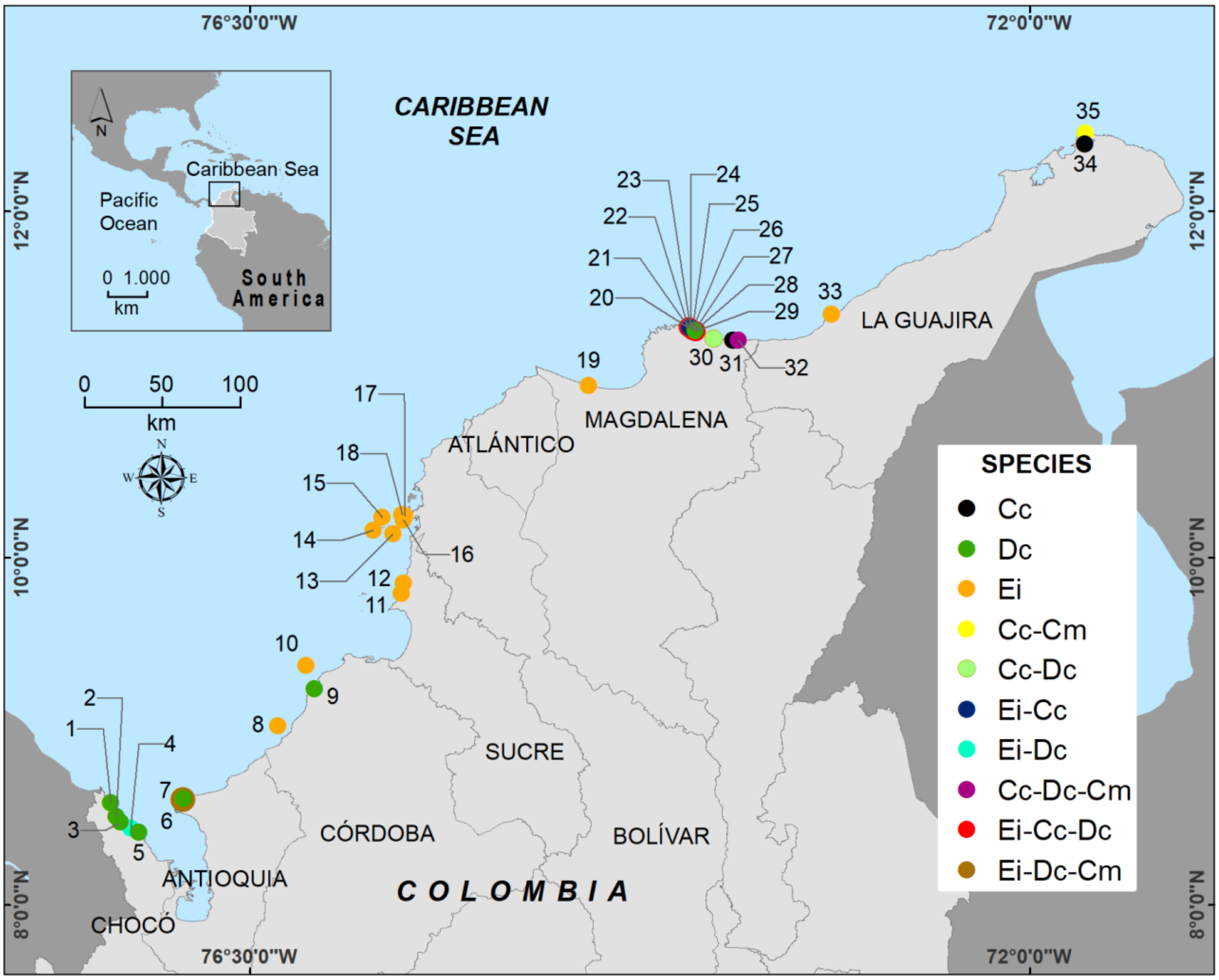

Figure 1. Biogeography and nesting beaches of sea turtles in the Colombian Caribbean. 1. Capitancito, 2. Acandí, 3. Playona, 4. Santuario de Fauna Acandí, Playón, Playona, 5. Playeta, 6. Bobalito, 7. Pueblo Nuevo, 8. Isla Tortuguilla, 9. Moñitos, 10. Isla Fuerte, 11. Playa Chichimán, 12. Playa Salina, 13. Barú, 14. Isla Rosario, 15. Isla Tesoro, 16. Playa Blanca, 17. Playa Palitos, 18. Punta Gigante, 19. Atazcosa, 20. Boca del Saco, 21. El Medio, 22. Cabo San Juan del Guía, 23. Playa Escondida, 24. La Piscina, 25. Arrecifes, 26. La Gumarra, 27. Castillete, 28. San Felipe, 29. Cañaveral, 30. Mendihuaca, 31. Don Diego, 32. Quintana, 33. Punta Los Guamachitos, 34. Bahía Hondita, 35. Punta Gallinas.

Cuba

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1.1. Distribution, abundance, trends.

1.1.1. Nesting sites.

Nesting activity within the Cuban archipelago is monitored in 78 beaches in total (Table 1 and 2), with different levels of monitoring (11 % level 1) and types of protocols (21 % B protocol and the rest E protocol). The southwestern region is where most important nesting areas are concentrated (Figure 1), with Cayo Largo, Cayos de San Felipe, Guanahacabibes peninsula and Isla de la Juventud as the main nesting sites in order of importance [10,18,33]. However, Jardines de la Reina (Gardens of the Queen), in the southeastern region, also present high levels of nesting, being important for hawksbill [10,18,33]. Green turtle (*Chelonia mydas*), is the most frequent nesting turtle accounting for 85 % of all nesting, which occurs from June to September [10,18,33]. Loggerhead (*Caretta caretta*) accounts for 10 % of nesting and it occurs mainly from April to July [10,18,33]. Hawksbills (*Eretmochelys imbricata*) only accounts for 5 % of nesting, preferably from October to February although reported year-round; while leatherback (*Dermochelys coriacea*) is very infrequent with only sporadic nesting reported [10,18,33].

As observed in Figure 1, Cuban nesting beaches are widely distributed around the archipelago, with 68 % of them having lengths of 2 km or less and representing 26 % of the total monitored area (Table 2). However, those beaches host 31 % of loggerhead's nesting, 67 % of hawksbills and 76 % of green turtles. As a result, there are high density areas such as Caleta de los Piojos and La Barca beaches in Guanahacabibes National Park, with an average of 21 and 16 loggerhead nests per km respectively; while Los Cocos beach in Cayo Largo cay, and Caleta de los Piojos beach have an average of 765.28 and 426,92 green turtle nests per km respectively. In the case of hawksbill, El Faro and el Dátiri beaches, in Jardines de la Reina National Park have the highest average densities (26.67 and 12.22 nests per km respectively).

The number of nesting females per year has been estimated as a proportion of the number of nests per species (Table 1). Green turtle has an average of 1441 females nesting per year, although tagging programs have identified so far 2383 females since 2001 (except for Isla de la Juventud). The other two species have lower levels of nesting and, as a result, less nesters per year (94 hawksbill and 167 loggerheads). Tagging programs for the latter species has been able to identify 74 hawksbills just in Jardines de la Reina and 216 loggerheads in Guanahacabibes peninsula, Isla de la Juventud and Cayo Largo where tagging program has been conducted. Loggerhead is the species with the longest remigration interval reported, followed by green turtle.

Trends in nesting population have only been assessed for most important nesting areas [10]. Green turtle populations show positive trends in all nesting areas except in South of Isla de la Juventud where illegal take is the most severe amongst protected areas. In the latter area, as well as in San Felipe National Park, loggerhead and hawksbill populations are also declining.

Reproductive success indicators are presented in Table 1. Hawksbill had the higher clutch size despite its smaller carapace length but the other indicators of success like hatchling emergences and nesting success are the lowest of the three species. Green turtle has the highest reproductive success indicators of the three species.

1.1.2. Marine areas.

Sea turtle studies in marine waters have been limited in Cuba due to logistic and financial constraints. Most of the studies have been focuses on hawksbill feeding grounds in Jardines de la Reina archipelago [10,18,33,72,73,75], although other biological information like migration routes, diet and sex and size distribution in fishery areas is also available for hawksbill [10,18,33] as well as for other species [60,61,62,67,69,84] including reports of presence of leatherback [58,89] and olive ridley [59,81].

Using the information available about migratory routes, potential feeding grounds for green turtle, loggerhead and hawksbill have been identified in the southern shelf of Cuba, mostly in the Ana María Gulf, where satellites tracks of specimens of the three species have converged. Sea turtles nesting sites in Cuba also show close interaction with feeding grounds elsewhere in the Caribbean, such as Yucatán peninsula, Florida and Nicaragua's bank.

Recently, we started studies on marine habitat quality at a feeding ground of green turtle juveniles in the north coast of Cuba [108].

1.2. Other biological data

We also gather regularly information about spatial nesting distribution within nesting areas [109], spatial and temporal variation of females nesting size [109] and hatchling production [110].

1.3. Threats.

1.3.1. Nesting sites.

1.3.2. Marine areas.

A national analysis of actual and potential threats affecting nesting sites and marine habitats of sea turtles in Cuba was carried out [10]. Illegal take is the main threat identified. However, climate change, hurricane impacts, and pollution were also identified as threats of importance for sea turtle conservation. A summary of all threats analyzed is presented also in Table 1.

1.4. Conservation

After more than 20 years of marine turtle conservation in Cuba, several populations are showing signs of recovery. This has been possible with the implementation of several action measurements (Table 3) within a National System of protected areas combined with a legal protection of all the species [10]. In 2008, the Ministry of the Fishery Industry, with the Resolution 009/2008 declared a total prohibition of legal turtle catch while in 2011, the Ministry of Science, Technology, and Environment (Ministerio de Ciencia, Tecnología y Medio Ambiente, or CITMA) banned any capture, use, or traffic of marine turtles, except for research and conservation purposes with the Resolution 160/2011.

Cuba is also signatory of several international conventions that promote biodiversity conservation, including marine turtles (Table 3).

Marine turtle conservation program in Cuba have strengthened over the last decades with the establishment of a national monitoring protocol for nesting [10], feeding grounds [111] and nesting temperature [112]. However, some monitoring sites have been active for over 36 years (since 1983) while others started in 1998 or later and have 20 years of results or less. Conservation efforts is not the same in all areas; that is why an analysis was also performed on monitoring effectiveness [18] and management capacity in protected areas, in order to address threats to marine turtles [10]. Despite the diversity of monitoring conditions, the Cuban program gathers information on 79 nesting beaches and almost all the important nesting beaches are included in protected areas, where in situ conservation actions are undertaken.

The Cuban Marine Turtle Conservation Program have invested significant efforts on capacity building and public awareness activities. Capacity building activities have been important to maintain well-trained personnel and environmental educators in both protected areas and coastal communities. As for public awareness a national campaign was developed, with activities and materials addressing children environmental education, but also turtle awareness of fishers and consumers. The national campaign makes use of different educational platforms, such as photo exhibitions, printed T-shirts, press conferences, community festivals and large format publicity, among other actions. Although the impacts of the campaign are not enough to mitigate the threat posed by illegal trade, most of the surveyed people expressed that they now perceive their role as consumers of turtle products differently, and that they know what they can do to reduce illegal trade.

3.5. Research

In Cuba there are not many specialists devoted to marine turtle research, since most monitoring is carried out by conservation staff or volunteers. As a result, 85 % of the 114 references presented in this report involve at least one out of the six currently most active Cuban marine turtle specialists. However, national and international collaboration as well as student degree and postgraduate research made possible the development of different research in Cuba. Maine topics were: growth rates [22,31,50,101,102], genetics [2,12, 32,34,35, 105, 106], stocks defined by genetic markers [2,12, 106, 105], tracking (satellite or other) [61, 62, 70], population dynamics [67,70-72, 87], foraging ecology (diet) [108], capture-tagging-recapture [16,93 36,37 67,70-72], Photo-ID [3], natural and artificial diet [2,4,39], application of Geographic Information Systems [8], ecotourism value of turtles [41,91] and reproductive success [18,19,48,49,51,52,53], in particular, the influence of vegetation in this success [52,113,114]. Ongoing projects are presented in Table 4.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Cuba.

Topic	Regional management units							
	C. caretta	**Ref #**	***C. mydas***	**Ref #**	***E. imbricata***	**Ref #**	***D. coriacea***	**Ref #**
Occurrence								
Nesting sites	Y	10,18,33	Y	10,18,33	Y	10,18,33	Y	18
Pelagic foraging grounds	N		N		N		JA	
Benthic foraging grounds	JA	57	JA	17,57	JA	57	N	
Key biological data								
Nests/yr: recent average (range of years)	318,2 (2010-2018)	33,64, 110	3488 (2010-2018)	33,64, 110	149,57 (2010-2018)	33,64	n/a	
Nests/yr: recent order of magnitude	150-400	33,64	2500-5000	33,64	100-250	33,64	<10	33
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	7	33,64	8	33,64	4	33,64	N	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	3	6,33,64	3	33,64	4	33,64	1	33
Nests/yr at "major" sites: recent average (range of years)	322,66 (2010-2015)	33,64,109	3028,66 (2010-2015)	33,64,109	151,5 (2010-2015)	33,64,109	n/a	
Nests/yr at "minor" sites: recent average (range of years)	19,83 (2010-2015)	33,64,109	32 (2010-2015)	33,64,109	12 (2010-2015)	33,64,109	n/a	
Total length of nesting sites (km)	184	18	191	18	105	18	n/a	
Nesting females / yr	167	B10/B18	1441	D10/D18	94	F10/F18	n/a	
Nests / female season (N)	1-2 (49a) (22b)	a:16; b:92	Mean: 1.95 (1480) Min: 1.4 (83) Max: 2.22 (32)	15	1.45 ±0.07 (29)	74	n/a	
Female remigration interval (yrs) (N)	4.08 (12a); 2.77 (13b)	a: Azanza per. com; b: Moncada per. com	Mean: 2.67±1.71 (202a); Min: 1 (30a); Max: 13 (1a)	Azanza per. com	2.4 ±0.5 (12)	74	n/a	
Sex ratio: Hatchlings (F / Tot) (N)	0.33a (3); 0.90b (4)	24	1.0a (16);0,80b (34)	24	n/a	73,74	n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		0.84 (2087); 0.76 (1322); 0.77 (722)	66;74;28	n/a	

Min adult size, CCL or SCL (cm)	80-84 CCL;85 CCL	61;93	95.64±0.43 CCL (607)	15,62	64 CCL(Fb); 68 SCL (Ma)	a:66; b:74	n/a	
Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	93 (7-22);103.9 (921)	16;93	114,96 ±3,36 (230)	15	130,87 (772)	74	n/a	
Emergence success (hatchlings/egg) (N)	0.74-0.82 (80);0.72 (532)	51;64	0.75 (230);0.75-0.88 (117);0.80 (1945)	19;51;64	0.69 (512);0,58 (374);0,61(283)	66;49;64	n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	0.67 (18 yr)	16	0.60-0.70 (17 yr)	5,11	0.4 (228)	48	n/a	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	Up (r=0.48;1998-2016); 3 up 2 down (2010-2018)	16;10	Up (2010-2018)	10	1 up 2 down (2010-2018)	10	n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	8 (1983); 58 (1998)	93;16	20 (1982); 12 (1998)	94;15	4 (1988)	66	n/a	
Published studies								
Growth rates	N		Y	102	Y	22,31,50,101,102	n/a	
Genetics	Y	106	Y	12,2,105	Y	32,34,35	n/a	
Stocks defined by genetic markers	Y	106	Y	12,2,105	N		n/a	
Remote tracking (satellite or other)	Y	61	Y	62	Y	70	n/a	
Survival rates	N		N		N		n/a	
Population dynamics	Y	67,87	Y	67	Y	67,70-72	n/a	
Foraging ecology (diet or isotopes)	N		Y	108	Y		n/a	
Capture-Mark-Recapture	Y	16,93	Y	36,37	Y	67,70-72	n/a	
Foto-ID	Y	3	Y	3	Y	3	n/a	
Natural and artificial diet	Y	2	Y	2	Y	2,4,39	n/a	
GIS	N		Y	8	Y		n/a	
Ecotouristic value of turtles	Y	41	Y	41,91	Y	41	n/a	
Reproductive succes	Y	18,51	Y	18,19,51	Y	48,49,52,53	n/a	
Effect of vegetation on nesting and hatching success	N		Y	113,114	Y	52		

Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y	69	Y	69	Y	69	Y	69
Bycatch: presence of industrial fisheries?	Y	69	Y	69	Y	69	Y	69
Bycatch: quantified?	Y (97)	69	Y (342)	69	Y (298)	27,29,30,69	Y (8)	69
Take. Intentional killing or exploitation of turtles	Y	10,64	Y	10,64	Y	10,64	n/a	
Take. Egg poaching	N	10	N	10	N	10	n/a	
Coastal Development. Nesting habitat degradation	Y	10	Y	10	Y	10	n/a	
Coastal Development. Photopollution	Y	10	Y	10	N	10	n/a	
Coastal Development. Boat strikes	N	10	N	10	N	10	n/a	
Egg predation	Y	93	Y	94,7,19	Y	52	n/a	
Pollution (debris, chemical)	n/a		Y	10	n/a		n/a	
Pathogens	n/a		Y	7	n/a		n/a	
Climate change	Y	16,17,40,63,78,103	Y	16,17,40,63, 78,103	N		n/a	
Foraging habitat degradation	N		Y	108	Y	115	n/a	
Hurricanes impact	Y	17	Y	17	N		N	
Fibropapilloma	Y	57	Y	57,108	Y	57		
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	Y (1983-ongoing;1998-ongoing;2002-ongoing)	93;16;54	Y (1983-ongoing;1998-ongoing;2002-ongoing)	94,15,54	1988-ongoing;1995-ongoing	80,66	n/a	
Number of index nesting sites	14	64	14	64	11	64	n/a	
Monitoring at foraging sites (period: range of years)	n/a		2013-ongoing	107	1992-2006	4,75	n/a	
Conservation								
Protection under national law	Y	10,55,64,90,82,83,86	Y	10,55,64,90, 82,83,86	Y	10,55,64,90,45, 46,82	Y	10,55,64, 90,45,46, 82
Number of protected nesting sites (habitat preservation) (% nests)	10 (90 %) (43 %)	38,64	10 (90 %) (80 %)	38,64	10 (90 %) (97 %)	38,64	0	

Number of Marine Areas with mitigation of threats	11	10,93, 43	11	10,94, 43	11	10	0	
N of long-term conservation projects (period: range of years)	4 (1983-ongoing;1998-ongoing (2);2002-ongoing)	93;16;54;21	4 (1983-ongoing;1998-ongoing (2);2002-ongoing)	94,15,54;21	2 (1988-ongoing;1995-ongoing)	80,66;21	0	
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a	
Hatcheries	Y	93	Y	47,94	N		n/a	
Head-starting	N		N		Y	95-100	n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		n/a				n/a	
By-catch: onboard best practices	Y	23	Y	23	Y	23	n/a	
By-catch: spatio-temporal closures/reduction	Y	10,23,25,68,69	Y	10,23,68,69	Y	10,23,68,69	n/a	10,58,89
Education outreach	Y	9,13,14,25,42,43,44	Y	9,13,14,25	Y	9,13,14,25	N	

Table 2. Sea turtle nesting beaches in Cuba

Nesting activity (clutches and crawls) for the compiled sea turtle nesting beaches for four species *(L. kempii* (Lk), *E. imbricata* (Ei), *C. mydas* (Cm), *C. caretta* (Cc)) in Cuban beaches.

We also include the length of the beaches, the coordinates and the monitoring level and protocol implemented.

NOTE: Column "% Monitored" represents the beach's monitoring geographical coverage, at the last time it occurred. However, many of the beaches have not been monitored in the last 5 years (*)

Beach ID*	**Nesting beach name**	**Index site**	**Crawls/yr: recent average (range of years) (2010-2015)**			**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
	CC-NW ATL		**Cc**	**Ei**	**Cm**	**Long**	**Lat**					
CU1	Los Cayuelos	N	6,7	1,0	19,5	-84,9318	21,8339	0,6	100	18,64,65	2	B
CU2	Caleta Larga	N	3,3	1,0	24,2	-84,9066	21,8251	0,7	100	18,64,65	2	B
CU3	Caleta de los Piojos	Y	4,0		69,8	-84,8523	21,8175	0,13	100	18,64,65	1	B
CU4	El Holandés	Y	7,7		50,0	-84,7735	21,8278	1,02	100	18,64,65	1	B
CU5	La Barca	**Y**	**12,4**		**193,0**	-84,7565	21,847	0,525	100	18,64,65	1	B
CU6	Las Cadenas	N	2,0		21,3	-84,7514	21,8551	0,3	100	18,64,65	2	B
CU7	Perjuicio	N	3,0		52,3	-84,706	21,8844	0,5	100	18,64,65	2	B
CU8	Resguardo	N	2,3		21,6	-84,6786	21,8954	0,15	100	18,64,65	2	B
CU9	Antonio	Y	2,7		60,8	-84,6634	21,9002	0,325	100	18,64,65	1	B
CU10	Las Canas	N	1,0		42,0	-84,513	21,7856	0,8	100	18,64,65	2	E
CU11	Juan García	N	8,8	4,0	8,0	-83,38	21,59	2	100	18,64,65	1	B
CU12	Real Oeste	N	64,5	4,5	332,3	-83,36	21,58	4	100	18,64,65	2	B
CU13	El Sijú	Y	56,3	20,7	92,8	-83,3	21,57	4	100	18,64,65	1	B
CU14	El Coco	N	2,5	1,0	9,5	-83,24	21,57	4,5	100	18,64,65	2	B
CU15	Punta Francés	N	13,5	3,0	5,0	-83,1737	21,5987	2	100	18,64,65	1	B
CU16	Playa Larga	N	13,5		7,5	-82,7379	21,4757	4	100	18,64,65	2	E
CU17	El Guanal	Y	63,8	2,3	211,2	-82,8045	21,4523	8	100	18,64,65	1	B
CU18	Punta del Este	N	7,5	2,0	42,0	-82,5728	21,5453	5	100*	18,64,65	2	E
CU19	Cayo Campos	N	12,0	7,0	16,0	-81,5368	21,6366	10	100*	18,64,65	2	E

Beach ID*	Nesting beach name	Index site	Crawls/yr: recent average (range of years) (2010-2015)			Central point		Length (km)	% Moni-tored	Refe-rence #	Moni-toring Level (1-2)	Moni-toring Protocol (A-F)
	CC-NW ATL		Cc	Ei	Cm	Long	Lat					
CU20	Cayo Estopa	N	16,0		2,0	-81,5368	21,6366	10	100*	18,64,65	2	E
CU21	Cayo Rosario	N	26,5	2,0	63,0	-81,5368	21,6366	10	100	18,64,65	2	E
CU22	Rico Peraces	N	24,5	3,5	7,0	-81,4526	21,6788	10	100*	18,64,65	2	E
CU23	Los Majaes	N		5,0		-81,4526	21,6788	10	100*	18,64,65	2	E
CU24	Sirena	N			7,5	-81,5706	21,6061	0,07	100	18,64,65	2	E
CU25	Paraíso	N				-81,5612	21,6003	1,08	100	18,64,65	2	E
CU26	Mal Tiempo	N			579,5	-81,5568	21,5895	2,03	100	18,64,65	2	E
CU27	Lindamar	N				-81,5227	21,5998	4,06	100	18,64,65	2	E
CU28	P. Blanca	N			533,0	-81,4999	21,6060	2	100	18,64,65	2	E
CU29	Los Cocos	N	1,0		826,5	-81,4205	21,6550	1,08	100	18,64,65	2	E
CU30	Tortuga	N			200,0	-81,4101	21,6646	1,06	100	18,64,65	2	E
CU31	Cinco Balas	N	9,5	19,8	24,8	-79,3316	21,0559	3,4	100	18,64,65	2	E
CU32	Alcatracito	N	1,0	3,5	7,0	-79,3107	21,0431	0,722	100	18,64,65	2	E
CU33	Alcatraz	N	2,0	7,7	12,0	-79,2953	21,0373	2	100	18,64,65	2	E
CU34	Boca Grande	N		5,5	9,5	-79,2313	21,0079	2,5	100	18,64,65	2	E
CU35	El Almendrón	N		1,0	10,0	-79,1992	20,9805	1,882	100	18,64,65	2	E
CU36	Boca de Guano	N	2,0	4,5	29,0	-79,1629	20,9643	1,1	100	18,64,65	2	E
CU37	Los Cocos	N	4,5	3,0	50,3	-79,1443	20,9436	0,6	100	18,64,65	2	E
CU38	Los Bayameses	N	1,0	2,0	56,5	-79,0942	20,9033	0,3	100	18,64,65	2	E
CU39	El Guincho	Y	7,3	9,0	38,2	-79,0298	20,8576	1,97	100	18,64,65	2	E
CU40	La Piedra	N		4,5	68,5	-79,1146	20,9149	0,75	100	18,64,65	2	E
CU41	P. Bonita	Y	2,7	3,0	18,3	-79,0492	20,8682	0,8	100	18,64,65	2	E
CU42	Caballones Oeste	Y	1,3	12,8	11,0	-78,9668	20,8542	1,46	100	18,64,65	2	E
CU43	La Yana	N	3,5	4,5	14,2	-79,0057	20,8496	0,8	100	18,64,65	2	E
CU44	Caballones Este	Y	1,0	6,8	6,7	-78,945	20,8147	3,54	100	18,64,65	2	E

Beach ID*	Nesting beach name	Index site	Crawls/yr: recent average (range of years) (2010-2015)			Central point		Length (km)	% Moni-tored	Refe-rence #	Moni-toring Level (1-2)	Moni-toring Protocol (A-F)
	CC-NW ATL		**Cc**	**Ei**	**Cm**	**Long**	**Lat**					
CU45	El Dátiri	Y	4,0	11,0	14,2	-78,9495	20,798	0,9	100	18,64,65	2	E
CU46	Los Pinos	N	4,5	3,7	25,3	-78,931	20,7874	1,28	100	18,64,65	2	E
CU47	La Canita	N	2,0	2,0	23,8	-78,9145	20,7816	0,2	100	18,64,65	2	E
CU48	La Cana	N	1,0	2,3	16,8	-78,9012	20,7774	1	100	18,64,65	2	E
CU49	El Manchado	N	1,0	1,3	14,2	-78,8749	20,7731	1,5	100	18,64,65	2	E
CU50	El Partío	N	4,0	1,0	1,0	-78,8630	20,7767	0,6	100	18,64,65	2	E
CU51	B.P Chiquita	N	3,0	3,4	7,5	-78,8051	20,7377	0,3	100	18,64,65	2	E
CU52	Las Cruces	N	1,7	11,2	10,8	-78,7778	20,7101	1	100	18,64,65	2	E
CU53	Crucesitas	N		1,7	10,3	-78,7705	20,7084	0,61	100	18,64,65	2	E
CU54	Cachiboca	Y	1,5	3,6	12,2	-78,7528	20,6956	1,7	100	18,64,65	2	E
CU55	El Faro	Y	1,0	6,4	7,4	-78,7484	20,6776	0,24	100	18,64,65	2	E
CU56	La Ballena	Y	4,0	5,8	7,6	-78,7367	20,6746	1,36	100	18,64,65	2	E
CU57	Indio Grande	N	3,0	1,0	3,6	-78,7131	20,6604	0,4	100	18,64,65	2	E
CU58	Indio Chiquito	N		1,0	6,0	-78,7112	20,6564	0,45	100	18,64,65	2	E
CU59	Los Hierros	N	1,0		1,7	-78,7044	20,6514	0,3	100	18,64,65	2	E
CU60	Carabineros	N	3,0	7,0	14,5	-78,6823	20,6541	0,95	100	18,64,65	2	E
CU61	Bártula	N		3,7	4,5	-78,6377	20,6467	0,4	100	18,64,65	2	E
CU62	Juan Grin	Y		1,5	3,0	-78,5582	20,6259	0,2	100	18,64,65	2	E
CU63	Boca Seca	Y	3,3	5,7	4,8	-78,5269	20,6183	2,29	100	18,64,65	2	E
CU64	Boca Rica	N		1,0	2,0	-78,4818	20,6072	0,1	100	18,64,65	2	E
CU65	Campo Santo	N	1,0	1,0		-78,4209	20,5859	0,1	100	18,64,65	2	E
CU66	Caguama	N	6,2	6,3	9,0	-78,3917	20,5536	5	100	18,64,65	2	E
CU67	Tío Joaquín	N		10,5	4,0	-78,76	21,4331	1,5	100	18,64,65	2	E
CU68	Las Canas	N		6,0	1,0	-78,7848	21,392	2	100	18,64,65	2	E
CU69	Obispo	N	2,7	3,5	3,5	-80,1943	23,1091	4	100	18,64,65	2	E
CU70	Mulata	N	3,0			-80,0855	23,0711	2	100	18,64,65	2	E

Beach ID*	Nesting beach name	Index site	Crawls/yr: recent average (range of years) (2010-2015)			Central point		Length (km)	% Moni-tored	Refe-rence #	Moni-toring Level (1-2)	Moni-toring Protocol (A-F)
	CC-NW ATL		**Cc**	**Ei**	**Cm**	**Long**	**Lat**					
CU71	Roteño	N				-80,0644	23,0634	2	100	18,64,65	2	E
CU72	La Quebrada Punta Cocina	N	3,0		12,3	-77,8192	22,2433	20	100	18,64,65	1	B
CU73	Cayo Blanco	N			6,0	-79,5972	21,5960	1,5	100	18,64,65	2	E
CU74	Majahuevo	N	2,0	1,0	5,2	-79,5677	21,6402	2	100	18,64,65	2	E

Table 3. International conventions protecting sea turtles and signed by Cuba

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	Y	Y	Y	CM, CC	National and international commerce prohibit	Harvesting prohibited
SPAW	Y	Y	Y	DC		
CMS	Y	Y	Y	ALL	Identification and conservation of migratory routes	Marine protected areas, fishing season closed during migration period
CBD	Y		Y	ALL	Conserve biological diversity	Conservation actions and Protected areas established

Table 4. Projects and databases on sea turtles in Cuba.

#	RMU	Cou n-try	Region / Location	Project Name or descriptive title	Key words	Star t date	End date	Leadin g organi-zation	Public / Privat e	Collab o-ration with	Reports / Informatio n material	Current Sponsor s	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	CC and CM NW ATL; EI-NW ATL-WC-USA	Cuba	Caribbea n	Protortugas Cuba Database	Nesting, reproductive success, Tagging, Threats, Cuba	201 0	Ongoin g	ENPFF	Public	CIP, INSTE C	Monitoring protocols, Biennial Reports	None	Yanet Forneiro (tortugas@ua.ffauna.co.cu)	Julia Azanza (julia_dragmarino@yahoo.es)
T4.2	CC and CM NW ATL; EI-NW ATL-WC-USA	Cuba	Caribbea n	Prevention of the effect of Climate Change on endangered species	Incubation temperature, sex proportion, beach dynamic, Cuba	201 0	Ongoin g	InSTE C-UH	Public	ENPF F, CIP	Final report (2019); publications	Ocean Foundat ion Ccambi o (Fundaci ón Nuñez-Jiménez)	Julia Azanza (julia_dragmarino@yahoo.es)	Yanet Forneiro (tortugas@ua.ffauna.co.cu)
T4.3	CC and CM NW ATL; EI-NW ATL-WC-USA	Cuba	Caribbea n	Study and conservatio n of marine turtles in Cuba	Nesting, Tagging, Cuba	199 6	Ongoin g	CIP-MINA L	Public	ENPF F, INSTE C	CIP annual reports to MINAL; publications	MINAL	Félix Moncada (fmoncada@cip.alinet.cu)	Yanet Forneiro (tortugas@ua.ffauna.co.cu), Julia Azanza (julia_dragmarino@yahoo.es)

Table 4. continuation

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
T4.1	N	BD-Protortugas	All	2010	Ongoing	N	Y	Y	N	N	N	109
T4.2	N	BD-Cambio Climático	Península de Guanahacabibes, San Felipe, Cayo Largo and Jardines de la Reina	2010	Ongoing	N	N	N	N	N	N	110
T4.3	N	BD-CIP	All	2010	Ongoing	N	Y	Y	N	N	N	111

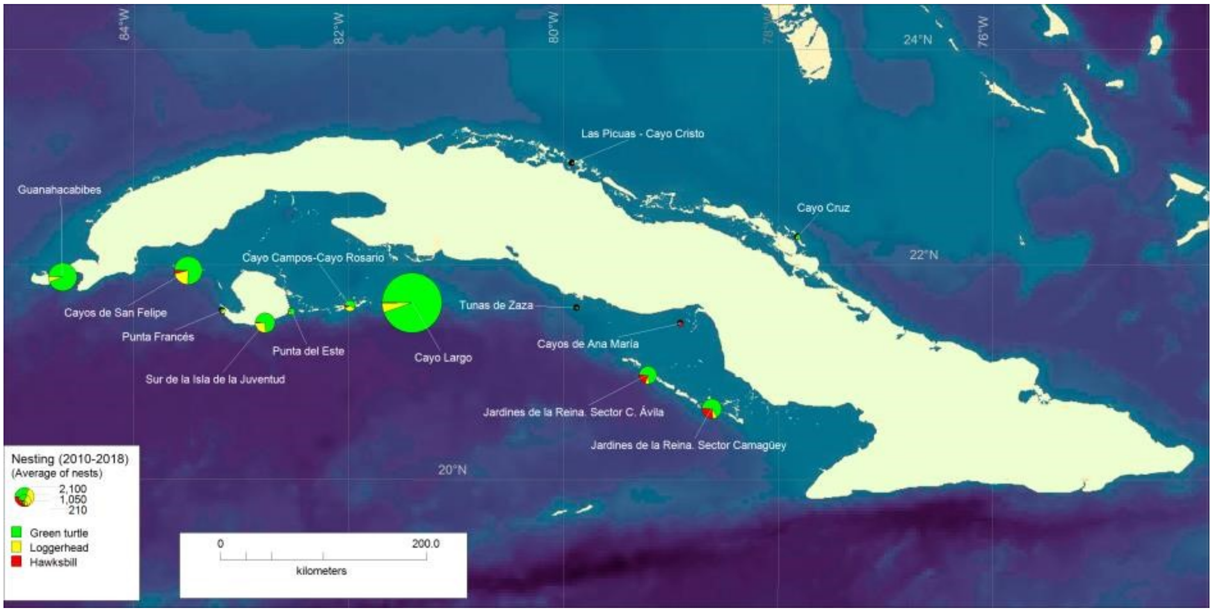

Figure 1. Main sea turtle nesting beaches for four species in Cuban archipelago.

Curacao

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Curacao.

Topic	***E. imbricata***	***C. mydas***	***C. caretta***	Ref #
Occurrence				
Nesting sites	Y	Y	Y	1-5
Pelagic foraging grounds	n/a	n/a	n/a	
Benthic foraging grounds	Y	Y	N	1-5
Key biological data				
Nests/yr: recent average (range of years)	n/a	n/a	n/a	
Nests/yr: recent order of magnitude	n/a	n/a	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a	n/a	n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a	n/a	n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a	n/a	n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a	n/a	n/a	
Total length of nesting sites (km)	n/a	n/a	n/a	
Nesting females / yr	n/a	n/a	n/a	
Nests / female season	n/a	n/a	n/a	
Female remigration interval (yrs)	n/a	n/a	n/a	
Sex ratio: hatchlings (F / Tot)	n/a	n/a	n/a	

Sex ratio: juveniles (F / Tot)	n/a	n/a	n/a	
Sex ratio: Adults (F / Tot)	n/a	n/a	n/a	
Min adult size, CCL or SCL (cm)	n/a	n/a	n/a	
Age at maturity (yrs)	n/a	n/a	n/a	
Clutch size (n eggs)	n/a	n/a	n/a	
Emergence success (hatchlings/egg)	n/a	n/a	n/a	
Nesting success (Nests/ Tot emergence tracks)	n/a	n/a	n/a	
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a	n/a	n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a	n/a	n/a	
Oldest documented abundance: nests/yr (range of years)	n/a	n/a	n/a	
Published studies				
Growth rates	N	N	N	
Genetics	N	N	N	
Stocks defined by genetic markers	N	N	N	
Remote tracking (satellite or other)	N	N	N	
Survival rates	N	N	N	
Population dynamics	N	N	N	
Foraging ecology (diet or isotopes)	N	N	N	

Capture-Mark-Recapture	N	N	N	
Threats				
Bycatch: small scale / artisanal	Y	Y	Y	
Bycatch: industrial	Y	Y	Y	
Bycatch: quantified?	Y	Y	Y	
Intentional killing or exploitation of turtles	N	N	N	
Egg poaching	Y	Y	Y	
Egg predation	Y	Y	Y	
Photopollution	N	N	N	
Boat strikes	Y	Y	Y	
Nesting habitat degradation	Y	Y	Y	
Foraging habitat degradation	Y	Y	Y	
Other	Y	Y	Y	
Long-term projects				
Monitoring at nesting sites	Y	Y	Y	
Number of index nesting sites	1	1	1	
Monitoring at foraging sites	Y	Y	N	
Conservation				
Protection under national law	Y	Y	Y	
Number of protected nesting sites (habitat preservation)	N	N	N	

Number of Marine Areas with mitigation of threats	n/a	n/a	n/a	
Long-term conservation projects (number)	>1 (2014-ongoing)	>1 (2014-ongoing)	>1 (2014-ongoing)	1
In-situ nest protection (eg cages)	N	N	N	
Hatcheries	N	N	N	
Head-starting	N	N	N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a	n/a	n/a	
By-catch: onboard best practices	n/a	n/a	n/a	
By-catch: spatio-temporal closures/reduction	n/a	n/a	n/a	
Other	N	N	N	

Table 2. Sea turtle nesting beaches in Curacao.

No data are available

Table 3. International conventions protecting sea turtles and signed by Curacao.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles

						(UNEP/CMS/Resolution 9.18 on Bycatch).
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973).	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.

The Convention for the protection of the marine environment of the North-East Atlantic (the OSPAR Convention) (1992).	Y	y	y	Dc, Cc	To protect and conserve marine ecosystems and biological diversity of the North-East Atlantic.	These two species are considered threatened and/or declining wherever the species is present in OSPAR regions (Dc : every OSPAR Regions, Cc : OSPAR Regions IV and V)
Marine Strategy Framework Directive (2008).	Y	Y	Y	Dc, Cc	This Directive leds European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	These two species of marine turtles are considered as an indicator for MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 4. Projects and databases on sea turtles in Curacao.

RMU	**Country**	**Region / Location**	**Project Name or descriptive title**	**Key words**	**Start date**	**End date**	**Leading organisation**	**Public/Private**	**Collaboration**	**Reports / Information material**	**Current Sponsors**
Caribbean	Curacao	Curacao	Facial recognition for population studies	Database, sea turtles, resident turtles, sea sightings,	2016	ongoing	STCC	Private	Local dive operators		none

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4 Berendse, B.C. Vreugdenhil, A. 2019. Action and monitoring report 2018, Sea Turtle Conservation Curacao

5 Berendse, B.C. Vreugdenhil, A. 2020. Action and monitoring report 2019, Sea Turtle Conservation Curacao

French Guiana

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6. CRPMEM. Dock du Larivot, 97351 Matoury. bigsharkchum@yahoo.com

7.1. Distribution, abundance, trends

7.1.1. Nesting sites

Three species of sea turtles are regularly nesting in French Guiana: leatherback (*Dermochelys coriacea),* green (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*). Hawksbill (*Eretmochelys imbricate*) nesting are also occurring but are infrequent.

There are 4 nesting sites (Figure 7.1, Table 7.1 & Table 7.2):

Awala Yalimapo: The beach called "Les Hattes", located in Awala-Yalimapo, is a major nesting site for leatherback and green turtle.

Remote beaches (Azteque, Rizieres…): It consists of several isolated beaches located in western French Guiana. It is a major nesting site for green turtle. Coastline dynamics causes rapid changes to the shoreline, leading to the wearing away or disappearance of beaches in some places, and the expansion or generation of new one elsewhere.

Cayenne, Rémire-Montjoly: It consists of 3 beaches located in Cayenne (Zephir Montabo beach) and Rémire-Montjoly (Salines Montjoly and Gosselin Apcat beaches). It is a major nesting site for leatherback and olive ridley.

Kourou: This beach is a minor nesting site for the 3 species.

The recent trends for leatherback are negative, with a decrease of 98% of nests per year between 2009 and 2020. The trend is stable for green turtle and olive ridley, but with a significant decline in 2019-2020 for olive ridley.

7.1.2. Marine areas

French Guiana's waters host both oceanic (Dc, Lo) and neritic (Cm, Lo) foraging areas. Juvenile green turtles are regularly seen around rocky islets (for example the "Iles du Salut" and the Grand Connetable Nature Reserve).

A monitoring project started in 2019 at the Grand Connetable Nature Reserve to estimate the abundance of juvenile green turtles and foraging site fidelity.

7.2. Other biological data

Based on 28 years (1987-2013) of capture-mark-recapture data from 46 051 individuals in northwestern French Guiana, key demographic parameters have recently been estimated for leatherback (Ref 48: Chevallier et al, 2020):

Average annual adult survival probability: 0.789 ± 0.009.

Interval among laying seasons (=female remigration interval): 2.777 ± 0.118 years.

Further reproductive seasons for an adult female having just bred: 1.704 ± 0.034.

7.3. Threats

7.3.1. Nesting sites

Egg poaching

There is a very high rate of poaching on Yalimapo beaches (western part of French Guiana) especially at the very beginning of the green turtles nesting season (January-February). There is poor knowledge about the poaching scheme but it is assumed that a cross border traffic exists between French Guiana and Surinam. At the moment, patrolling activities aren't sufficient to discourage poachers.

Predation by dogs

There are many roaming dogs on western beaches, or dogs of which the owners let them free without looking after them (both western and eastern beaches). Dogs are attacking adults (especially olive ridley on the eastern beaches) and are also responsible for the destruction of nests.

Human disturbance

Except for the western remote beaches, all nesting sites are open and accessible to the public. Therefore, incivilities may happen on hatchlings and adults. Despite the presence of animators on beaches during nesting season, there is sometimes a lack of knowledge of the good behavior to adopt in order to not disturb sea turtles.

Light pollution

Some public lights or lights from private houses and shops are disorientating both hatchlings and adults, especially on Cayenne and Rémire-Montjoly beaches.

Nesting habitat degradation

The coastline erosion lead humans to implement some techniques to fight against it and to protects the habitations, which can damage even more nesting sites and oceans (eg: dikes made of big plastic bags filled with natural local sand). Plastic pollution is also damaging beaches and can injure turtles.

7.3.2. Marine areas

Illegal drift gillnet fishing

Further to represent unfair competition for professional fishers, the IUU (Illegal, Unreported and Unregulated) fishing threatens fish stock and biodiversity. From the last research studies led in 2012 (Ref 53: Ifremer, 2012), IUU fishing represented two third of fishing activities in French Guiana. Illegal boats come mainly from neighbor countries: Surinam and Brazil.

IUU Longline fishing

Even though French Guiana's fisheries do not use longlines there use by illegal foreign fleets (from Venezuela, Trinidad, Suriname, Guyana, Brazil fishing in French Guianas' waters) is very common. It would be good to assess the level of effort to set up an observer program to assess the level of interaction and to develop and implement mitigations measures regionally

Bycatch in legal coastal fishing

Regarding legal coastal fishing, the French Guiana Regional Fisheries Committee (CRPMEM Guyane) has been collaborating with WWF on environmental issues around gillnetters since 2005. Thanks to a series of on-board observations and interviews with fishermen and ship-owners, a consensus has emerged around technical innovations that could reduce the potential for interactions between coastal fishing nets and large marine vertebrates (including sea turtles). It is in this context that the PALICA 2 project (Active Fisheries for the Limitation of Interactions and Accidental Catches) has been developed: the tests carried out are focusing on the various flotation systems, as well as the size of the nets and the elements that make them detectable by sea turtles (color of buoys, lights, etc.).

A complementary project called ARRIBA (Alert to Risks Relating to Interactions Blocking Arribadas) started in 2020 and concerns the modulation of fishing effort off the Cayenne and Rémire-Montjoly coast, during olive ridley nesting season.

Coastal set fishing nets 'Courtine'

This type of nets, mostly used by local communities for their subsistence, are sometimes deployed along nesting sites, especially in Kourou. Totally prohibited since 1984 in French Guiana, there are currently discussions between authorities, conservation organizations and local communities to figure out how to authorize them while limiting their impact.

Venezuelan Hardliners

A fleet with 45 licenses operated in French Guiana, though there have been no onboard observer programs, it seems that this handline operated artisanal fishery would have little impact on turtles. This will be confirmed with the development of an onboard observer program.

Trawling.

The local fleet has been TED certified since 2010.

Offshore mining activities

Offshore mining activities are not allowed in French waters anymore. However, the risk of pollution linked to this activity from the neighbor countries still exists.

7.4. Conservation

Conservation status

Sea turtles are subject to several international conventions (Table 7.3). In France, they are protected under national law by the ministerial order from 14 October 2005 (Ref 50).

The Marine Turtle National Action Plan 2014-2023 in French Guiana

The "Marine Turtles Network of French Guiana" consists of a wide variety of actors who are directly or indirectly involved in the conservation of marine turtles: NGOs, research organizations, socio-professionals (like fishermen), communities, civil security and tourism stakeholders. This network meets within the framework of the Marine Turtle National Action Plan (NAP).

This NAP follows the Marine Turtle Restoration Plan 2007-2012 that was driven by WWF (Table 7.4). This strategic planning document was drawn up in 2014 for a period of 10 years (2014-2023) to improve the conservation status of French Guianese breeding populations of leatherback, green and olive ridley turtles. It proposes an intervention strategy based on the prioritization of identified conservation issues. The framework is organized around five specific objectives and two transversal specific objectives that were determined collectively:

Alleviating threats

Research for conservation

Transboundary cooperation

Environmental education

Promotion as socio-economic asset

Networking of the actors

Governance

Each objective includes a number of sub-operational objectives, which are broken down into several actions to be implemented. Coordination of the marine turtle NAP in French Guiana is entrusted to the OFB (Office Français de la Biodiversité), under the supervision of the biodiversity team of DGTM (Direction Générale des Territories et de la Mer: local representation of French Government).

They both support the different actors in the implementation of the actions planned.

Databases

The Marine Turtle Databases in French Guiana is regulated by a convention signed in 2013 by 8 organizations: DEAL Guyane, CNRS, Kulalasi, Kwata, ONCFS, SEPANGUY, PNR Guyane and WWF Guyane. It contains all nesting and tagging data since 1987. This database is actually managed by the OFB and DGTM.

A strandings database also exists for both sea turtles and marine mammals since 2013. The REG (Réseau des échouages de Guyane: Stranding network of French Guiana) consists of 15 organizations and is actually driven by the GEPOG association.

7.5. Research

In the framework of the marine turtle NAP in French Guiana, many published research studies have been conducted on sea turtles. Those works include genetics (Ref 30, 32, 36, 44), remote tracking (Ref 27, 28, 30, 33-35, 38-41), survival rates (Ref 48) and foraging ecology (Ref 23, 27, 39). Leatherbacks have been the most studied, especially since the publication of a scientific article based on 28 years (1987-2013) of capture-mark-recapture data (Ref 48).

Ongoing studies are, among others, focusing on age and size reaction norm for sexual maturity for Atlantic leatherback (Girondot et al, submitted) and estimation of maternal investment of green turtle by automatic identification of nesting behaviors and number of laid eggs from a tri-axial accelerometer (Jeantet et al, in prep). The use of new methods of analysis (package R phenology) will also allow to estimate the total number of clutches per nesting sites based on sample count, the number of nests per female per season, and the remigration interval. Regarding the reduction of bycatch, different actors are leading together 2 innovative projects (PALICA 2 and ARRIBA) in close collaboration with local fishermen.

Current objectives and key knowledge gaps identified by the marine turtle NAP are:

Use genetic studies to define breeding sub-populations at the scale of the Guiana shield

Use tagging data to understand the spatio-temporal trends of these sub-populations (12 consecutive years of tagging are available for leatherback, 9 years for green and 10 years of olive ridley)

Understand the dynamics of the populations and estimate key demographic parameters at nesting sites (sex-ratio, clutch size, emergence success, nesting success) and at sea (survival rate, recruitment rate, emigration rate, return rate) for the 3 species

Improve knowledge of males (movements, behavior during breeding season, interaction with fisheries, ecology)

Improve knowledge of foraging juvenile green turtles

Assess interactions between sea turtles and fishing activities (legal and illegal)

Characterize pollutants and disease affecting marine turtles

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Table 1. Biological and conservation information about sea turtle Regional Management Units in French Guiana.

Topic	*C. mydas*	Ref #	*D. coriacea*	Ref #	*L. olivacea*	Ref #
Occurrence						
Nesting sites	Y	1-10, 33, 55	Y	1-10, 33, 48-49, 55	Y	1-10, 33, 55
Oceanic foraging areas	N	34-35, 40, 44	Y	15, 20-25, 28, 37, 41	Y	26, 38-39, 42
Neritic foraging areas	Y	34-35, 40, 44	N	15, 20-25, 28, 32, 37, 41	Y	26, 38-39, 42
Key biological data						
Nests/yr: recent average (range of years)	1664 (2014-2020)	1-10, 55	2634 (2014-2020)	1-10, 55	3052 (2014-2020)	1-10, 55
Nests/yr: recent order of magnitude						
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	2	1-10, 55	2	1-10, 55	1	1-10, 55
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	2	1-10, 55	2	1-10, 55	3	1-10, 55
Nests/yr at "major" sites: recent average (range of years)						
Nests/yr at "minor" sites: recent average (range of years)						
Total length of nesting sites (km)	20	*see note*	20	*see note*	20	*see note*
Nesting females / yr	854 (2014-2018)	1-10, 33	914 (2014-2018)	1-10, 33	1841 (2014-2018)	1-10, 33
Nests / female season (N)	2,27 (2012)	5	West: 3,76 (2012) East: variable	5, 57 *see note*	1,3 (2012)	5
Female remigration interval (yrs) (N)	<=3	5, 16	2,77	16, 48	1,3	*CMR data*
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a	

Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)						
Age at maturity (yrs)	n/a		n/a		n/a	
Clutch size (n eggs) (N)						
Emergence success (hatchlings/egg) (N)						
Nesting success (Nests/ Tot emergence tracks) (N)						
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	stable (2014-2020)	43, 55	decreasing by 98% (2009-2020)	43, 45-49, 55	stable (2002-2020)	43, 55
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		10 000-50 000 (1978-1995)	15	1716-3257 (2002–2007)	26
Published studies						
Growth rates	N		Y	49	N	
Genetics	Y	36, 44	Y	32	Y	30
Stocks defined by genetic markers	N		Y	32	N	
Remote tracking (satellite or other)	Y	33-35, 40	Y	27-28, 33, 41	Y	30, 38-39
Survival rates	N		Y	48	N	
Population dynamics	N		N		N	
Foraging ecology	N		Y	23, 27	Y	39
Capture-Mark-Recapture	N		Y	48	N	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (SN, DN)	13-14, 53	Y (SN, DN)	13-14, 53	Y (SN, DN)	13-14, 53
Bycatch: presence of industrial fisheries?	Y (ST)	13-14, 53	Y (ST)	13-14, 53	Y (ST)	13-14, 53

Bycatch: quantified?	Y (ST) 0/Yr, N (SN, DN)	53	Y (ST) 0/Yr, N (SN, DN)	53	Y (ST) 0/Yr, N (SN, DN)	53
Intentional killing of turtles	N		N		N	
Take. Illegal take of turtles	Y	1-14	Y	1-14	Y	1-14
Take. Permitted/legal take of turtles	N		N		N	
Take. Illegal take of eggs	Y	1-14	Y	1-14	Y	1-14
Take. Permitted/legal take of eggs	N		N		N	
Coastal Development. Nesting habitat degradation	Y	13-14	Y	13-14	Y	13-14
Coastal Development. Photopollution	Y	13-14	Y	13-14	Y	13-14
Coastal Development. Boat strikes	N		N		N	
Egg predation	Y	1-14	Y	1-14	Y	1-14
Pollution (debris, chemical)	Y	58	Y	58	Y	58
Pathogens	n/a		n/a		n/a	
Climate change	n/a		n/a		n/a	
Foraging habitat degradation	n/a		n/a		n/a	
Other	n/a		n/a		n/a	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (1999-ongoing)	1-10, 55	Y (1987-ongoing)	1-10, 55	Y (1999-ongoing)	1-10, 55
Number of index nesting sites	1	Table 2	2	Table 2	1	Table 2
Monitoring at foraging sites (period: range of years)	N		N		N	
Conservation						
Protection under national law	Y	50	Y	50	Y	50
Number of protected nesting sites (habitat preservation) (% nests)	1 (95%)	*see note*	1 (15%)	*see note*	1 (1%)	*see note*
Number of Marine Areas with mitigation of threats	0		0		0	
N of long-term conservation projects (period: range of years)	1 (2007-2023)	11-14	1 (2007-2023)	11-14	1 (2007-2023)	11-14
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		N		1 (2003-2011)	*see note*

Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	TTED (ST), alternative fishing techniques (DN)	51, 54	TTED (ST), alternative fishing techniques (DN)	51, 54	TTED (ST), alternative fishing techniques (DN)	51, 54
By-catch: onboard best practices	Y	52	Y	52	Y	52
By-catch: spatio-temporal closures/reduction	N		N		ARRIBA project (2020-2021)	
Other	N		N		N	

NOTES:

Total length of nesting sites: There is no report which details the length of the beaches. They are evaluated in agreement with the monitoring partners. Moreover, in French Guiana the beaches come back and forth because of the phases of erosion /accretion, especially in the West (Awala-Yalimapo and isolated sites). So 20 km is an approximate size of the nesting beaches.

Nests / female season: A recent analyse (Ref 57) of 16 years (2003-2018) of CMR on the eastern population of leatherback (Cayenne and Rémire-Montjoly) showed cyclic variations of the nesting activity, with an expansion phase during the ten first years of the century, and then a decline in the following decade. Two types of females have been identified in the nesting population: a first category of females which nest lately and only few times (1-2 times) during the nesting period, and a second category nesting earlier in the season, with a higher clutch frequency (5-7 times).

Number of protected nesting sites: In theory, the nesting sites located in Amana Natural Reserve (Awala Yalimapo and remote beaches) are protected.

Hatcheries: There was a hatchery from 2003 to 2011 at Cayenne and Rémire-Montjoly nesting site.

Table 2. Sea turtle nesting beaches in the French Guiana.

Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Central point		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CM-SC ATL				Long	Lat					
Awala Yalimapo	Y	1438 (2014-2020)	1859 (2014-2020)	-53,947422	5,7457611	2,5	100	1-10, 55	1	B
Remote beaches (Azteque, Rizieres…)	N	156 (2014-2020)	239 (2014-2020)	-53,742747	5,691944	5	Variable	1-10, 55	2	
Kourou	N	25 (2014-2020)	35 (2014-2020)	-52,644328	5,173675	5	100	1-10, 55	2	
Cayenne, Rémire-Montjoly	N	52 (2014-2020)	57 (2014-2020)	-52,270484	4,92272	7,5	100	1-10, 55	1	B
DC-NW ATL										
Awala Yalimapo	Y	368 (2014-2020)	416 (2014-2020)	-53,947422	5,7457611	2,5	100	1-10, 55	1	B
Remote beaches (Azteque, Rizieres…)	N	13 (2014-2020)	15 (2014-2020)	-53,742747	5,691944	5	Variable	1-10, 55	2	

Kourou	N	47 (2014-2020)	50 (2014-2020)	-52,644328	5,173675	5	100	1-10, 55	2	
Cayenne, Rémire-Montjoly	Y	2219 (2014-2020)	2335 (2014-2020)	-52,270484	4,92272	7,5	100	1-10, 55	1	B
LO-W ATL										
Awala Yalimapo	N	9 (2014-2020)	11 (2014-2020)	-53,947422	5,7457611	2,5	100	1-10, 55	1	B
Remote beaches (Azteque, Rizieres…)	N	18 (2014-2020)	22 (2014-2020)	-53,742747	5,691944	5	Variable	1-10, 55	2	
Kourou	N	34 (2014-2020)	39 (2014-2020)	-52,644328	5,173675	5	100	1-10, 55	2	
Cayenne, Rémire-Montjoly	Y	3000 (2014-2020)	3261 (2014-2020)	-52,270484	4,92272	7,5	100	1-10, 55	1	B

Table 3. International conventions protecting sea turtles and signed by French Guiana (France).

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (UNEP/CMS/Resolution 9.18 on Bycatch).
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co- operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .
CITES: Convention on International Trade in	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to	All seven species listed in Appendix I of CITES.

Endangered Species of Wild Fauna and Flora (1975).					ensure that international trade in specimens of wild animals and plants does not threaten their survival.	
Cartagena: Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (1986).	Y	Y	Y	ALL	A Caribbean agreement for the protection and enhancement of the Caribbean Sea.	
Ramsar: Convention on Wetlands (1975).	Y	Y	Y	ALL	An intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Sea turtles are not specifically covered by Ramsar, but existing and potential Ramsar sites are used by sea turtles for nesting and foraging. ex: Basse-Mana (réserve de l'Amana) in French Guiana.

Table 4. Projects and databases on sea turtles in in French Guiana.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public / Private	Collaboration with	Reports / Info material	Current Sponsor	Primary Contact (name and Email)
T4.1	CM-SC ATL DC-NW ATL LO-W ATL	France	French Guiana	Plan de restauration des tortues marines en Guyane (PRTM)	Conservation program	2007	2012	DREAL, ONCFS, WWF	Public	Sea Turtles Network in French Guiana			
T4.2	CM-SC ATL DC-NW ATL LO-W ATL	France	French Guiana	Plan National d'Action en faveur des Tortues Marines de Guyane (PNATMG)	Conservation program	2014	2023	DGTM, OFB	Public	Sea Turtles Network in French Guiana			Mathilde Lasfargue, coordination.pnatmg@ofb.gouv.fr

T4.3	CM-SC ATL DC-NW ATL LO-W ATL	France	French Guiana	Base de données des pontes de tortues marines en Guyane	Monitoring beaches, nesting data, tagging	1987	still going	DGTM, OFB	Private	8 Signatories of the convention in 2013			Mathilde Lasfargue, coordination.pnatmg@ofb.gouv.fr
T4.4	CM-SC ATL DC-NW ATL LO-W ATL	France	French Guiana	Base de données des échouages en Guyane	Strandings	2013	still going	Réseau des échouages de Guyane (REG)	Private	15 organizations (GEPOG, Kwata, RNNA, …)			reseau.echouages.guyane@gmail.com

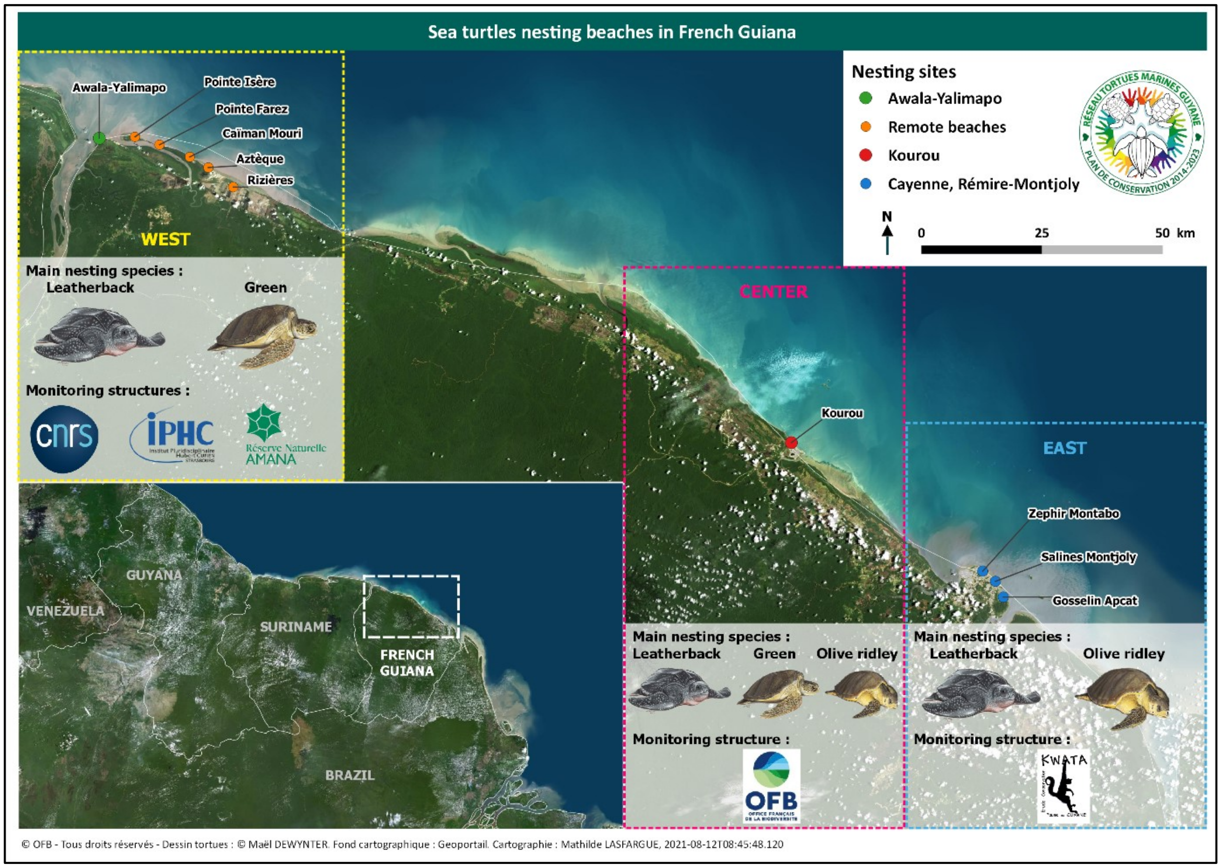

Figure 1. Sea turtle nesting sites in French Guiana

Guadeloupe

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Guadeloupe.

	REGIONAL MANAGEMENT UNIT									
Topic	***C. mydas***	**Ref #**	***D. coriacea***	**Ref #**	***E. imbricata***	**Ref #**	***C. caretta***	**Ref #**	***L. olivacea***	**Ref #**
Occurrence										
Nesting sites	Y	18	Y	18	Y	18	N		N	
Pelagic foraging grounds	Y	13	n/a		Y	13	n/a		n/a	
Benthic foraging grounds	Y	13	n/a		Y	13	n/a		n/a	
Key biological data										
Nests/yr: recent average (range of years)	1315 (2007-2008)	7, Tab 4,1	353 (2007-2008)	7, Tab 4,1	3061 (2007-2008)	7, Tab 4,1	n/a		n/a	
Nests/yr: recent order of magnitude	179 - 2873	7	64 - 870	7	1435 - 6415	7	n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a		n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a		n/a		n/a	
Nests / female season (N)	2,93 (9 populations)	25, 26	6,17 (4 populations)	25, 26	4,5 (212 ind.)	25, 27	n/a		n/a	

Female remigration interval (yrs) (N)	2,86 (9 populations)	25, 26	2,28 (5 populatio ns)	25, 26	2,69 (86)	25, 27	n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	0,71 (55)	16	n/a		0,71 (35)	16	n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	75 CCL	Tab 4,1	87 CCL	Tab 4,1	73,5 CCL	Tab 4,1	n/a		n/a	
Age at maturity (yrs)	n/a		n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	112,8 (24 populations)	22	100	22	155 (93 nests)	25, 27	n/a		n/a	
Emergence success (hatchlings/egg) (N)	0,81 (29)	16	n/a		0,91 (19)	16	n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		n/a		n/a	
Trends										
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a		n/a		n/a	
Published studies										
Growth rates	N		N		N		N		N	
Genetics	Y	9	Y	10	Y	11	N		N	
Stocks defined by genetic markers	Y	9	Y	10	Y	11	N		N	
Remote tracking (satellite or other)	Y	5, 12, 13, 1	Y	15	Y	17	N		N	
Survival rates	N		N		N		N		N	

Population dynamics	Y	7, 17, 16	Y	7, 17	Y	14, 16, 7, 17	N		N	
Foraging ecology (diet or isotopes)	Y	1, 12,13	N		N		N		N	
Capture-Mark-Recapture	Y	1	N		N		N		N	
Threats										
Bycatch: presence of small scale / artisanal fisheries?	Y (SN, FP)	6, 8	Y (SN, FP)	6, 8	Y (SN, FP)	6, 8	Y (SN, FP)	6, 8	Y (SN, FP)	6, 8
Bycatch: presence of industrial fisheries?	N		N		N		N		N	
Bycatch: quantified?	500 (SN, FP)	8, 2, 3, 6	n/a	8, 2, 3, 6	200 (SN, FP)	8, 2, 3, 6	n/a		n/a	
Take. Intentional killing or exploitation of turtles	Y	2, 3	n/a		Y	2, 3	n/a		n/a	
Take. Egg poaching	Y	2, 3	n/a		Y	2, 3	n/a		n/a	
Coastal Development. Nesting habitat degradation	Y	2, 3, 18	Y	2, 3, 18	Y	2, 3, 18	n/a		n/a	
Coastal Development. Photopollution	Y	2, 3, 19	Y	2, 3, 19	Y	2, 3, 19	n/a		n/a	
Coastal Development. Boat strikes	Y	2, 3	Y	2, 3	Y	2, 3	Y	2, 3	Y	2, 3
Egg predation	Y	2, 3, 4	Y	2, 3, 4	Y	2, 3, 4	n/a		n/a	
Pollution (debris, chemical)	Y	2, 3, 21	Y	2, 3, 21	Y	2, 3, 21	Y	2, 3	Y	2, 3
Pathogens	Y	2, 3, 20	n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a		n/a	

Foraging habitat degradation	Y	2, 3, 23	n/a		Y	24	n/a		n/a	
Other	N		N		N		n/a		n/a	
Long-term projects (>5yrs)										
Monitoring at nesting sites (period: range of years)	Y (1999-ongoing)		Y (1999-ongoing)		Y (1999-ongoing)		n/a		n/a	
Number of index nesting sites	n/a		n/a		n/a		n/a		n/a	
Monitoring at foraging sites (period: range of years)	Y (2003 - 2014)		n/a		Y (2003 - 2014)		n/a		n/a	
Conservation										
Protection under national law	Y	28	Y	28	Y	28	Y	28	Y	28
Number of protected nesting sites (habitat preservation) (% nests)	n/a		n/a		n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	n/a		n/a		n/a		n/a		n/a	
N of long-term conservation projects (period: range of years)	>1 (1999-2027)	28	>1 (1999-2027)	28	>1 (1999-2027)	28	>1 (1999 - 2027)	28	>1 (1999-2027)	28
In-situ nest protection (eg cages)	N		N		N		n/a		n/a	
Hatcheries	N		N		N		n/a		n/a	
Head-starting	N		N		N		n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N		N		N	
By-catch: onboard best practices	N		N		N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N		N		N	
Other	N		N		N		N		N	

Note: No idea if increasing or declining, Data not published yet.

Table 2. Sea turtle nesting beaches in Guadeloupe.

Nesting beach name	Index site	Species	Nests/yr: recent average (range of years)	Crawls/yr: recent average (2012, 2013, 2014)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)
					Long	Lat	Long	Lat	Long	Lat				
North West Atlantic	Secteur 1 : Grand Cul-de-Sac Marin	*Eretmochelys imbricata*		1105.3					61.535331	16.332888		89	T4.2	1
North West Atlantic	Secteur 1 : Grand Cul-de-Sac Marin	*Dermochelys coriacea*		85.0					61.535331	16.332888		89	T4.2	1
North West Atlantic	Secteur 1 : Grand Cul-de-Sac Marin	*Chelonia mydas*		38.2					61.535331	16.332888		89	T4.2	1
North West Atlantic	Secteur 2 : Basse Terre - Côte sous le vent	*Eretmochelys imbricata*		515.3					61.774859	16.151056		90	T4.2	1
North West Atlantic	Secteur 2 : Basse Terre - Côte sous le vent	*Dermochelys coriacea*		59.6					61.774859	16.151056		90	T4.2	1
North West Atlantic	Secteur 2 : Basse Terre - Côte sous le vent	*Chelonia mydas*		47.9					61.774859	16.151056		90	T4.2	1
North West Atlantic	Secteur 3 : Basse Terre - Côte au vent	*Eretmochelys imbricata*		126.3					61.564317	16.031895		69	T4.2	1
North West Atlantic	Secteur 3 : Basse Terre - Côte au vent	*Dermochelys coriacea*		82.2					61.564317	16.031895		69	T4.2	1

North West Atlantic	Secteur 3 : Basse Terre - Côte au vent	*Chelonia mydas*		22.6					61.564317	16.031895		69	T4.2	1
North West Atlantic	Secteur 4 : Façade littorale nord-est de Grande Terre	*Eretmochelys imbricata*		126.3					61.370591	16.219534		82	T4.2	1
North West Atlantic	Secteur 4 : Façade littorale nord-est de Grande Terre	*Dermochelys coriacea*		0.6					61.370591	16.219534		82	T4.2	1
North West Atlantic	Secteur 4 : Façade littorale nord-est de Grande Terre	*Chelonia mydas*		0.7					61.370591	16.219534		82	T4.2	1
North West Atlantic	Secteur 5 : Façade littorale sud-est de Grande Terre	*Eretmochelys imbricata*		52.5					61.374918	16.340537		67	T4.2	1
North West Atlantic	Secteur 5 : Façade littorale sud-est de Grande Terre	*Dermochelys coriacea*		0.0					61.374918	16.340537		67	T4.2	1
North West Atlantic	Secteur 5 : Façade littorale sud-est de Grande Terre	*Chelonia mydas*		157.8					61.374918	16.340537		67	T4.2	1
North West Atlantic	Secteur 6 : la Désirade et Petite Terre	*Eretmochelys imbricata*		398.7					61.096639	16.289124		100	T4.2	1
North West Atlantic	Secteur 6 : la Désirade et Petite Terre	*Dermochelys coriacea*		42.2					61.096639	16.289124		100	T4.2	1
North West Atlantic	Secteur 6 : la Désirade et Petite Terre	*Chelonia mydas*		701.1					61.096639	16.289124		100	T4.2	1
North West Atlantic	Secteur 7 : Marie-Galante	*Eretmochelys imbricata*		1975.8					61.327570	15.929187		67	T4.2	1

North West Atlantic	Secteur 7 : Marie-Galante	*Dermochelys coriacea*		0.3					61.327 570	15.929 187		67	T4.2	1
North West Atlantic	Secteur 7 : Marie-Galante	*Chelonia mydas*		5.3					61.327 570	15.929 187		67	T4.2	1
North West Atlantic	Secteur 8 : Iles des Sainte	*Eretmochely s imbricata*		32.6					61.603 223	15.929 187		85	T4.2	1
North West Atlantic	Secteur 8 : Iles des Sainte	*Dermochelys coriacea*		0.3					61.603 223	15.853 858		85	T4.2	1
North West Atlantic	Secteur 8 : Iles des Sainte	*Chelonia mydas*		4.3					61.603 223	15.853 858		85	T4.2	1

Table 3. International conventions protecting sea turtles and signed by Guadeloupe.

International Conventions	**Signed**	**Binding**	**Compliance measured and reported**	**Species**	**Conservation actions**	**Relevance to sea turtles**
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under

Convention. CMS instruments can be both binding and non-binding.					conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch*).
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co- operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
Convention of Carthagene (1986)	Y	Y	Y	ALL	A Caribbean agreement for the protection and enhancement of the Caribbean Sea	

Table 4. Projects and databases on sea turtles in Guadeloupe.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)
T4 .1	North West Atlantic	France	Guadeloupe	Base de données de pontes tortues marines de Guadeloupe	Database, crawls, monitoring beaches	2000	still going	Reseau Tortues Marines de Guadeloupe (actually ONF)	Public				Caroline CREMADES, caroline.cremades@onf.fr
T4 .2	North West Atlantic	France	Guadeloupe	Swot database	Nesting Data, crawls	2012	2014	SWOT	Public				

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Guatemala

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Guatemala.

Topics	*E. imbricata*	Ref #	*C. mydas*	Ref #	*C. caretta*	Ref #	*D. coriacea*	Ref #
Occurrence								
Nesting sites	Y	1	n/a		n/a		Y	1
Pelagic foraging grounds	n/a		n/a		n/a		n/a	
Benthic foraging grounds	n/a		n/a		n/a		n/a	
Key biological data								
Nests/yr: recent average (range of years)	5 (hatchery, 2015-2019)	1	n/a		n/a		1 (hatchery, 2011-2019)	
Nests/yr: recent order of magnitude	estimated <10	1	n/a		n/a		estimated <10	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	1		n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a	1	n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	5 (hatchery, 2015-2019)		n/a		n/a		n/a	
Total length of nesting sites (km)	28	1	n/a		n/a		28	1
Nesting females / yr	3		n/a		n/a		1	
Nests / female season (N)	n/a		n/a		n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	n/a		n/a		n/a		n/a	

Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	354 (3, hatchery)	1	n/a		n/a		0 (1, harchery)	1
Emergence success (hatchlings/egg) (N)	122 (3, hatchery)	1	n/a		n/a		0 (1, harchery)	1
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		n/a	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a		n/a	
Published studies								
Growth rates	n/a		n/a		n/a		n/a	
Genetics	n/a		n/a		n/a		n/a	
Stocks defined by genetic markers	n/a		n/a		n/a		n/a	
Remote tracking (satellite or other)	n/a		n/a		n/a		n/a	
Survival rates	n/a		n/a		n/a		n/a	
Population dynamics	n/a		n/a		n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a		n/a		n/a	
Capture-Mark-Recapture	n/a		n/a		n/a		n/a	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y	1	Y	1	Y	1	Y	1
Bycatch: presence of industrial fisheries?	Y		Y		Y		Y	
Bycatch: quantified?	n/a		n/a		n/a		n/a	

Take. Intentional killing or exploitation of turtles	N	1	N		n/a		N	1
Take. Egg poaching	Y	1	Y		Y		Y	1
Coastal Development. Nesting habitat degradation	Y	1	Y		Y		Y	1
Coastal Development. Photopollution	Y	1	Y		Y		Y	1
Coastal Development. Boat strikes	Y	1	Y		Y		Y	1
Egg predation	Y	1	n/a		n/a		Y	1
Pollution (debris, chemical)	Y	1	n/a		n/a		Y	1
Pathogens	n/a		n/a		n/a		n/a	
Climate change	Y		n/a		n/a		Y	
Foraging habitat degradation	Y		n/a		n/a		Y	
Other	n/a		n/a		n/a		n/a	
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	n/a	1	n/a	1	n/a	1	n/a	
Number of index nesting sites	n/a		n/a		n/a		n/a	
Monitoring at foraging sites (period: range of years)	n/a		n/a		n/a		n/a	
Conservation								
Protection under national law	Y	1.2	Y	2,3,4	Y	2,3,4	Y	2,3,4
Number of protected nesting sites (habitat preservation) (% nests)	3	1	3	1	3	1	3	1
Number of Marine Areas with mitigation of threats	n/a		n/a		n/a		n/a	
N of long-term conservation projects (period: range of years)	n/a	2	n/a	2	n/a	2	n/a	2
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a	
Hatcheries	Y	1	n/a		n/a		Y	1
Head-starting	n/a		n/a		n/a		n/a	

By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a	
By-catch: onboard best practices	n/a		n/a		n/a		n/a	
By-catch: spatio-temporal closures/reduction	n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		n/a	

Table 2. Sea turtle nesting beaches in Guatemala.

Nesting beach name	**Index site**	**Species**	**Nests/yr: recent average (range of years)**	**Crawls/yr: recent average (range of years)**	**Western limit**		**Eastern limit**		**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
					Long	**Lat**	**Long**	**Lat**	**Long**	**Lat**					
North West Atlantic	San Francisco del Mar	*Dermochelys coriacea*	<10	<25					-88.435941	15.851389	13	90%	1,2,3,4	2	E
North West Atlantic	Jaloa	*Dermochelys coriacea*	<10	<25					-88.347447	15.804084	13	90%	1,2,3,4	2	E
North West Atlantic	Cabo 3 Puntas	*Dermochelys coriacea*	<10	<25							15	90%	1,2,3,4	2	E

Table 3. International conventions protecting sea turtles and signed by Guatemala.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
Guatemala is currently a signatary of this convention and it has been recently ratified in 2016, however , there is not a depositary governmental organization or focal point at the moment/CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	N	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch*).

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
UNCLOS: The United Nations Convention on the Law of the Sea. Came into force in 1994.	Y	Y	Y	ALL	An international treaty that defines the rights and responsibilities of nations with respect to their use of the world's oceans and establishes guidelines for the management of marine natural resources (Wikipedia, 2015).	Being complicit in marine turtle bycatch contradicts the objectives of UNCLOS. This is especially true in relation to UNCLOS Article 61 concerning the conservation of the living resources in Exclusive Economic Zones (EEZs), and UNCLOS Article 64 concerning highly migratory species in EEZs. Furthermore, relevant Articles under the section Conservation and Management of the Living Resources of the High Seas are Article 116, concerning the right to fish; Article 117, concerning the duty of States to adopt with respect to their nationals measures for the conservation of the living resources of the high seas; Article118, concerning cooperation of States in the conservation and management of living resources and Article 119, concerning conservation of the living resources of the high seas .
Ramsar convention/ The protected area where the nesting beaches are located in the Caribbean is a designated RAMSAR Wetland.	Y	Y	Y	ALL	is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Based on a MOU between IAC and Ramsar, of the Parties to both Conventions in order to identify and strngthen conservation and wise use of Ramsar Sites (https://www.ramsar.org/sites/default/f

						iles/documents/library/mou_seaturtlesconvention_eng_8-7-12.pdf)
Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	Y	Y	Y	ALL	he Convention promotes the protection, conservation and recovery of the populations of sea turtles and those habitats on which they depend, on the basis of the best available data and taking into consideration the environmental, socioeconomic and cultural characteristics of the Parties (Article II, Text of the Convention). These actions should cover both nesting beaches and the Parties' territorial waters.	Is an international initiative with wide collaborative opportunities, and has a froup of experts supporting and directing the actions and strategies that the President of this Conventions promotes.

Table 4. Projects and databases on sea turtles in Guatemala.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	NW-ATL	Guatemala	Punta Manabique	Refugio de Vida Silvestre Punta de Manabique	n/a	n/a	n/a	Consejo Nacional de Áreas Protegidas CONAP	n/a	n/a	n/a	n/a	Airam Andrea López Roulet hidrobiologicosconap@gmail.com	Ana Silvia Morales ansilmo@gmail.com Tannia Paola Sandoval

														tannia_tpsg@ hotmail.com

#	Region / Location	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
T4.1	Punta Manabique	n/a	n/a	San Francisco del Mar, Jaloa, Cabo Tres Puntas	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1,2,3,4

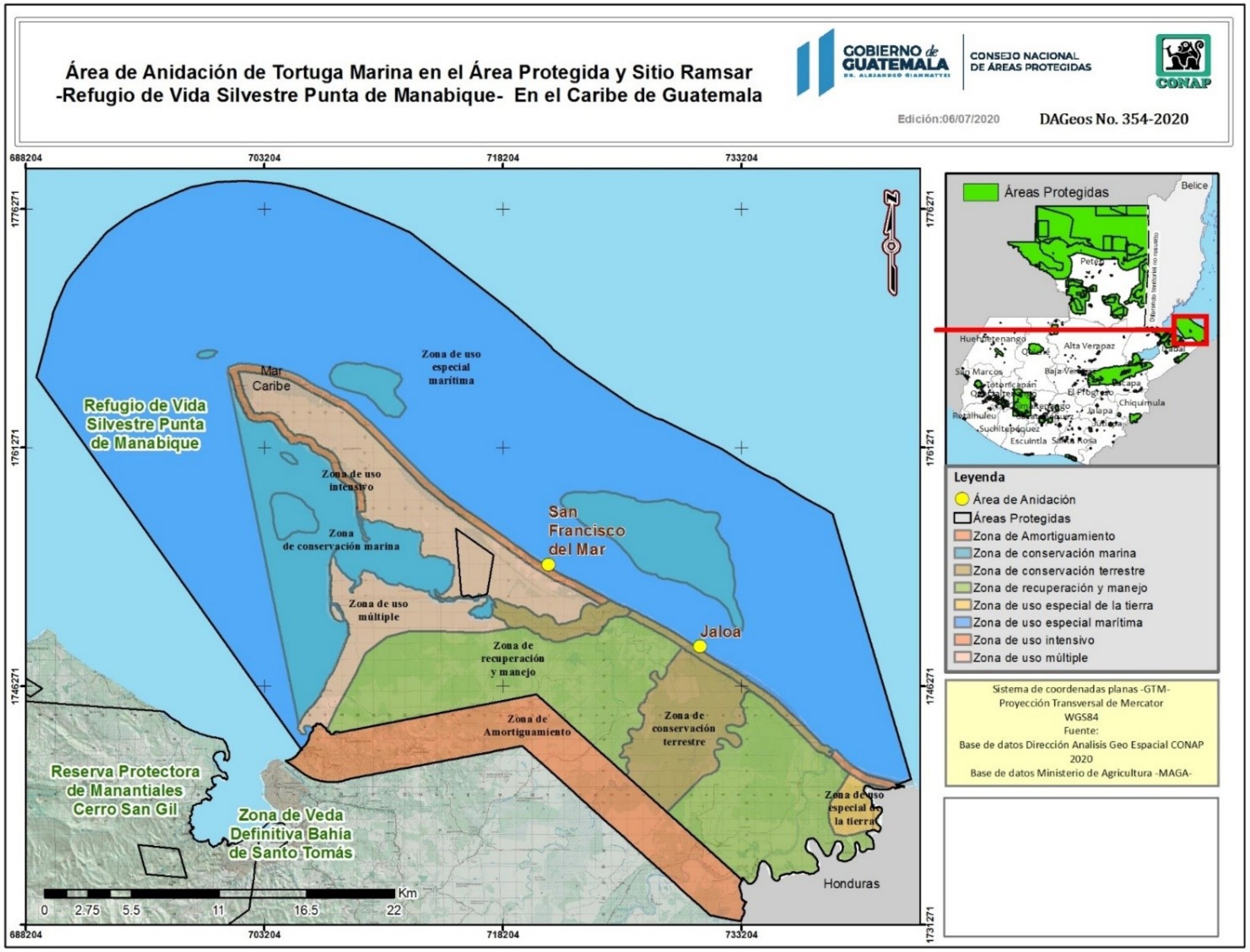

Figure 1. Sea turtle nesting area in the Protected Area and Ramsa site Wildlife Refuge Punta Manabique, Guatemala.

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4 Protegida Refugio de Vida Silvestre Punta de Manabique.

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5 Ratificación de la Convención sobre Especies Migratorias

Martinique

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Martinique.

Topics	***C. mydas***	**Ref #**	***D. coriacea***	**Ref #**	***E. imbricata***	**Ref #**
Occurrence						
Nesting sites	Y	8	Y	8	Y	8
Pelagic foraging grounds	NA		n/a		NA	
Benthic foraging grounds	NA		n/a		NA	
Key biological data						
Nests/yr: recent average (range of years)	n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a	

Nests / female season (N)	n/a		n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	70.00	T 4,1	105 CCL	T 4,1	70 CCL	T 4,1
Age at maturity (yrs)	n/a		n/a		n/a	
Clutch size (n eggs) (N)	110 to 130	6	100	6	110 to 180	6
Emergence success (hatchlings/egg) (N)	n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a	
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a	
Published studies						
Growth rates	Y	5	N		N	
Genetics	Y	10	N	11	Y	12

Stocks defined by genetic markers	Y	10	Y	11	Y	12
Remote tracking (satellite or other)	Y	5	N		Y	3
Survival rates	N		N		N	
Population dynamics	N		N		N	
Foraging ecology (diet or isotopes)	Y	2,3,4,5	N		N	
Capture-Mark-Recapture	Y	3.5	N		Y	3.5
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (SN, FP)	19.2	Y (SN, FP)	19.2	Y (SN, FP)	19.2
Bycatch: presence of industrial fisheries?	N		N		N	
Bycatch: quantified?	500 (SN, FP)	9,19,20	n/a		200 (SN, FP)	9,19,20
Take. Intentional killing or exploitation of turtles	Y	T4.3	n/a		Y	T4.3
Take. Egg poaching	n/a		n/a		n/a	
Coastal Development. Nesting habitat degradation	Y	8	Y	8	Y	8
Coastal Development. Photopollution	Y	8.15	Y	8.15	Y	8.15
Coastal Development. Boat strikes	n/a		n/a		n/a	
Egg predation	Y	21	Y	21	Y	21
Pollution (debris, chemical)	Y	16	Y	16	Y	16

Pathogens	n/a		n/a		n/a	
Climate change	n/a		n/a		n/a	
Foraging habitat degradation	Y	2.5	n/a		n/a	
Other	N		N		N	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (2004-2015)	*T 4.1*	Y (2004-2015)	*T 4.1*	Y (2004-2015)	*T 4.1*
Number of index nesting sites	Y	8	Y	8	Y	8
Monitoring at foraging sites (period: range of years)	Y (2013/2017)	*3.4*	n/a		n/a	
Conservation						
Protection under national law	Y	23	Y	23	Y	23
Number of protected nesting sites (habitat preservation) (% nests)	n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	n/a		n/a		n/a	
N of long-term conservation projects (period: range of years)	>1 (1999-2027)	23	>1 (1999-2027)	23	>1 (1999-2027)	23
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		N		N	

Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other	N		N		N	

Table 2. Sea turtle nesting beaches in Martinque.

Nesting beach name	**Index site**	**Species**	**Nests /yr: recent average (range of years)**	**Crawls/yr: recent average (2011, 2013, 2014)**	**Western limit**		**Eastern limit**		**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**
					Long	Lat	Long	Lat	Long	Lat				
North West Atlantic	Secteur 1 : Le Diamant	*Eretmochelys imbricata*		282.745	2.58				61.030619	14.477817		100	T4.2	1
North West Atlantic	Secteur 1 : Le Diamant	*Dermochelys coriacea*		26.6	2.58				61.030619	14.477817		100	T4.2	1

North West Atlantic	Secteur 1 : Le Diamant	*Chelonia mydas*		9.8	2.58				61.030619	14.477817		100	T4.2	1
North West Atlantic	Secteur 2 : Le Prêcheur-Anse à Voile	*Eretmochelys imbricata*		155.7	0.25				61.215379	14.847575		100	T4.2	1
North West Atlantic	Secteur 2 : Le Prêcheur-Anse à Voile	*Dermochelys coriacea*		33.6	0.25				61.215379	14.847575		100	T4.2	1
North West Atlantic	Secteur 3 : Le Prêcheur-Anse Lévrier	*Eretmochelys imbricata*		200.2	0.19				61.218319	14.845833		100	T4.2	1
North West Atlantic	Secteur 3 : Le Prêcheur-Anse Lévrier	*Dermochelys coriacea*		21.3	0.19				61.218319	14.845833		100	T4.2	1
North West Atlantic	Secteur 3 : Le Prêcheur-Anse Lévrier	*Chelonia mydas*		21.5	0.19				61.218319	14.845833		100	T4.2	1
North West Atlantic	Secteur 4 : Lorrain-Crabière	*Eretmochelys imbricata*		84.7	0.25				61.062900	14.839132		100	T4.2	1
North West Atlantic	Secteur 4 : Lorrain-Crabière	*Dermochelys coriacea*		200.5	0.25				61.062900	14.839132		100	T4.2	1
North West Atlantic	Secteur 5 : Lorrain-Grande Anse Lorrain	*Eretmochelys imbricata*		39.8	0.93				61.059124	14.835802		100	T4.2	1

North West Atlantic	Secteur 5 : Lorrain-Grande Anse Lorrain	*Dermochelys coriacea*		107.5	0.93				61.059124	14.835802		100	T4.2	1
North West Atlantic	Secteur 6 : Sainte-Marie Anse Charpentier	*Eretmochelys imbricata*		20.18	0.35				61.018503	14.809475		100	T4.2	1
North West Atlantic	Secteur 6: Sainte-Marie Anse Charpentier	*Dermochelys coriacea*		145.0	0.35				61.018503	14.809475		100	T4.2	1
North West Atlantic	Secteur 7 :Sainte-Anne Anse-à-Prune	*Eretmochelys imbricata*		94.4	0.51				60.865665	14.396859		100	T4.2	1
North West Atlantic	Secteur 7 :Sainte-Anne Anse-à-Prune	*Dermochelys coriacea*		110.3	0.51				60.865665	14.396859		100	T4.2	1
North West Atlantic	Secteur 8: Sainte-Anne Anse Four à Chaux	*Eretmochelys imbricata*		200.5	0.36				60.813481	14.475579		100	T4.2	1
North West Atlantic	Secteur 8 : Sainte-Anne Anse Four à Chaux	*Dermochelys coriacea*		79.3	0.36				60.813481	14.475579		100	T4.2	1
North West Atlantic	Secteur 9 : Sainte-Anne Anse Grosse Roche	*Eretmochelys imbricata*		113.915	0.92				60.813505	14.483792		100	T4.2	1
North West Atlantic	Secteur 9 : Sainte-Anne Anse Grosse Roche	*Dermochelys coriacea*		252.385	0.92				60.813505	14.483792		100	T4.2	1

North West Atlantic	Secteur 10 : Sainte-Anne Anse Meunier	*Eretmochelys imbricata*		45.115	0.8				60.885675	14.413924		100	T4.2	1
North West Atlantic	Secteur 10 : Sainte-Anne Anse Meunier	*Dermochelys coriacea*		45.395	0.8				60.885675	14.413924		100	T4.2	1
North West Atlantic	Secteur 10 : Sainte-Anne Anse Meunier	*Chelonia mydas*		4.61	0.8				60.885675	14.413924		100	T4.2	1
North West Atlantic	Secteur 11 : Sainte-Anne Anse Trabaud	*Eretmochelys imbricata*		220.48	1.5				60.849511	14.410617		100	T4.2	1
North West Atlantic	Secteur 11 : Sainte-Anne Anse Trabaud	*Dermochelys coriacea*		113.29	1.5				60.849511	14.410617		100	T4.2	1
North West Atlantic	Secteur 12: Sainte-Anne Grande Terre	*Eretmochelys imbricata*		325.7	0.56				60.871888	14.396360		100	T4.2	1
North West Atlantic	Secteur 12: Sainte-Anne Grande Terre	*Dermochelys coriacea*		116.0	0.56				60.871888	14.396360		100	T4.2	1
North West Atlantic	Secteur 13 : Sainte-Anne Grande Anse Salines	*Dermochelys coriacea*		150	1.3				60.878734	14.403352		100	T4.2	1
North West Atlantic	Secteur 13 : Sainte-Anne Grande Anse Salines	*Eretmochelys imbricata*		150	1.3				60.878734	14.403352		100	T4.2	1

North West Atlantic	Secteur 14 : Vauclin Grand Macabout	*Eretmochelys imbricata*		25.9	1.47				60.823730	14.497353		100	T4.2	1
North West Atlantic	Secteur 14 : Vauclin Grand Macabout	*Dermochelys coriacea*		268.46	1.47				60.823730	14.497353		100	T4.2	1

Table 3. International conventions protecting sea turtles and signed by Martinque.

International Conventions	**Signed**	**Binding**	**Compliance measured and reported**	**Species**	**Conservation actions**	**Relevance to sea turtles**
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the

can be both binding and non-binding.					appropriate and necessary steps to conserve such species and their habitat.	Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch).*
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co- operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
Convention of Carthagene (1986)	Y	Y	Y	ALL	A Caribbean agreement for the protection and enhancement of the Caribbean Sea	

Table 4. Projects and databases on sea turtles in Martinque.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private	Primary Contact (name and Email)
T4.1		France	Martinique	Base de données de pontes tortues marines de Martinique	Database, crawls, monitoring beaches	2004	2015	Reseau Tortues Marines de Martinique (actually ONF)	Public	Caroline CREMADES, caroline.cremades@onf.fr
T4.2		France	Martinique	Swot database	Nesting Data, crawls	2011	2014	SWOT	Public	
T4.3		France	Martinique	tableau récapitulatif des menaces avérées entre 2004 et 2015	poaching, predation, disturbance, crawls	2004	2015	ONCFS	Public	

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Madeira

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1.1. Distribution, abundance, trends (Caretta caretta) – Northwest Atlantic

1.1.1. Nesting sites

There are no sea turtle nesting sites on the coastlines of the Madeira Autonomous Region, which includes the Madeira Archipelago with the islands of Madeira, Porto Santo and Desertas, as well as the Selvagens Archipelago.

1.1.2. Marine areas

The waters of the Madeira Autonomous Region include the Madeira Exclusive Economic Zone (EEZ) also named Subarea Madeira of the Portuguese EEZ. The area includes important seamounts that are fished by local artisanal fisheries, mainly longline (Fig. 1).

Since satellite telemetry did not find any migration corridors or preferential area , we have use a relative abundance index based on a adapted capture by unit effort index to access relative in-water abundance and temporal trends thereof. We use coastal based nautical whale watching operations as platforms of opportunity and ask them to quantify the number of turtles sighted per hour at sea. The time series covers the period from 2007 till today and shows clear abundance3 variations over time. Neithe US nesting data nor NAO index seem to clearly explain the variation, except for the steep decline in 2020 which is a result of basically no sampling effort because of the pandemic (Fig. 2)-

1.2. Other biological data (*Caretta caretta*)

Data have been collected on migratory behavior using satellite telemetry, diving behavior using time-depth-recorders, on age and growth using skeletochronology, on sex ration via hormonal assay and laparoscopy, on diet via stomach lavage and necropsies, and on epibionts (see Tab. 1 and references within). See Table 1.

1.3. Threats (*Caretta caretta*)

1.3.2. Marine areas

In Madeiran waters the main threats are accidental capture by longline fishing operations (Fig. 3), persistent debris pollution that gets ingested or where turtles get entangled, and a few boat strikes.

Strandings are recorded and kept in a database but not yet quantitively evaluated. However, turtle behavior seems to have changed since during the last 5 years they are approaching the shoreline more, and a few get hooked by coastal sports fishermen. During the years before turtles were rarely seem close to shore and could mostly be observed starting at distances of 3nm offshore.

Since the Madeiran longline operations fish at depth of around 1000m, and have soaking times in excess of 16 hours, most turtles captured are killed.

1.4. Conservation (*Caretta caretta*)

See Table 3.

Madeira has no dedicated rtecovery facility. The local Government has set up a stranding network hotline that coordinates and reports strandings and other events to local NGO's. For turtles no NGO or rescue centre exists. The University of Madeira and the author have gratuitously assumed this role but had to resort to crowd funding to cover medical expenses.

Immediate conservation priorities are 1) to find funding to start a dedicated recovery facility, since around 8 turtles are received every year, sometimes more; 2) start a bycatch mitigation project to find ways to reduce longline bycatch without reducing the target species capture; 3) reduce persistent debris pollution through education of the local population; 4) redo satellite tracking studies with more individuals and better oceanographic remote sensing data to address habitat usage in greater detail

1.5. Research (*Caretta caretta*)

The data on the relative abundance index must be published, as does the bycatch data. A paper is almost ready for submission on ingested plastic found during necropsies. See Table 4.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Madeira.

Topic	*C. caretta*	Ref #	*C. mydas*
Occurrence			
Nesting sites	N		N
Oceanic foraging areas	Y		N
Neritic foraging areas	N		Y
Key biological data			
Nests/yr: recent average (range of years)	n/a		n/a
Nests/yr: recent order of magnitude	n/a		n/a
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/a		n/a
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a
Total length of nesting sites (km)	n/a		n/a
Nesting females / yr	n/a		n/a
Nests / female season (N)	n/a		n/a

Female remigration interval (yrs) (N)	n/a		n/a
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a
Sex ratio: Immatures (F / Tot) (N)	´2/1	1	n/a
Sex ratio: Adults (F / Tot) (N)	n/a		n/a
Min adult size, CCL or SCL (cm)	n/a		n/a
Age at maturity (yrs)	n/a		n/a
Clutch size (n eggs) (N)	n/a		n/a
Emergence success (hatchlings/egg) (N)	n/a		n/a
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a
Trends			
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a
Recent trends (last 20 yrs) at foraging grounds (range of years)	Stable (iii)		n/a
Oldest documented abundance: nests/yr (range of years)	n/a		n/a
Published studies			
Growth rates	Y	3,4,5,6,7	n/a
Genetics	Y	5,8,9,10	n/a
Stocks defined by genetic markers	Y	8,9,10	n/a
Remote tracking (satellite or other)	Y	11,12,13,21,25,26	n/a
Survival rates	Y	14,15	n/a
Population dynamics	Y	1,5,6,7,9,16	n/a

Foraging ecology	Y	7,11,12,13,17,18,19,20, 21,22,23,27,32,33	n/a
Capture-Mark-Recapture	N		n/a
Threats			
Bycatch: presence of small scale / artisanal fisheries?	N	19,21,27,28,29,30,34	n/a
Bycatch: presence of industrial fisheries?	Y (PLL, DLL)	24,25	n/a
Bycatch: quantified?	Y	27,28,29,30	n/a
Intentional killing of turtles	N		n/a
Take. Illegal take of turtles	N		n/a
Take. Permitted/legal take of turtles	N		n/a
Take. Illegal take of eggs	N		n/a
Take. Permitted/legal take of eggs	N		n/a
Coastal Development. Nesting habitat degradation	N		Y
Coastal Development. Photopollution	N		n/a
Coastal Development. Boat strikes	Y		Y
Egg predation	N		n/a
Pollution (debris, chemical)	Y	in prep, 23, 31,32, 33,34	Y
Pathogens	N		n/a
Climate change	N		n/a
Foraging habitat degradation	Y	23	Y
Other	N		Tourism

Long-term projects (>5yrs)			
Monitoring at nesting sites (period: range of years)	N		N
Number of index nesting sites	N		N
Monitoring at foraging sites (period: range of years)	Y(2007-present)	in prep	N
			N
Conservation			N
Protection under national law	Y		Y
Number of protected nesting sites (habitat preservation) (% nests)	N		N
Number of Marine Areas with mitigation of threats	n/a		N
N of long-term conservation projects (period: range of years)	N		N
In-situ nest protection (eg cages)	n/a		N
Hatcheries	n/a		N
Head-starting	n/a		N
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N
By-catch: onboard best practices	N		N
By-catch: spatio-temporal closures/reduction	N		N
Other	N		N

Table 3. International conventions protecting sea turtles and signed by Portugal (Madeira)

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992)	Y	Y	Y	*C. caretta*	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992)
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binfind and non-binding	Y	Y	Y	*C. caretta*	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. CMS has a specific resolution on bycatch datailing various actions needed to reduce bycatch of migratory species that will include marine turtles (UNEP/CMS/Resolution 9.18 on Bycatch)

Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	*C. caretta*	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species.
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	Y	Y	Y	*C. caretta*	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival	All seven species listed in Appendix I of CITES
UNFSA: United Nations Fish Stock Agreement. Known formally as the Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.	Y	Y	Y	*C. caretta*	A legal regime for the long-term conservation and sustainable use of straddling and highly migratory fish stocks (i.e. addressing problems related to the management of high seas fish stocks).	Ratified by 81 states and the European Union. Mentions a range of problems, including those related to unselective fishing gear. Elaborates on the fundamental principle that countries should, inter alia, cooperate to ensure conservation. Most shrimp are trawled within EEZs, though in those instances where tropical shrimp may be caught outside of EEZs, or where there are straddling stocks (i.e stocks that migrate through, or occur in, more than one EEZ), UNFSA will have a bearing on the EU's involvement in such cases.

Regional Fisheries Management Organisations (RFMOs) and Regional Fisheries Bodies (RFBs).	Y	Y	Y	*C. caretta*	The EU is party to numerous RFMOs and RFBs that although not classed as global agreements are considered as binding multilateral agreements.	The main relevance has to do with the EU's Common Fisheries Policy (CFP) - the framework that establishes the rules that govern how the shared fish stocks within European Union water are managed. The CFP now includes na external dimension establishing the standards by which EU vesses should adhere to when fishing outside of EU waters. The relevance of the CFP to this is detailed in section 6.1
Marine Strategy Framework Directive (2008).	Y	Y	Y	*C. caretta*	This Directive leads European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	This species of marine turtles is considered as an indicator of MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 4. Projects and databases on sea turtles in Madeira.

#	Country	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public / Private	Collaboration with	Primary Contact (name and Email)
T4.1	Portugal	Conservation support project for North Atlantic Caretta caretta* sea turtles - Life Nature Project contract no. B4-3200/96/541 (Life96Nat/P/3019)	Conservation project	1997	1999	UMa	Public	CMF	thomas.dellinger@staff.uma.pt

T4.2	Portugal	Diving behaviour of juvenile loggerhead sea turtles (Caretta caretta) and its relation to deep-sea longline fishing, in Madeiran Waters (PDCTM/P/MAR/15248/1999 & PDCTM-POCTI/P/MAR/15248/1999)	Conservation project	2001	2005	UMa	Public		thomas.dellinger@staff.uma.pt
T4.3	Portugal	Trophic ecology and population structure of juvenile, pelagic stage loggerhead sea turtles (Caretta caretta) in the North Atlantic Ocean (Praxis/P/BIA/11310/1998 and POCTI/P/BIA/11310/2001)	Conservation project	1999	2002	UMa	Public		thomas.dellinger@staff.uma.pt
T4.4	Portugal	Madeira Turtle Project	Conservation project	1994	present	UMa	Public		thomas.dellinger@staff.uma.pt

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
T4.1	N					Y	Y	N	Y	Y	11,12,13,25

T4.2	N							N	Y		
T4.3	N							N	Y		
T4.4	N			2007	present			N	Y		

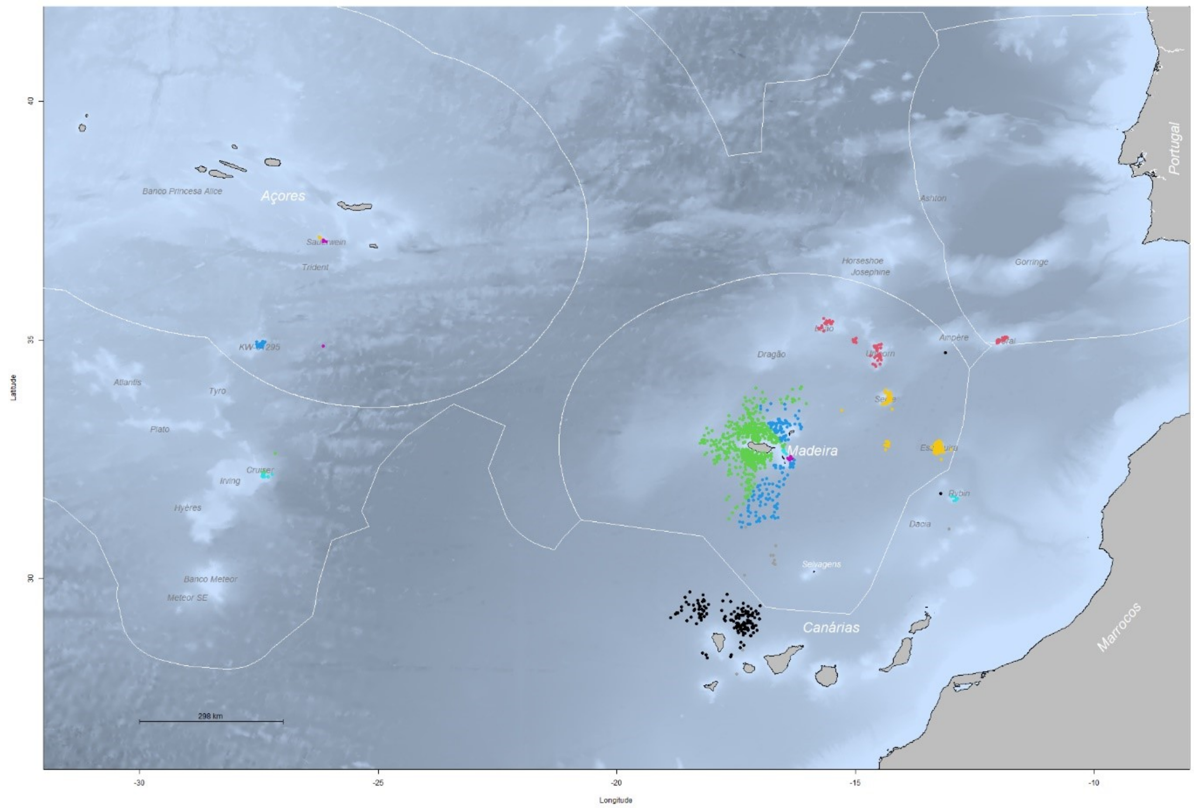

Figure 1. Black-scabbard-fish longline fishing locations used in 2019-20 showing the Portuguese Exclusive Economic Subareas and the main seamounts. These fishing operations crete most turtle bycatch (from Duarte 2021).

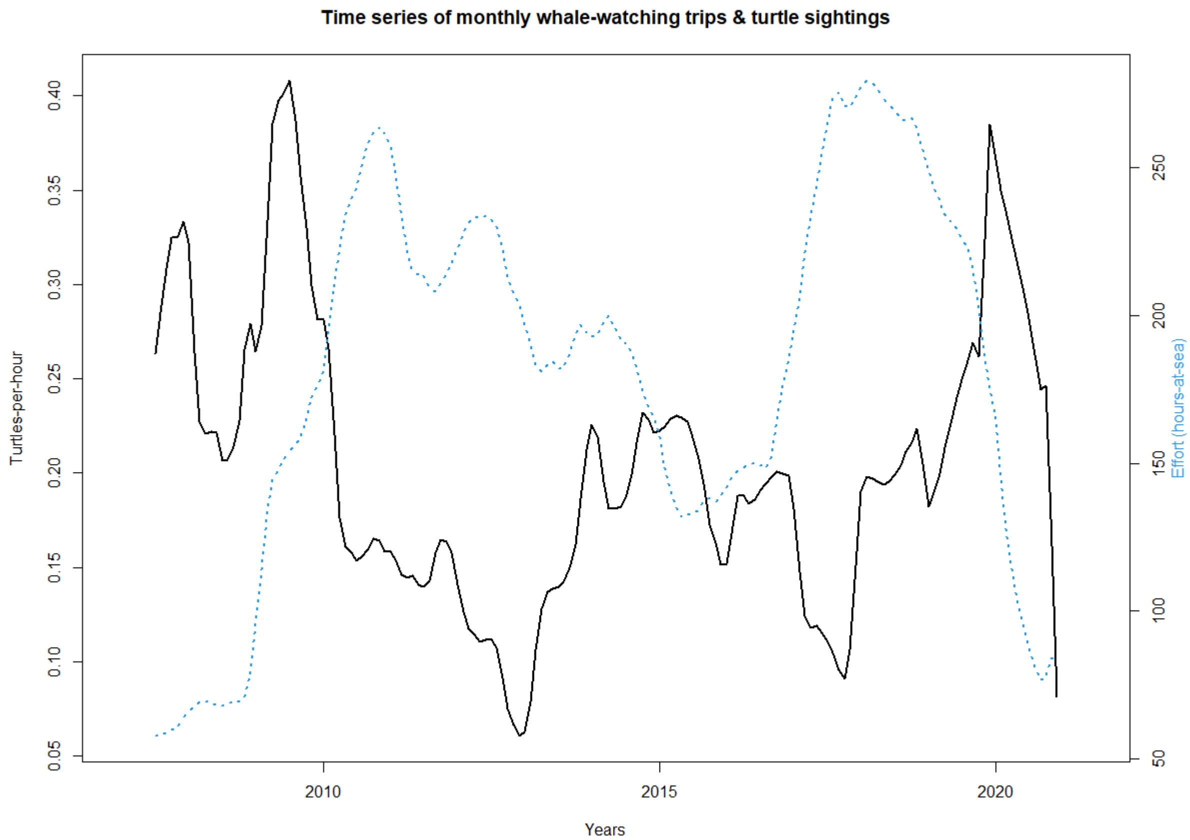

Figure 2. Turtle sightings around Madeira Island by the whale watching industry. Shown are the cumulative hours at sea as a effort measure, and the number of turtles sighted per hour as a relative abundance index. The time series is based on 10 day blocks covering 2007 to the present. Effort and sightings do not correlate.

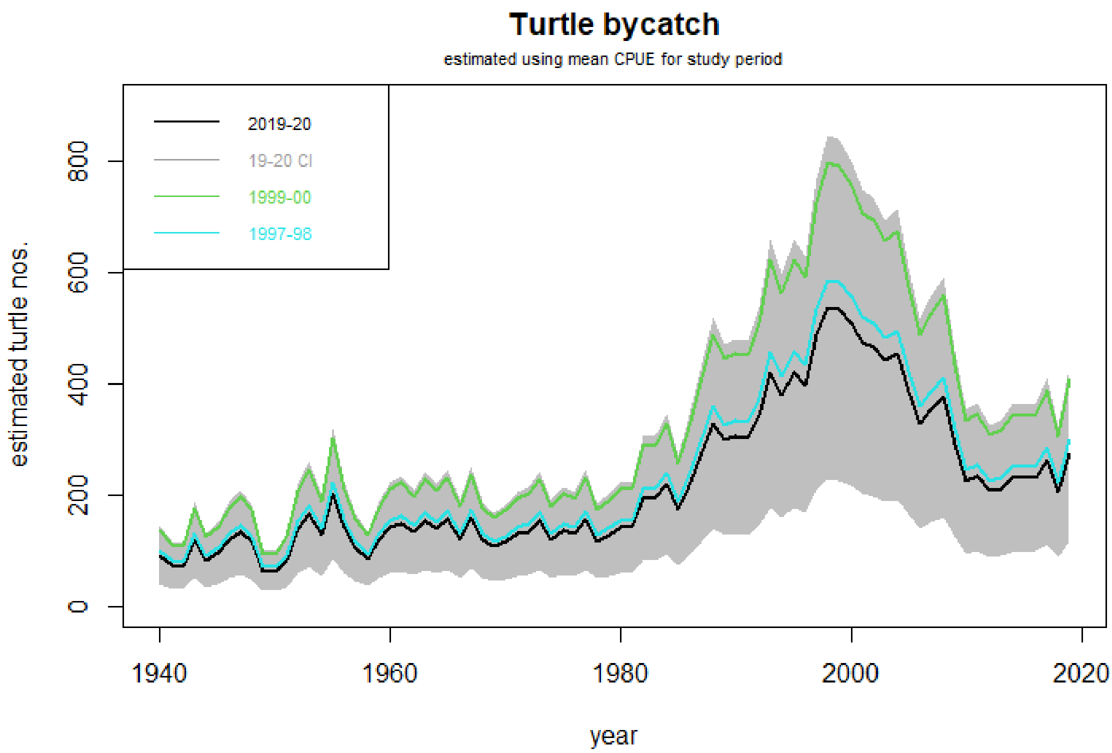

Figure 3. Estimated number of turtles captured by the black-scabbard fish longline fishery around Madeira, based on CPUE values measured as turtles captured by ton of black-scabbard fish landed at different 3 times and back-calculated over all landings (CI=95% confidence interval; form Duarte 2021).

Mexico

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1. Distribution, abundance, trends – Northwest Atlantic

1.1. Nesting sites.

In this Regional Management Unit (RMU) we have nesting activity of hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) (1, 2, 36, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 40, 41, 42, 43, 44, 45, 52, 53, 58, 59).

The nesting beaches are located all over the Mexican littoral in the Gulf of Mexico (GoM) and Caribbean Sea (Table 1), with hawksbills presenting the highest nesting intensity in the Yucatan Peninsula (Figure 1a), the of Kemp's ridleys in northwestern GoM (Figure 1b), greens having the widest distribution in the GoM and Caribbean (Figure 1c), and loggerheads mainly restricted to the Caribbean Sea (Figre 1d).

Western GoM is underrepresented in these maps, there are very important Kemp's Ridley and green turtles nesting beaches, as well as some peculiar hawksbill nesting zones in islands of a reef system in front of Veracruz, and minor nesting beaches for this same species in the south-central littoral in GoM.

Some of the nesting beaches in the map are considered Index nesting beaches in the region, representing general trends for these species in Mexico. The range of crawl/year activity in the region is highly variable, going from 25 to more than 1,500, and in the case of Kemp's Ridley to even more than 15,000 crawls/yr (Table 1).

Also, the length of the nesting beaches is highly variable, going from some hundreds of meters to several dozens of kilometers, but all of them with Monitoring level 1, and protocol B.

Regarding the abundances of nesting females, the smallest number is for hawksbill turtles with some more individuals than 1,000 each year in the past 21 years for all this RMU, the green turtle rookeries are the next with more than 4,000 individuals per year, and the highest number is of course the Kemp's Ridley nesting populations up to 5,000 individuals per year in the whole RMU (Table 2).

After almost three decades of nesting beach monitoring and conservation efforts, almost the four species present clear increasing trends. In a long term period of evaluation (20 years) the trend of the number of registered nests for hawksbill turtles is slightly down (8,9,10,11,12,13,14,15,16,17,18), it is going up for Kemp's

Ridleys (36,37), up (≈19%) for green turtles (8,9,10,11,12,13,14,15,16,17,18,40,41,42,43,44,45,61,62,63,64), and also going up (≈6.7%) for loggerhead turtles (40,41,42,43,44,45,61,62,63,64,65,66).

1.1.2. Marine areas.

Derived from several satellite tracking projects for the four-dominant species in this RMU, the main feeding and migratory grounds for post-nesting individuals are well known (Figure 2). There is a close link between north and south Gulf of Mexico, particularly between the peninsulas of Florida and Yucatan, sharing important nesting rookeries.

There is also a reported link between the nesting beaches inside the Mexican littoral of the GoM and some feeding grounds in the Caribbean, fact that supports the need of multinational conservation efforts for restoring these populations.

As in many parts of the world, the costs of doing in-water monitoring and research are higher than those for the nesting beaches, provoking big information gaps for the marine life stages and for their habitats.

1.2. Other biological data

Some key information for population recovery is the success of incubation periods, with reported values of emergence success for hawksbills close to 78% (8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18), 57% for Kemp´s Ridley (36), 80% for green turtles (8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 40, 41, 42, 43, 44, 45), and 82% for loggerheads (54).

1.3. Threats.

1.3.1. Nesting sites.

1.3.2. Marine areas.

In land, one of the main threats to sea turtles and their habitats in Mexico is the coastal development, including all the variants and different factors associated with it. It is the result of gaps in federal laws, as well as a lack of a strategic planning for urbanization that considers the natural capital in our country. And in-water, one of the main threats is the bycatch, there are illegal fishing gears that are used close to sea turtle aggregations (feeding and reproductive) and every year cause hundreds of dead in this region.

1.4. Conservation

The four species have shown in different moments their resilience for recovery in the long term, and there are now several indicators suggesting that the conservation efforts that have been continuously implemented to protect nesting beaches and hatchlings are the reason why populations such as the green turtles are exponentially increasing in this RMU.

Mexico has already signed different international conventions to protect the sea turtles, banning their hunting and contributing to diminish the pressures over their critical habitats through distinct strategies (Table 4).

Besides these conventions and legal tools, sea turtles in Mexico are protected by two laws, the Mexican Official Norms 059 and 162 by the Ministry of Environment and Natural Resources (SEMARNAT in Spanish). The first one lists all the flora and fauna species considered endangered in Mexico, and it is the key law for endangered species protection.

In the other hand, the Norm 162 specifies the technical criteria that must be complained about sea turtle beach monitoring and how guided visits to nesting beaches must be done. This is a law that was born to standardize and regulate the conservation and protection activities that are done for sea turtle recovery in Mexico.

Regarding the conservation programs, the Sea Turtle Conservation Program in Mexico has recently achieved 50 years of continuous activities. The Mexican littoral where sea turtles nest, as well as the in-water where they stay, are monitored and studied by dozens, or maybe hundreds, of projects that have contributed from different points of view to build these half century of conservation actions in this RMU.

In terms of conservation priorities, the Federal Government, through different strategies for bringing together all the stakeholders that collaborate in sea turtle conservation, built the Action Programs for Species Conservation (PACE in Spanish), equivalent to a national recovery strategy, and every sea turtle species (6) in Mexico has its own instrument.

In these documents the participants who contributed to build them identified several actions to implement in terms of knowledge, management, restoration, protection, culture, lobbying, and climate change. These documents are the nowadays reference for priorities in sea turtle restoration in Mexico.

1.5. Research

The conservation projects in the Mexican territory in this RMU do big efforts to publish and make public all the knowledge regarding sea turtles and their habitat in this region. However, as most of the projects that collect the data needed for generating the information are not run by scientific entities, and the resources are scarce, the scientific research is not the main priority in the sea turtle conservation programs, and in several cases, it is not even a priority for many national and international funding agencies.

With this said, the research that is done in the Mexican territory very frequently comes from opportunities with students to attend some of the information gaps, which are a lot, using the resources implemented for conserving, managing or monitoring the sea turtle populations and their habitats.

However, with huge efforts and very productive and strong alliances with national and international partners, in this RMU we have research efforts and publications regarding growth rates (4, 46, 47, 56), genetics (21, 22, 48, 49), stocks defined by genetic markers (22, 49), remote tracking (23, 24, 50, 51), population dynamics (25), foraging ecology (), capture-mark-recapture (25, 38), among others.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Mexico.

Topic	*Eretmochelys imbricata*	Ref #	*Lepidochelys kempii*	Ref #	*Chelonia mydas*	Ref #	*Caretta caretta*	Ref #	*Dermochelys coriácea*
Occurrence									
Nesting sites	Y	1,2	Y	36	Y	8,9,10,11,12,13, 14,15,16,17,18,40, 41,42,43,44,45,58	Y	52,53,58,59	Y
Pelagic foraging grounds	Y	3	Y		n/a		n/a	52,53	Y
Benthic foraging grounds	Y	4,5,6,7, 7a	Y		Y	46	Y	46	N
Key biological data									
Nests/yr: recent average (range of years)	3578 (1995-2016)	8,9,10,11,12, 13, 14,15,16,17, 18	12000 (2009-2015)	36	13505 (2000-2016)	8,9,10,11,12,13, 14,15,16,17,18,40 ,41,42,43,44,45,61, 62,63,64,65,66	1713 (2000-2016)	40,41,42, 43,44, 45,61,62, 63,64, 65,66	n/a
Nests/yr: recent order of magnitude	>500	8,9,10,11, 12,13, 14,15,16, 17,18			>3500 (2000-2016)		1713 (2000-2016)		<20
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	5	8	3	37	14		8		<10
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	6	8	7	37	4				5
Nests/yr at "major" sites: recent average (range of years)	500		12000 (2009-2015)		>3,500		184.5 (2000-2016)		n/a

Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		<50		n/a		n/a
Total length of nesting sites (km)	275	8	212	36,37	160	8,9,10,11,12, 13,14, 15,16,17,18, 40,41,42, 43,44,45,61, 62,63,64,65,66	30	40,41,42, 43,44,45,61, 62,63,64, 65,66	n/a
Nesting females / yr	>1000 (1995-2016)	8	5000	37	4220	8,9,10,11,12,13, 14,15,16,17, 18,40,41, 42,43,44,45	n/a		n/a
Nests / female season (N)	2.5 (>500)	8,19	2	37	3.85 (>2000)	8,9,10,11,12, 38,57,60	2.33	52,54,57	n/a
Female remigration interval (yrs) (N)	3.21 (>500)	8,19	n/a		2.27 (>500)	38	2.63	52	n/a
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a
Sex ratio: Immatures (F / Tot) (N)	60M:40F (102)	20	n/a		n/a		n/a		n/a
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a
Min adult size, CCL or SCL (cm)	89.95 CCL	20.00	63.5 CCL	37.00	108.01 SCL	39	n/a		n/a
Age at maturity (yrs)	15-20yr	20	14-25	36,37,67	14-25yr	39	n/a		n/a
Clutch size (n eggs) (N)	138.78 (>1000)	19,20	95(xxx)	37	108.86 (>1000)	8,9,10,11,12,13, 14,15,16,17, 18,40,41,42, 43,44,45,61, 62,63,64,65,66	109.86	40,41,42, 43,44,45,54	n/a
Emergence success (hatchlings/egg) (N)	78.35 (>3000) (2006-2016)	8,9,10,11, 12,13, 14,15,16, 17,18	0.57 (10560)	36	80.62 (>1000)	8,9,10,11,12,13, 14,15,16,17,18,40, 41,42,43,44,45	81.98	54	<40%

Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		n/a		n/a
Trends									
Recent trends (last 20 yrs) at nesting sites (range of years)	Slightly Down (1995-2016)	8,9,10,11, 12,13, 14,15,16, 17,18	Up (1995-2015)	36,37	Up ≈19% (2000-2016)	8,9,10,11,12,13, 14,15,16,17, 18,40,41,42, 43,44,45,61,62, 63,64,65,66	Up ≈6.7% (2000-2016)	40,41,42, 43,44,45,61, 62,63,64, 65,66	n/a
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a		n/a
Oldest documented abundance: nests/yr (range of years)									n/a
Published studies									
Growth rates	Y	4	Y		Y	46,47,56	N		n/a
Genetics	Y	21,22	N		Y	48,49	Y		n/a
Stocks defined by genetic markers	Y	22	N		Y	49	n/a		n/a
Remote tracking (satellite or other)	Y	23,24	Y		Y	50,51	Y	53	n/a
Survival rates	N		N		N		N		n/a
Population dynamics	Y	25	N		Y		Y		n/a
Foraging ecology (diet or isotopes)	Y		Y		Y		N		n/a
Capture-Mark-Recapture	Y	25	Y		Y	38	Y		n/a
Threats									
Bycatch: presence of small scale / artisanal fisheries?	Y (PLL, DLL, SN, FP)	26	Y (SN, ST)	37	Y (PLL, DLL, SN, FP)	26	Y		Y

Bycatch: presence of industrial fisheries?	Y (PLL, DLL, ST, MT, FP)	27	Y (ST)	37	Y (PLL, DLL, ST, MT, FP)	26	N		N
Bycatch: quantified?	Y	26	Y		Y	26	Y		N
Take. Intentional killing or exploitation of turtles	Y		Y		Y		Y	54	N
Take. Egg poaching	Y	8,9,10,11,12	Y	37	Y		Y		N
Coastal Development. Nesting habitat degradation	Y	8,9,10,11, 12,28	Y		Y		Y		Y
Coastal Development. Photopollution	Y	29	Y		Y		Y		Y
Coastal Development. Boat strikes	Y		Y		Y		Y		Y
Egg predation	Y	8,9,10, 11,12	Y		Y		Y		N
Pollution (debris, chemical)	Y	29,30,31,32	Y	37	Y		Y		Y
Pathogens	Y	33	n/a		Y		Y		n/a
Climate change	Y	34,35	Y	37	Y		Y		Y
Foraging habitat degradation	n/a		n/a		Y		n/a		n/a
Other	n/a		n/a		n/a		n/a		n/a
Long-term projects (>5yrs)									
Monitoring at nesting sites (period: range of years)	Y (1988-ongoing)		Y (1977-ongoing)		Y (1988-ongoing)	8,9,10,11,12,13, 14,15,16,17,18,40, 41,42,43,44,45	Y (1988-ongoing)		n/a
Number of index nesting sites	9		6	36	13		8		n/a
Monitoring at foraging sites (period: range of years)	Y (2001-ongoing)		N		Y (2001-ongoing)	46	Y		n/a

Conservation									
Protection under national law	Y		Y		Y		Y		Y
Number of protected nesting sites (habitat preservation) (% nests)	MAIN NESTING SITE PROTECTED		50		n/a		n/a		n/a
Number of Marine Areas with mitigation of threats			0		n/a		n/a		n/a
N of long-term conservation projects (period: range of years)	>5 (1990-ongoing)		1 (1975-2011)		>5 (1990-ongoing)		>10 (1990-ongoing)		n/a
In-situ nest protection (eg cages)	Y		Y	36	Y		Y		Y
Hatcheries	Y		Y	36	Y		Y		Y
Head-starting	N		N	36	Y		N		N
By-catch: fishing gear modifications (eg, TED, circle hooks)	Y		Y	37	Y		Y		Y
By-catch: onboard best practices	Y		Y		Y		N		N
By-catch: spatio-temporal closures/reduction	Y		Y		Y		Y		Y
Other	n/a				n/a		n/a		n/a

Table 2. Sea turtle nesting beaches in Mexico

Four species (*L. kempii* (Lk), *E. imbricata* (Ei), *C. mydas* (Cm), *C. caretta* (Cc)) in the Mexican littoral in the Gulf of Mexico and Caribbean Sea.

We also include the length of the beaches, the coordinates and the monitoring level and protocol implemented.

Nesting beach name	**Index site**	**Average number of Crawls per year**				**Central point**		**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
		Lk	**Ei**	**Cm**	**Cc**							
LK-NW-ATL						Long	Lat					
Rancho Nuevo	Y	>10000				-97.7703	23.3332	30	100	36	1	B
Barra del Tordo	Y	>1500				-97.83755	23.055269	45	100	36	1	B
Altamira	Y	>750				-97.840297	22.6705944	19	100	36	1	B
Miramar	Y	>500				-97.856527	22.49375	20	100	36	1	B
EI-NW ATL												
San Lorenzo	Y		100-300			-90.453814	20.702917	1.8	100	8	1	B
Punta Xen			1001-1500			-90.845167	19.232956	30	100	8	1	B
Chenkan	Y		501-1000			-91.013167	19.107806	18	100	8	1	B
Sabancuy			301-500			-91.188833	18.991528	24.5	100	8	1	B
Isla Aguada	Y		301-501			-91.466387	18.792072	28.2	100	8	1	B
Chacahito			50-100			-91.419386	18.524425	9	100	8	1	E

Xicalango			50-101			-91.9167	18.6489	9	100	8	1	E
Victoria			50-102			-91.625689	18.446986	14	100	8	1	E
Celestun	Y		100-300			-90.39771	20.86853	24	100	13,14,15,16,17,18	1	B
Las Coloradas	Y		501-1000			-87.94328	21.60462	21.5	100	13,14,15,16,17,18	1	B
El Cuyo	Y		501-1000			-87.67949	21.51783	25	100	13,14,15,16,17,18	1	B
Holbox	Y		1001-1500			-87.34255	21.563952	24	100	13,14,15,16,17,18	1	B
CM-NW-ATL												
Chenkan	Y			25-50		-91.013167	19.107806	18	100	8	1	B
Sabancuy				1001-1500		-91.188833	18.991528	24.5	100	8	1	B
Isla Aguada	Y			>1500		-91.466387	18.792072	28.2	100	8	1	B
Las Coloradas	Y			>1500		-87.94328	21.60462	21.5	100	13,14,15,16,17,18	1	B
El Cuyo	Y			>1500		-87.67949	21.51783	25	100	13,14,15,16,17,18	1	B
Cancun				100-300		-86.741667	21.138889	0.3	100	40,41,42,43,44,45	1	B
Tamul				1001-1500		-86.81336	21.02236	9	100	40,41,42,43,44,45	1	B
Paamul	Y			>1500		-87.1878	20.5281	2.5	100	61,62,63,64,65	1	B
Aventuras DIF	Y			>1500		-87.3325	20.3681	1.5	100	61,62,63,64,65	1	B
Chemuyil	Y			>1500		-87.3386	20.3517	0.3	100	61,62,63,64,65	1	B
Xcacel	Y			>1500		-87.3436	20.3408	2.5	100	61,62,63,64,65	1	B
Xel-Ha	Y			>1500		-87.3519	20.3189	0.3	100	61,62,63,64,65	1	B
Kanzul	Y			1001-1500		-87.4511	20.1669	4	100	61,62,63,64,65	1	B

Cahpechen	Y			1001-1500		-87.4664	20.1225	8.5	100	61,62,63,64,65	1	B	
San Juan	Y			1001-1500		-87.4364	19.9264	5	100	61,62,63,64,65	1	B	
Holbox	Y			100-300		-87.34255	21.563952	24	100	13,14,15,16,17,18	1	B	
CC-NW-ATL													
Cancun					<25	-86.741667	21.138889	0.3	100	40,41,42,43,44,45	1	B	
Tamul					50-100	-86.81336	21.02236	9	100	40,41,42,43,44,45	1	B	
Paamul	Y				301-500	-87.1878	20.5281	2.5	100	61,62,63,64,65	1	B	
Aventuras DIF	Y				301-500	-87.3325	20.3681	1.5	100	61,62,63,64,65	1	B	
Chemuyil	Y				301-500	-87.3386	20.3517	0.3	100	61,62,63,64,65	1	B	
Xcacel	Y				301-500	-87.3436	20.3408	2.5	100	61,62,63,64,65	1	B	
Tankah	Y				100-300	-87.4072	20.2464	0.3	100	61,62,63,64,65	1	B	
Kanzul	Y				100-300	-87.4511	20.1669	4	100	61,62,63,64,65	1	B	
Cahpechen	Y				100-300	-87.4664	20.1225	8.5	100	61,62,63,64,65	1	B	
San Juan	Y				100-300	-87.4364	19.9264	5	100	61,62,63,64,65	1	B	

Table 2.1. Summary of the abundance levels for nesting populations in this RMU. (Ei: *E. imbricata*; Lk: *L. kempii*; Cm: *C. mydas*; Cc: *C. caretta*).

Parameter	**Ei**	**Lk**	**Cm**	**Cc**	**References**
Nesting females/yr	>1,000	5,000	4,220	n/a	8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 37, 40, 41, 42, 43, 44, 45
Nests/female/yr	2.5	2	3.85	2.33	8, 10, 11 ,12, 19, 37, 38, 52, 54, 57, 60
Female remigration interval	3.21	n/a	2.27	2.63	8, 19, 37, 38, 52

Table 2.2. Reported threats for nesting beaches and in-water habitats in the Mexican territory of the northwest Atlantic RMU.

Threat	Ei	Reference	Lk	Reference	Cm	Reference	Cc	Reference
Bycatch: presence of small scale / artisanal fisheries?	Y (PLL, DLL, SN, FP)	26	Y (SN, ST)	37	Y (PLL, DLL, SN, FP)	26	Y	54
Bycatch: presence of industrial fisheries?	Y (PLL, DLL, ST, MT, FP)	27	Y (ST)	37	Y (PLL, DLL, ST, MT, FP)	26	N	54
Bycatch: quantified?	Y	26	Y		Y	26	Y	54
Take. Intentional killing or exploitation of turtles	Y		Y		Y		Y	54
Take. Egg poaching	Y	8,9,10,11,12	Y	37	Y		Y	54
Coastal Development. Nesting habitat degradation	Y	8,9,10,11,12,28	N		Y		Y	54
Coastal Development. Photopollution	Y	29	N		Y		Y	54
Coastal Development. Boat strikes	Y		Y		Y		Y	54
Egg predation	Y	8,9,10,11,12	Y		Y		Y	54
Pollution (debris, chemical)	Y	29,30,31,32	Y	37	Y		Y	54

Pathogens	Y	33	n/a		Y		Y	54
Climate change	Y	34,35	Y	37	Y		Y	54
Foraging habitat degradation	n/a		Y		Y		n/a	54
Other	n/a		n/a		n/a		n/a	54

Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multispecific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net) (Y: Yes, N: No).

Table 3. International conventions protecting sea turtles and signed by Mexico.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavorable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
UNCLOS: The United Nations Convention on the Law of the Sea. Came into force in 1994.	Y	Y	Y	ALL	An international treaty that defines the rights and responsibilities of nations with respect to their use of the world's oceans and establishes guidelines for the management of marine natural resources (Wikipedia, 2015).
Ramsar Convention	Y	Y	Y	ALL	Is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	Y	Y	Y	ALL	The Convention promotes the protection, conservation and recovery of the populations of sea turtles and those habitats on which they depend, based on the best available data and taking into consideration the environmental, socioeconomic and cultural characteristics of the Parties (Article II, Text of the Convention). These actions should cover both nesting beaches and the Parties' territorial waters.

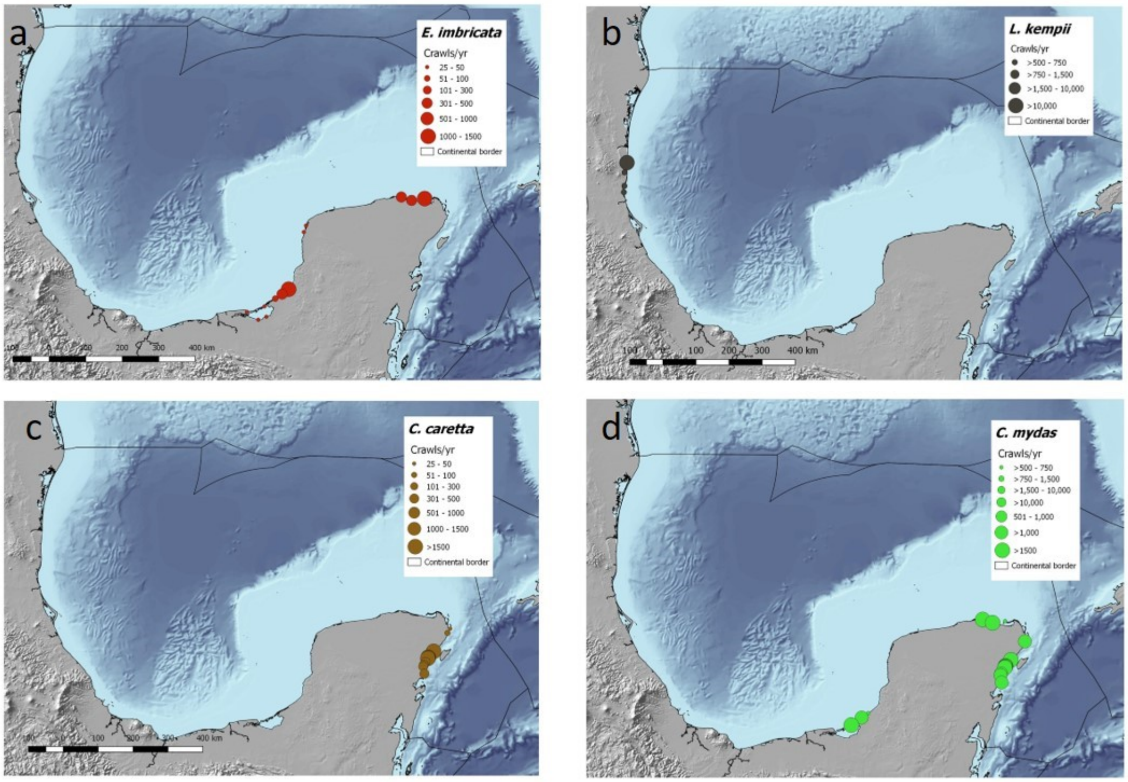

Figure 1. Main sea turtle nesting beaches for four species in Mexican littoral in the Gulf of Mexico.

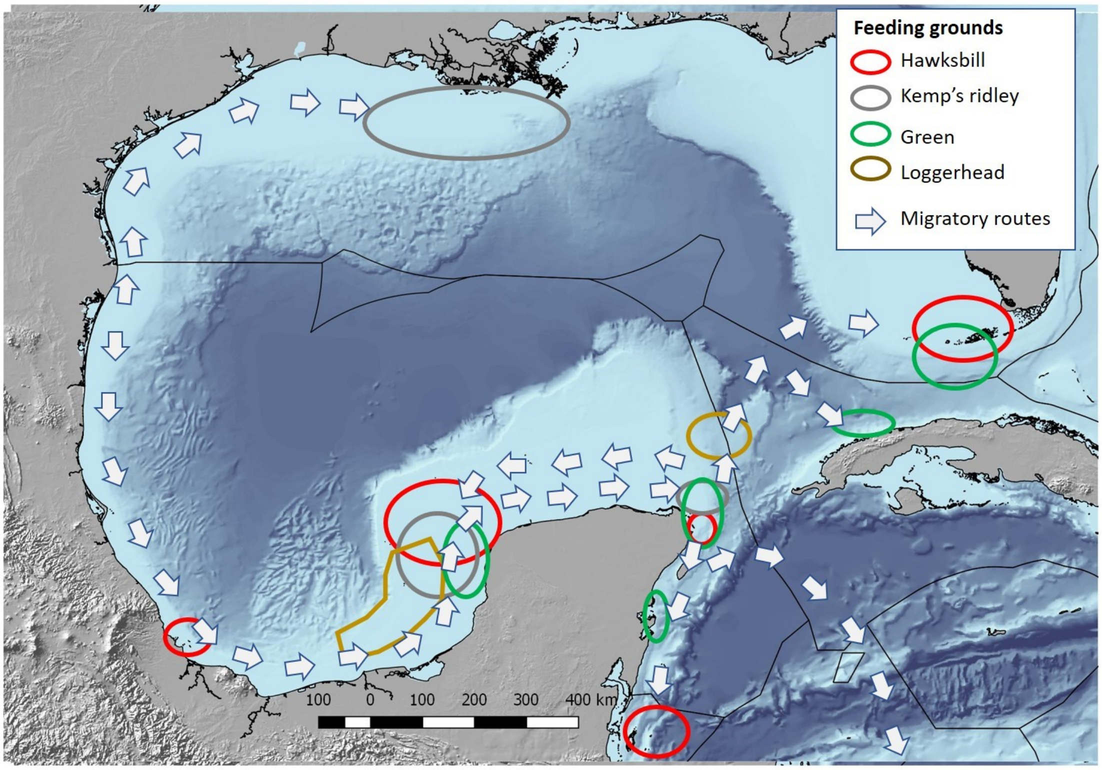

Figure 2. Schematic representation of the location of main feeding grounds per species and their main migratory routes from nesting beaches in the Mexican territory, and inside the Northwest Atlantic RMU.

Montserrat

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1.1. Distribution, abundance, trends.

Please see Table.

1.2. Other biological data

1.3. Threats

Please see Table 1.

Table 1. Biological and conservation information about sea turtle Regional Management Units in Montserrat.

Topic	***C. caretta***	Ref #	***C. mydas***	Ref #	***E. imbricata***	Ref #
Occurrence						
Nesting sites	Y	1	Y	1	Y	1
Oceanic foraging areas	U		U		U	
Neritic foraging areas	Y	1	Y	1	Y	1
Key biological data						
Nests/yr: recent average (range of years)	U	1,3,4	U	1,3,4	U	1,3,4
Nests/yr: recent order of magnitude	n/r	1,3,4	n/r	1,3,4	n/r	1,3,4
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	1,3,4	0	1,3,4	0	1,3,4

Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	0	1,3,4	U	1,3,4	U	1,3,4
Nests/yr at "major" sites: recent average (range of years)	n/r	1,3,4	n/r	1,3,4	n/r	1,3,4
Nests/yr at "minor" sites: recent average (range of years)	U	1,3,4	U	1,3,4	U	1,3,4
Total length of nesting sites (km)	5	1,3,4	5	1,3,4	5	1,3,4
Nesting females / yr	U	1,3,4	U	1,3,4	U	1,3,4
Nests / female season (N)	U	1,3,4	U	1,3,4	U	1,3,4
Female remigration interval (yrs) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Sex ratio: Hatchlings (F / Tot) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Sex ratio: Immatures (F / Tot) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Sex ratio: Adults (F / Tot) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Min adult size, CCL or SCL (cm)	U	1,3,4	U	1,3,4	U	1,3,4
Age at maturity (yrs)	U	1,3,4	U	1,3,4	U	1,3,4
Clutch size (n eggs) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Emergence success (hatchlings/egg) (N)	U	1,3,4	U	1,3,4	U	1,3,4
Nesting success (Nests/ Tot emergence tracks) (N)	U	1,3,4	U		U	
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	U		U		U	
Recent trends (last 20 yrs) at foraging grounds (range of years)	U		U		U	
Oldest documented abundance: nests/yr (range of years)	U		U		U	
Published studies						
Growth rates	N		N		N	

Genetics	N		Y	4	Y	4
Stocks defined by genetic markers	N		N		N	
Remote tracking (satellite or other)	N		N		N	
Survival rates	N		N		N	
Population dynamics	N		N		N	
Foraging ecology	N		N		N	
Capture-Mark-Recapture	N		Y	1,4	Y	1,4
Threats						
Bycatch: presence of small scale / artisanal fisheries?	U	1,4	U	1,4	U	1,4
Bycatch: presence of industrial fisheries?	U	1,4	U	1,4	U	1,4
Bycatch: quantified?	N	1,4	N	1,4	N	1,4
Intentional killing of turtles	U	1,4	Y	1,4	Y	1,4
Take. Illegal take of turtles	U	1,4	Y	1,4	Y	1,4
Take. Permitted/legal take of turtles	Y	1,4	Y	1,4	Y	1,4
Take. Illegal take of eggs	U	1,4	U	1,4	U	1,4
Take. Permitted/legal take of eggs	Y	1,4	Y	1,4	Y	1,4
Coastal Development. Nesting habitat degradation	Y	1,4	Y	1,4	Y	1,4

Coastal Development. Photopollution	Y	1,4	Y	1,4	Y	1,4
Coastal Development. Boat strikes	U	1,4	U	1,4	U	1,4
Egg predation	U	1,4	Y	1,4	Y	1,4
Pollution (debris, chemical)	U	1,4	U	1,4	U	1,4
Pathogens	U	1,4	U	1,4	U	1,4
Climate change	Y	1,4	Y	1,4	Y	1,4
Foraging habitat degradation	U	1,4	U	1,4	U	1,4
Other						
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (1999 to present)	1,4	Y (1999 to present)	1,4	Y (1999 to present)	1,4
Number of index nesting sites	7	1,4	7	1,4	7	1,4
Monitoring at foraging sites (period: range of years)	N	1,4	N	1,4	N	1,4
Conservation						
Protection under national law	Y	2,4	Y	2,4	Y	2,4
Number of protected nesting sites (habitat preservation) (% nests)	0		0		0	
Number of Marine Areas with mitigation of threats	n/r		n/r		n/r	
N of long-term conservation projects (period: range of years)	N		1 (2011-present)	Table 4	1 (2011-present)	Table 4
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		1 (2011-present)	Table 4	1 (2011-present)	Table 4
Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other						

Table 2. Sea turtle nesting beaches in Montserrat.

Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CC-NW ATL				Long	Lat	Long	Lat	Long	Lat					
Trant's Bay/Farm Bay	N	U	U					-62.171718	16.781897		opportunistic	3		
Plymouth	N	U	U					-62.218245	16.700531		opportuistic	3		
Fox's Bay	Y	U	U					-62.238085	16.724995		100	3		
Isle Bay	Y	U	U					-62.232667	16.738324		100	3		
Old Road Bay	Y	U	U					-62.233557	16.744418		100	3		
Lime Kiln Bay	Y	U	U					-62.232938	16.750972		100	3		
Woodlands Beach	Y	U	U					-62.223623	16.762882		100	3		
Bunkum Bay	N	U	U					-62.22084	16.771148		opportunistic	3		
Carrs Bay	Y	U	U					-62.20738	16.797671		100	3		
Little Bay	Y	U	U					-62.205680°	16.801195°		100	3		
Rendez-vous Bay	N	U	U					-62.205053°	16.808483°		opportunistic	3		
Maguerita Bay	N	U	U					-62.181304°	16.799258°		opportunistic	3		

CM-NW ATL														
Trant's Bay/Farm Bay	N	U	U					-62.171718	16.781897		opportunistic	3		
Plymouth	N	U	U					-62.218245	16.700531		opportuistic	3		
Fox's Bay	Y	U	U					-62.238085	16.724995		100	3		
Isle Bay	Y	U	U					-62.232667	16.738324		100	3		
Old Road Bay	Y	U	U					-62.233557	16.744418		100	3		
Lime Kiln Bay	Y	U	U					-62.232938	16.750972		100	3		
Woodlands Beach	Y	U	U					-62.223623	16.762882		100	3		
Bunkum Bay	N	U	U					-62.22084	16.771148		opportunistic	3		
Carrs Bay	Y	U	U					-62.20738	16.797671		100	3		
Little Bay	Y	U	U					-62.205680°	16.801195°		100	3		
Rendez-vous Bay	N	U	U					-62.205053°	16.808483°		opportunistic	3		
Maguerita Bay	N	U	U					-62.181304°	16.799258°		opportunistic	3		
EI ATL WC/USA														
Trant's Bay/Farm Bay	N	U	U					-62.171718	16.781897		opportunistic	3		
Plymouth	N	U	U					-62.218245	16.700531		opportuistic	3		
Fox's Bay	Y	U	U					-62.238085	16.724995		100	3		
Isle Bay	Y	U	U					-62.232667	16.738324		100	3		

Old Road Bay	Y	U	U					-62.233557	16.744418		100	3		
Lime Kiln Bay	Y	U	U					-62.232938	16.750972		100	3		
Woodlands Beach	Y	U	U					-62.223623	16.762882		100	3		
Bunkum Bay	N	U	U					-62.22084	16.771148		opportunistic	3		
Carrs Bay	Y	U	U					-62.20738	16.797671		100	3		
Little Bay	Y	U	U					-62.205680°	16.801195°		100	3		
Rendez-vous Bay	N	U	U					-62.205053°	16.808483°		opportunistic	3		
Maguerita Bay	N	U	U					-62.181304°	16.799258°		opportunistic	3		

1.4. Conservation

See Table 3.

Table 3. International conventions protecting sea turtles and signed by Montserrat.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on Migratory Species (CMS or Bonn Convention)	Y	Y	Y	ALL	N	Y
Convention on International Trade of Endangered Species of Fauna and Flora (CITES)	Y	Y	Y	ALL	N	Y
Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	N	N	N	ALL	n/r	Y
Protocol Concerning Specially Protected Areas and Wildlife (SPAW) to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention)	N	N	N	ALL	n/r	Y

1.5. Research

See Table 4.

Table 4. Projects and databases on sea turtles in Montserrat.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	**CM-NW ATL**	Montserrat	Caribbean	Montserrat Turtle Project	nesting monitoring; hatcheries	2011	Present	Fisheries and Ocean Governance Unit, Ministry of Agriculture, Trade, Lands, Housing and the Environment-MATLHE	Public	Alwyn Ponteen, Chief Officer - alwyn.ponteen@myport.ac.uk	

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Portugal

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Introduction

There is no nesting occurring along Portugal's continental shores, and observation of turtles at sea are done mostly opportunistically; most of the information available comes from stranding records, which are compiled by several stranding networks operating along the coast.

National waters, i.e. the 200 nautical mile Exclusive Economic Zone (EEZ) with its three sub-areas corresponding to continental Portugal, the Azores and Madeira (Figure 1), are within Leatherback (*Dermochelys coriacea*) and Loggerhead sea turtles (*Caretta caretta*) global distribution area, with the Leatherback being probably the most common species in continental Portugal's waters.

Although the LIFE+ MarPro airplane annual census (2011-2015) were dedicated to cetaceans and seabirds (flight altitude: 150 m asl; survey month: September), there were several sightings of loggerheads and leatherbacks across Portuguese waters (surveys until 50 nm) (see Figure 2).

Stranding records indicate that other species can be found in Portuguese waters. Between 1978 and 2019, 1101 sea turtles were reported stranded (88.2%) along the Portuguese coastline or were delivered by fishers (11.8%). The recorded strandings included loggerheads, *Caretta caretta* (N = 582; 52.9%), leatherbacks, *Dermochelys coriacea* (N=504; 45.8%), green turtles, *Chelonia mydas* (N = 11; 1.0%) and Kemp's Ridley, *Lepidochelys kempii* (N=4; 0.4%). Species other than the loggerhead and the leatherback appear very sporadically; continental waters are generally too cold for sea turtles and Portuguese coastal waters are therefore assumed not to be part of their regular migration route (Dellinger, 2010).

Between 2006 and 2019, 45 marine turtles were admitted to the marine animal rehabilitation center located in the central coast (currently CRAM-ECOMARE). Most individuals were loggerheads (N = 33; 73%), including adults (only 15%). Leatherbacks (N = 7; 16%), green turtles (N=3, 7%) and Kemp's Ridley (N = 2; 4%) were also admitted to the rehab centre. The primary cause of marine turtle admission to the rehab centre was bycatch-related in 60% of the cases. Most individuals were tagged with metal rings and pit tags, and some loggerheads, one Kemp's Ridley and one green turtle were equipped with satellite tags.

Section 1. RMU: Loggerhead turtle (*Caretta caretta*) – Northwest Atlantic

1.1. Distribution, abundance, trends

1.1.1. Nesting sites

There are no known nesting occurrences in continental Portugal.

1.1.2. Marine areas

Loggerheads are found sporadically on all coasts, but it is a regular visitor to the southern coast of the Algarve, in particular during the upwelling season. It is thought that the species also passes by during its migration between Atlantic and

Western Mediterranean pelagic habitats (Dellinger, 2010 and references herein). The importance of the south coast for this species is confirmed by frequent sightings (M. Laborde, *pers. comm.*), stranding records and by recent tag returns. A loggerhead that was tagged in the Atlantic Coast of France was captured in set nets in the north of Portugal in 2014 (CRAM-ECOMARE, *pers. comm.)*. More recently, a juvenile loggerhead (*Caretta caretta*), tagged in El Saler, in Valencia (Spain, December 2020) was found stranded in Cacela Velha beach, in the Algarve region (south coast of Portugal, June 2021) (RAALG network, *pers. comm.*). These observations support the idea that sea turtles travel along the Algarve to enter or exit the Mediterranean sea. Studies suggest that passing of the Gibraltar Strait, the entry point to the Mediterranean, is dependent on body size, with smaller turtles travelling along the shore eastwards where tides and currents are softer (i.e. summer months). This may contribute to the high incidence the high incidence of loggerhead sea turtle strandings along the south coast during the summer.

Currently, there are no abundances indexes, but efforts are planned for the future along the south coast (M. Laborde, *pers. comm*).

1.2. Other biological data

See Table 1.

Stranding records

Loggerhead turtles comprised of half of the total sea turtle records along the Portuguese coast between 1978 and 2019 (N = 582; 52.9%). After 2009, a relative increase of stranding densities was observed for this species (Table 1; Figure 3). Considering average values, the highest value for loggerhead strandings/10Km was registered in 2009-2013 and a decline was observed in the following period (2014-2019). However, the stranding network in the south coast was not operational between 2017 and part of 2020, which could have led to an underestimation of loggerhead strandings during the most recent period (most strandings occur in the south).

Stranding seasonality

Spatial and temporal distribution of these records indicate that the highest loggerhead stranding density was observed on the southern coast during spring and summer (Figure 4).

Biometrics

An analysis of biometric data for turtles found stranded along continental Portugal between 1978 and 2013 show that all stranded loggerheads (C. caretta) were immature (median CCL 48.5 cm) (Nicolau et al., 2016).

Diet

Considering the digestive tracts of 95 loggerheads (2010-2013) stranded in the continental coast, crustaceans were the main prey group, particularly Polybius henslowii (very abundant during the upwelling season) and Pagurus spp., followed by mollusks and fish (Nicolau 2017).

1.3. Threats

1.3.1. Nesting sites

Not Applicable

1.3.2. Marine areas

The causes of sea turtle strandings along the Portuguese continental coast were analysed by Nicolau et al. (2016) and are presented in Figure 5. According to the authors, considering those individuals that were fresh enough for a necropsy and thus the determination of the cause of stranding was possible, 36.8 % of the loggerheads died in result of anthropogenic threats, mainly interaction with fisheries was the main cause of stranding for of loggerheads (24.9 %). Other anthropogenic causes detected in loggerheads were unknown traumatic events (9.3 %), boat collision (1.3 %), oil spill (1.0 %) and litter ingestion (0.3 %).

Bycatch

For loggerhead turtles, bycatch in set nets (trammel and gillnets), purse-seiners, trawlers and longliners were registered.

Pollution

Necropsy data and digestive tract analysis detected cases of fishhook ingestion by loggerhead turtles and marine litter by loggerhead and leatherback turtles. Nicolau et al. (2015) analysed the digestive tracts of 95 loggerheads and litter was present in 56 individuals (59.0%). Plastic was the main litter category (frequency of occurrence = 56.8%).

With respect to chemical pollution, Nicolau et al. (2017) analysed trace element concentrations in 38 loggerheads stranded between 2011 and 2013 and found that Hepatic Hg values (0.30 ± 0.03 mg g-1) were higher than values reported in loggerheads in the Canary Islands but lower than in Mediterranean loggerheads. In this study Cd concentrations were only exceeded by values found in turtles from the Pacific. Cd concentrations are probably related to the importance of crustaceans in loggerhead diet in the Portuguese coast (Nicolau et al., 2017).

1.4. Conservation

All sea turtles are protected through national and international legislation, namely national legislation referring to international conventions and EU directives: CITES Convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora, or Washington Convention), Bonn Convention (Convention on the Conservation of Migratory Species Belonging to Wild Fauna), Bern Convention (Convention on the Protection of Wildlife and Natural

Environment in Europe) and Habitats Directive (on the conservation of natural habitats and of wild flora and fauna: Decree-Law 140/99 amended by Decree-Law 49/2005, with the species *Caretta caretta* in Annexes B-II (requiring special conservation areas) and B-IV (requiring strict protection) and the remaining turtle species in Annex B-IV). In addition to international treaties, there is national legislation, starting with the Environment Framework Law (Law 11/87, amended by Law 13/2002), which specifically mentions migratory species, various laws regulating fishing activities, especially those restricting fishing effort for exclusive economic zones such as Council Regulation (EC) No 1954/2003 (Dellinger, 2010). See Table 3.

Currently, there are no direct conservation actions to minimize the impact at sea, but turtles found injured by fishermen or along the coast are sent to rescue and rehabilitation centres for their recovery. These centres, as well as research on sea turtles, are governed, among others, by the Washington and Berne Conventions and the Habitats Directive, and it is mandatory to hold a licence issued by the competent authorities (in continental Portugal, the Ministry for the Environment, Spatial Planning and Regional Development, through the Institute for Nature Conservation and Biodiversity). As there are no specific national or European legal standards for turtle recovery centres, these should be drawn up based on existing guidelines. The release of animals from captivity is governed, among others, by Decree-Law No. 565/99 (Dellinger, 2010).

The conservation priorities identified for continental Portugal includes coastal fisheries bycatch mitigation and good practices in collaboration with marine animal rehabilitation centres. Specific recommendations to decision makers or other subjects include the development of programmes envisaging bycatch monitoring and mitigation, fisheries good practices, marine turtle monitoring in Portuguese continental waters and Ocean Literacy concerning marine turtle conservation.

1.5. Research

Currently, the key knowledge gaps are related to population genetics, habitat use, and pathologies. There is also a need to identify efficient bycatch mitigation measures.

Existing but unpublished data that should be urgently published includes diet, and movement patterns after rehabilitation. See Table 4.

Section 2. RMU: Leatherback turtle (Dermochelys coriácea), Northwest Atlantic

2.1. Distribution, abundance, trends

2.1.1. Nesting sites

There are no known nesting occurrences in continental Portugal of any species.

2.1.2. Marine areas

Leatherbacks observations along the Portuguese coast are fairly common (M. Laborde, *pers. comm.*). Currently, there are no abundances indexes, but efforts are planned for the future along the south coast (M. Laborde, *pers. comm*).

Leatherbacks from Caribbean pass through waters in the 3 sub-areas of the Portuguese EEZ, in particular nesting turtles from Trinidad (Eckert, 2006), confirmed by the report of a leatherback with a metal tag from Trinidad and Tobago stranded in the central cost of Portugal in 2010 (CRAM-ECOMARE, *pers. comm.).* Also noteworthy is the passage through Portuguese waters of turtles tagged in Ireland *en route* to Africa (http://www.turtle.ie). These observations suggest that Portuguese waters are pelagic feeding and passage areas for leatherback turtles on their seasonal migration to feeding areas of higher latitudes, and also for return to tropical nesting beaches.

2.2. Other biological data

Stranding records

Leatherbacks comprised nearly half of all sea turtle records done along the Portuguese coast between 1978 and 2019 (N=504; 45.8%); after 2009, a relative increase of stranding densities was observed for this species (Table 2; Figure 6). The highest average value of strandings/10Km was registered between 2014 and 2019, with a peak of 77 leatherback individuals stranding in 2015.

Stranding seasonality

Spatial and temporal distribution of these records indicate that the highest leatherback strandings are more common along the North-Central and Central-Southwestern sectors during autumn and in the southern sector during summer (Figure 6).

Biometrics

An analysis of biometric data for turtles found stranded along continental Portugal between 1978 and 2013 show that leatherback (D. coriacea) strandings included both juvenile and adults (median CCL = 139.0) (Nicolau et al., 2016).

2.3. Threats

2.3.1. Nesting sites

Not Applicable

2.3.2. Marine areas

The causes of Leatherback sea turtle strandings along the Portuguese continental coast were analysed by Nicolau et al. (2016) and are presented in Figure 7; 20.0 % of the leatherbacks died in result of anthropogenic threats, mainly interaction with fisheries, which were the main cause of stranding (17.8 %).

Bycatch

Leatherbacks bycatch occurred in monofilament set nets, pots, longlines and trawls and there were some recorded cases of nonfatal bycatch in beach-seine nets (artisanal fishery).

2.4. Conservation

All sea turtles are protected through national and international legislation, namely national legislation referring to international conventions and EU directives: CITES Convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora, or Washington Convention), Bonn Convention (Convention on the Conservation of Migratory Species Belonging to Wild Fauna), Bern Convention (Convention on the Protection of Wildlife and Natural Environment in Europe) and Habitats Directive (on the conservation of natural habitats and of wild flora and fauna: Decree-Law 140/99 amended by Decree-Law 49/2005, with the species *Caretta caretta* in Annexes B-II (requiring special conservation areas) and B-IV (requiring strict protection) and the remaining turtle species in Annex B-IV). In addition to international treaties, there is national legislation, starting with the Environment Framework Law (Law 11/87, amended by Law 13/2002), which specifically mentions migratory species, various laws regulating fishing activities, especially those restricting fishing effort for exclusive economic zones such as Council Regulation (EC) No 1954/2003 (Dellinger, 2010).

Currently, there are no direct conservation actions to minimize the impact at sea, but turtles found injured by fishermen or along the coast are sent to rescue and rehabilitation centres for their recovery. These centres, as well as research on sea turtles, are governed, among others, by the Washington and Berne Conventions and the Habitats Directive, and it is mandatory to hold a licence issued by the competent authorities (in continental Portugal, the Ministry for the Environment, Spatial Planning and Regional Development, through the Institute for Nature Conservation and Biodiversity). As there are no specific national or European legal standards for turtle recovery centres, these should be drawn up based on existing guidelines. The release of animals from captivity is governed, among others, by Decree-Law No. 565/99 (Dellinger, 2010).

The conservation priorities identified for continental Portugal includes coastal fisheries bycatch mitigation and good practices in collaboration with marine animal rehabilitation centres. Specific recommendations to decision makers or other subjects include the development of programmes envisaging bycatch monitoring and mitigation, fisheries good practices, marine turtle monitoring in Portuguese continental waters and Ocean Literacy concerning marine turtle conservation.

2.5. Research

Currently, the key knowledge gaps are related to population genetics, habitat use, and pathologies. There is also a need to identify efficient bycatch mitigation measures.

Existing but unpublished data that should be urgently published includes diet, and movement patterns after rehabilitation.

Table 1. Biological and conservation information about sea turtle Regional Management Units in Portugal.

Topic	*C. caretta*	Ref #	*D. coriacea*	Ref #	*L. kempii*	Ref #	*C. mydas*	Ref #
Occurrence								
Nesting sites	N		N		N		N	
Oceanic foraging areas	Y, **both**	1,3,4,7	Y, **both**	1,3,4,6		1,3,4		1,3,4
Neritic foraging areas	**Y, both**	1,3,4	Y, **both**	1,3,4,6	?	1,3,4	?	1,3,4
Key biological data								
Nests/yr: recent average (range of years)	n/a		n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		n/a	
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/a		n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a		n/a	

Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a		n/a	
Nests / female season (N)	n/a		n/a		n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	n/a		n/a		n/a		n/a	
Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	n/a		n/a		n/a		n/a	
Emergence success (hatchlings/egg) (N)	n/a		n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		n/a	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a		n/a	
Published studies								
Growth rates	N		N		N		N	

Genetics	N		N		N		N	
Stocks defined by genetic markers	N		N		N		N	
Remote tracking (satellite or other)	N		N		N		N	
Survival rates	N		N		N		N	
Population dynamics	N		N		N		N	
Foraging ecology	Y	2	N		N		N	
Capture-Mark-Recapture	N		N		N		N	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y (strandings & deliveries; most SN but others exist: LL, purse seine and MT)	2,3 and strandings data	Y (strandings; most SN but others exist: FP, OTH:beach seine and MT	2,3 and strandings data	Y (SN)	2,3 and strandings data	Y (SN)	2,3 and strandings data
Bycatch: presence of industrial fisheries?								
Bycatch: quantified?								
Intentional killing of turtles	N		N		N		N	
Take. Illegal take of turtles	N		N		N		N	

Take. Permitted/legal take of turtles	N		N		N		N	
Take. Illegal take of eggs	n/a		n/a		n/a		n/a	
Take. Permitted/legal take of eggs	n/a		n/a		n/a		n/a	
Coastal Development. Nesting habitat degradation	n/a		n/a		n/a		n/a	
Coastal Development. Photopollution	n/a		n/a		n/a		n/a	
Coastal Development. Boat strikes	Y	3,4	Y	3,4	n/a		n/a	
Egg predation	n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	Y	2,5	N		N		N	
Pathogens	N		N		N		N	
Climate change	N		N		N		N	
Foraging habitat degradation	Y	3,5	N		N		N	
Other								
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	n/a		n/a		n/a		n/a	
Number of index nesting sites	n/a		n/a		n/a		n/a	
Monitoring at foraging sites (period: range of years)	Y	Marine Animal Stranding Network; Marine Animal Rehabilitation Centre ECOMARE	Y	Marine Animal Stranding Network; Marine Animal Rehabilitation Centre ECOMARE	Y	Marine Animal Stranding Network; Marine Animal Rehabilitation Centre ECOMARE	Y	Marine Animal Stranding Network; Marine Animal Rehabilitation Centre ECOMARE
Conservation								
Protection under national law	Y	1	Y	1	Y	1	Y	1

Number of protected nesting sites (habitat preservation) (% nests)	n/a		n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	N		N		N		N	
N of long-term conservation projects (period: range of years)	N		N		N		N	
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a		n/a	
Head-starting	n/a		n/a		n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	Wire leaders (PLL)	8	Wire leaders (PLL)	8	Wire leaders (PLL)	8	Wire leaders (PLL)	8
By-catch: onboard best practices	Y (voluntary, ongoing)	8	Y (voluntary, ongoing)	8	Y (voluntary, ongoing)	8	Y (voluntary, ongoing)	8
By-catch: spatio-temporal closures/reduction	N		N		N		N	
Other	N		N		N		N	

Table 3. International conventions protecting sea turtles and signed by Portugal.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992)	Y	Y	Y	*All*	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992)
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binfind and non-binding	Y	Y	Y	*All*	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. CMS has a specific resolution on bycatch datailing various actions needed to reduce bycatch of migratory species that will include marine turtles (UNEP/CMS/Resolution 9.18 on Bycatch)

Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	*All*	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species.
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	Y	Y	Y	*All*	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival	All seven species listed in Appendix I of CITES
UNFSA: United Nations Fish Stock Agreement. Known formally as the Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.	Y	Y	Y	*All*	A legal regime for the long-term conservation and sustainable use of straddling and highly migratory fish stocks (i.e. addressing problems related to the management of high seas fish stocks).	Ratified by 81 states and the European Union. Mentions a range of problems, including those related to unselective fishing gear. Elaborates on the fundamental principle that countries should, inter alia, cooperate to ensure conservation. Most shrimp are trawled within EEZs, though in those instances where tropical shrimp may be caught outside of EEZs, or where there are straddling stocks (i.e stocks that migrate through, or occur in, more than one EEZ), UNFSA will

						have a bearing on the EU's involvement in such cases.
Regional Fisheries Management Organisations (RFMOs) and Regional Fisheries Bodies (RFBs).	Y	Y	Y	*All*	The EU is party to numerous RFMOs and RFBs that although not classed as global agreements are considered as binding multilateral agreements.	The main relevance has to do with the EU's Common Fisheries Policy (CFP) - the framework that establishes the rules that govern how the shared fish stocks within European Union water are managed. The CFP now includes na external dimension establishing the standards by which EU vesses should adhere to when fishing outside of EU waters. The relevance of the CFP to this is detailed in section 6.1
The Convention for the protection of the marine environment of the North-East Atlantic (the OSPAR Convention) (1992).	Y	Y	Y	*All*	To protect and conserve marine ecosystems and biological diversity of the North-East Atlantic	This species is considered threatened and/or declining wherever the species is present in OSPAR regions (Cc: OSPAR Regions IV and V).

Marine Strategy Framework Directive (2008).	Y	Y	Y	*All*	This Directive leads European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	This species of marine turtles is considered as an indicator of MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 4. Projects and databases on sea turtles in Portugal.

Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private	Collaboration with	Current Sponsors	Primary Contact (name and Email)
Aveiro, Portugal	CRAM-Ecomare (previous CRAM-Quiaios)	Marine Wildlife Rehabilitation Centre	2006	ongoing	UA/SPVS	Private/Public*	ICNF	Private funds/ Government	Marisa Ferreira (mctferreira@socpvs.org) Catarina Eira (catarina.eira@ua.pt)
Lisbon, Portugal	National Stranding Network	Marine Animal Strandings	1978	ongoing	ICNF	Private/Public*	UA/SPVS/ UAlg/UEv	Private funds/ Government	Marina Sequeira (marina.sequeira@icnf.pt) Catarina Eira (catarina.eira@ua.pt)
Algarve, Portugal	Sea turtles sightings in Southern Portugal	caretta; loggerhead; leatherback; dermochelys; conservation; atlantic; portugal	2010	ongoing	AIMM - Associação para a Investigação do Meio Marinho	NGO		Private	Marina Laborde (marina_laborde@hotmail.com)
Algarve, Portugal	RAAlg - Algarve Stranding Network	caretta; loggerhead; leatherback; dermochelys; conservation; atlantic; portugal	2020	ongoing	UALG - University of Algarve	Public		Private	Ana Marçalo (amarcalo@ualg.pt)
Alentejo, Portugal	ARROJAL - Alentejo Stranding Network	caretta; loggerhead; leatherback; dermochelys; conservation; atlantic; portugal	2021	ongoing	CIEMAR - University of Évora	Public		Private	João Castro (jjc@uevora.pt)

Countrywide	National Stranding Network	caretta; loggerhead; leatherback; dermochelys; conservation; atlantic; portugal	2020	ongoing	CESAM - University of Aveiro	Public		Private	Catarina Eira (catarina.eira@ua.pt)

Database available	**Name of Database**	**Names of sites included (matching Table B, if appropriate)**	**Beginning of the time series**	**End of the time series**	**Track information**	**Nest information**	**Flipper tagging**	**Tags in STTI-ACCSTR?**	**PIT tagging**	**Remote tracking**
N	marproclinicaldatabase	Continental portuguese coast	2006	ongoing	Y	n/a	Y	N	Y	Y
N	Strandings database	Continental portuguese coast	1978	ongoing						
Y			2010	ongoing						
Y			2021	ongoing						

Table Supplementary 1. Evolution of average values (SE) of loggerhead strandings/10Km in Continental Portugal.

	C. caretta
1994-1998	0,15 (0,03)
1999-2003	0,15 (0,03)
2004-2008	0,17 (0,03)
2009-2013	0,56 (0,27)
2014-2019*	0,24 (0,09)

* dedicated stranding network in the south coast not operating between 2017-2020

Table 2. Evolution of average values (SE) of leatherback strandings/10Km in Continental Portugal

	D. coriacea
1994-1998	0,18 (0,05)
1999-2003	0,07 (0,01)
2004-2008	0,12 (0,02)
2009-2013	0,26 (0,03)
2014-2019*	0,32 (0,13)

* dedicated stranding network in the south coast not operating between 2017-2020

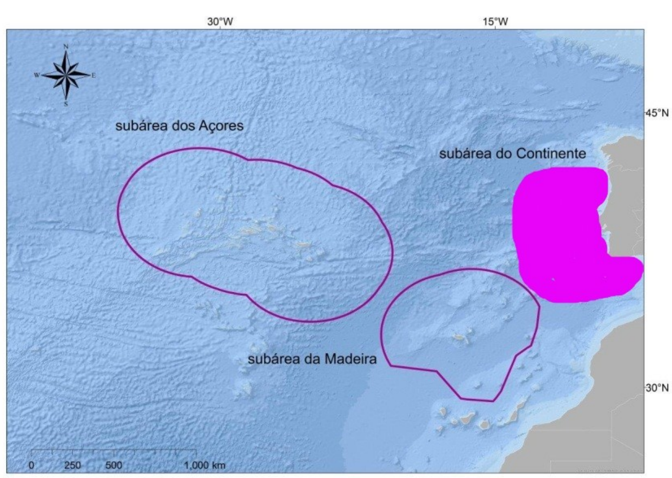

Figure 1. The three EEZs belonging to Portugal, with the continental EEZ highlighted.

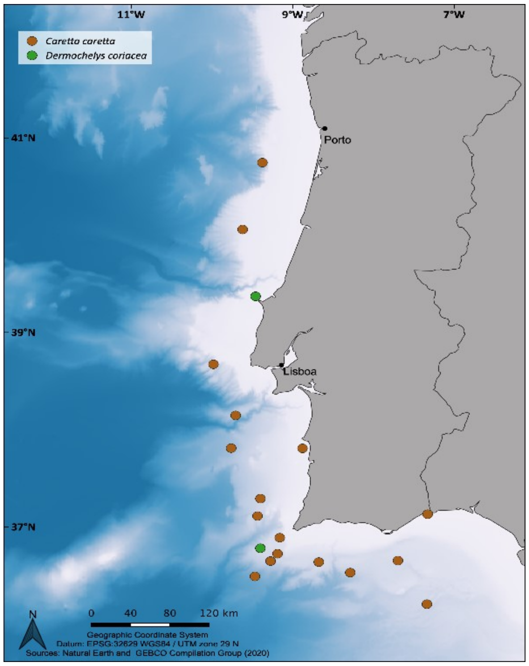

Figure 2. Loggerhead and leatherback sightings registered during the LIFE+ MarPro airplane surveys between 2011 and 2015.

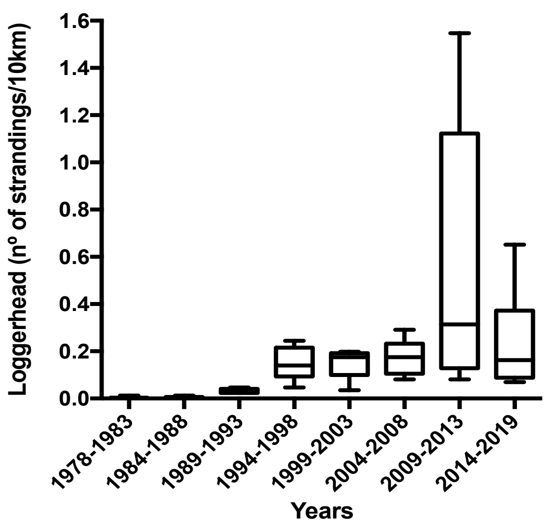

Figure 3. Loggerhead annual relative stranding densities (number of strandings per 10 km) per year periods in continental Portugal: The *box* stretches from the 25th to the 75th percentile. The *line*

across the *box* represents the median, and the ends of the *vertical line* indicate the 5th and 95th percentiles.

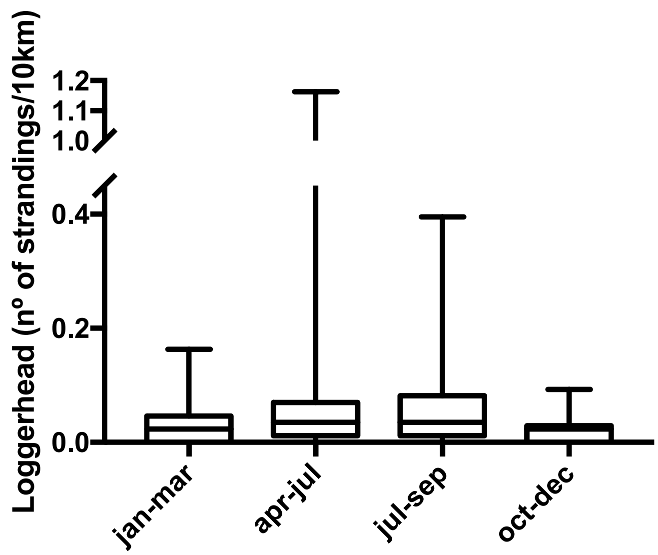

Figure 4. Seasonal variation in relative densities (number of individuals per 10km) of loggerhead strandings in continental Portugal between 1978 and 2019. The *box* stretches from the 25th to the 75th percentile. The *line across* the *box* represents the median, and the ends of the *vertical line* indicate the 5th and 95th percentiles.

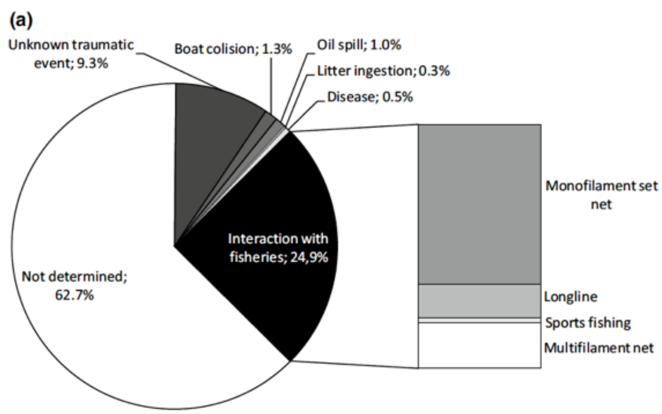

Figure 5. Causes of strandings and fisheries involved in incidental captures of loggerheads turtles (N = 386) (from Nicolau et al. 2016).

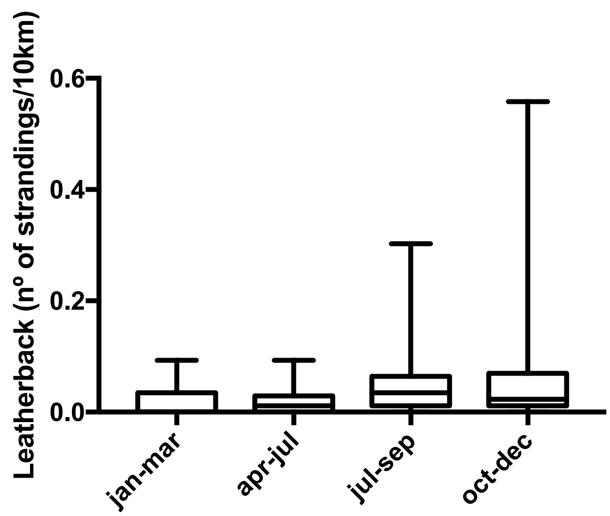

Figure 6. Seasonal variation in relative densities (number of individuals per 10km) of leatherback strandings in continental Portugal between 1978 and 2019. The *box* stretches from the 25th to the 75th percentile. The *line across* the *box* represents the median, and the ends of the *vertical line* indicate the 5th and 95th percentiles.

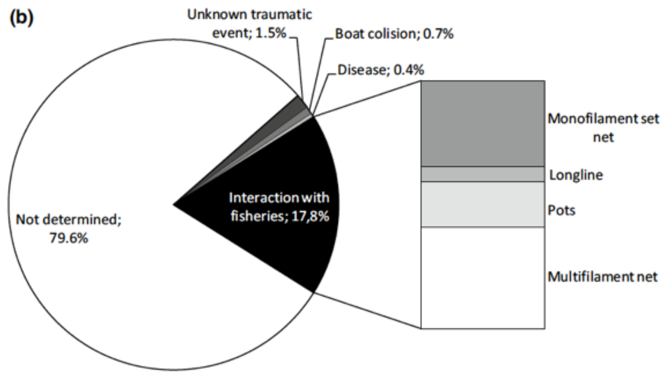

Figure 7. Causes of strandings and fisheries involved in incidental captures of leatherbacks turtles (N = 275) (from Nicolau et al. 2016).

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Saint Eustatius

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Eustach.

Topic	*C. mydas*	Ref #	*E. imbricata*	Ref #	*D. coriacea*	Ref #
Occurrence						
Nesting sites	Y	#1-#5	Y	#1-#5	Y	#1-#5
Pelagic foraging grounds	N	#1-#5	N	#1-#5	N	#1-#5
Benthic foraging grounds	Y	#1-#5	Y	#1-#5	N	#1-#5
Key biological data						
Nests/yr: recent average (range of years)	26 (2010-2014)	#1-#5	8.4 (2010-2014)	#1-#5	3 (2010-2014)	#1-#5
Nests/yr: recent order of magnitude	0 -50	#1-#5	0 - 25	#1-#5	0 - 25	#1-#5
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	1	#1-#5	1	#1-#5	n/a	#1-#5
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	1	#1-#5	1	#1-#5	1	#1-#5
Nests/yr at "major" sites: recent average (range of years)	26 (2010-2014)	#1-#5	4.5 (2010-2014)	#1-#5	n/a	#1-#5
Nests/yr at "minor" sites: recent average (range of years)	5 (2010 -2014)	#1-#5	5.25 (2010-2014)	#1-#5	3 (2010-2014)	#1-#5
Total length of nesting sites (km)	1.6	#1-#5	1.6	#1-#5	1.6	#1-#5
Nesting females / yr	175 (2010 -2014)	#1-#5	90 (2010-2014)	#1-#5	24 (2010 - 2014)	#1-#5
Nests / female season (N)	n/a	#1-#5	n/a	#1-#5	n/a	#1-#5
Female remigration interval (yrs) (N)	2-3 (1)	#1-#5	n/a	#1-#5	n/a	#1-#5
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	105.00	#1-#5	91.5	#1-#5	145	#1-#5
Age at maturity (yrs)	25-30		n/a		n/a	
Clutch size (n eggs) (N)	109.5 (104)	#1-#5	120 (42)	#1-#5	100 (15)	#1-#5

Emergence success (hatchlings/egg) (N)	0.82 (11,394)	#1-#5	0.68 (5051)	#1-#5	0.12 (1504)	#1-#5
Nesting success (Nests/ Tot emergence tracks) (N)	63% (6134)	#1-#5	68% (683)	#1-#5	17% (180)	#1-#5
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	7 (2002)	#1-#5	6 (2002)	#1-#5	10 (2002)	#1-#5
Published studies						
Growth rates	N		N		N	
Genetics	N		N		N	
Stocks defined by genetic markers	N		N		N	
Remote tracking (satellite or other)	Y		N		N	
Survival rates	N		N		N	
Population dynamics	N		N		N	
Foraging ecology (diet or isotopes)	N		N		N	
Capture-Mark-Recapture	Y		N		N	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y		N		N	
Bycatch: presence of industrial fisheries?	N		N		N	
Bycatch: quantified?	N		N		N	
Take. Intentional killing or exploitation of turtles	N		N		N	
Take. Egg poaching	N		N		N	
Coastal Development. Nesting habitat degradation	Y		Y		Y	
Coastal Development. Photopollution	Y		Y		Y	
Coastal Development. Boat strikes	Y		Y		N	
Egg predation	N		N		N	

Pollution (debris, chemical)	Y		Y		Y	
Pathogens	Y		Y		Y	
Climate change	Y		Y		Y	
Foraging habitat degradation	Y		Y		N	
Other	N		N		N	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (2002-ongoing)	#1-#5	Y (2002-ongoing)	#1-#5	Y (2002-ongoing)	#1-#5
Number of index nesting sites	1	#1-#5	1	#1-#5	1	#1-#5
Monitoring at foraging sites (period: range of years)	Y (2007-ongoing)	#1-#5	Y (2007-ongoing)	#1-#5	N	#1-#5
Conservation						
Protection under national law	Y	#1-#5	Y	#1-#5	Y	#1-#5
Number of protected nesting sites (habitat preservation) (% nests)	6 (100%)	#1-#5	6 (100%)	#1-#5	1 (100%)	#1-#5
Number of Marine Areas with mitigation of threats	1	#1-#5	1	#1-#5	1	#1-#5
N of long-term conservation projects (period: range of years)	>1 (2002-ongoing)	#1-#5	>1 (2002-ongoing)	#1-#5	>1 (2002-ongoing)	#1-#5
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		N		N	
Head-starting	N		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	N		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other	N		N		N	

Table 2. Sea turtle nesting beaches in the Saint Eustach.

RMU / Nesting beach name	Index site	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
					Long	Lat	Long	Lat	Long	Lat					
North West Atlantic	Zeelandia Beach	CM	26 (2010-2014)	52 (2010-2014)	17 30 365	062 58 835	17 30 060	062 58 255	17 30 129	062 58 388	1.4	100	#1 - #5	1	B
North West Atlantic	Zeelandia Beach	Ei	5.4 (2010-2014)	20.6 (2010-2014)	17 30 365	062 58 835	17 30 060	062 58 255	17 30 129	062 58 388	1.4	100	#1 - #5	1	B
	Oranjebay		3 (2010-2014)	14 (2010-2014)							1.5	100	#1 - #5	1	B
North West Atlantic	Zeelandia Beach	Dc	3 (2010-2014)	7.4 (2010-2014)	17 30 365	062 58 835	17 30 060	062 58 255	17 30 129	062 58 388	1.4	100	#1 - #5	1	B

Table 3. International conventions protecting sea turtles and signed by Saint Eustach.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Inter-American Convention for the protection of sea turtles	Y	Y	Y	ALL	Protection, Monitoring and tagging	Covers Sea turtles in the Caribbean
SPAW protocol	Y	Y	Y	ALL	Protection, Monitoring and tagging	Covers Sea turtles in the Caribbean

Table 4. Projects and databases on sea turtles in Saint Eustach.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Colla-boration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contact (name and Email)
T4.1	CM-EUX	St Eustatius	Caribbean Netherlands	St Eustatius Sea Turtle Conservation Program	Tracking; Nesting female; Caribbean Netherlands: Zeelandia	2002	Ongoing	St Eustatius National Parks Foundation	Public	DCNA,	www.statiapark.org	n/a	Jessica Berkel, research@statiapark.org	Clarisse Buma manager@statiapark.org
T4.2	EI-EUX	St Eustatius	Caribbean Netherlands	St Eustatius Sea Turtle Conservation Program	Tracking; Nesting female; Caribbean Netherlands: Zeelandia	2002	Ongoing	St Eustatius National Parks Foundation	Public	DCNA,	www.statiapark.org	n/a	Jessica Berkel, research@statiapark.org	
T4.3	DC-EUX	St Eustatius	Caribbean Netherlands	St Eustatius Sea Turtle Conservation Program	Tracking; Nesting female; Caribbean Netherlands: Zeelandia	2002	Ongoing	St Eustatius National Parks Foundation	Public	DCNA,	www.statiapark.org	n/a	Jessica Berkel, research@statiapark.org	Clarisse Buma manager@statiapark.org

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3 St Eustatius Sea Turtle Monitoring Program Annual Report 2012, Jessica Berkel

4 St Eustatius Sea Turtle Monitoring Program Annual Report 2013, Jessica Berkel

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Saint Pierre et Miquelon

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Pierre et Miquelon.

Topic	*C. caretta*		*D. coriacea*	
Occurrence				
Nesting sites	N		N	
Pelagic foraging grounds	N/A		Y	2,3,5,6,7
Benthic foraging grounds	Y	7	Y	2,3,5,6,7
Key biological data				
Nests/yr: recent average (range of years)	n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a	
Total length of nesting sites (km)	n/a		n/a	
Nesting females / yr	n/a		n/a	
Nests / female season (N)	n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a	
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a	
Min adult size, CCL or SCL (cm)	n/a		n/a	
Age at maturity (yrs)	n/a		n/a	
Clutch size (n eggs) (N)	n/a		n/a	
Emergence success (hatchlings/egg) (N)	n/a		n/a	

Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a	
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		N/A	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a	
Oldest documented abundance: nests/yr (range of years)			n/a	
Published studies				
Growth rates	N		N	
Genetics	N		N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	N		N	
Survival rates	N		N	
Population dynamics	N		N	
Foraging ecology (diet or isotopes)	N		N	
Capture-Mark-Recapture	N		N	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	NA	7	N	
Bycatch: presence of industrial fisheries?	Y		N	
Bycatch: quantified?	Y		N	
Take. Intentional killing or exploitation of turtles	N		N	
Take. Egg poaching	N		N	
Coastal Development. Nesting habitat degradation	N		N	
Coastal Development. Photopollution	N		N	
Coastal Development. Boat strikes	N		Y/N	7
Egg predation	N		N	

Pollution (debris, chemical)	NA	7	NA	7
Pathogens	N		N	
Climate change	n/a		n/a	
Foraging habitat degradation	n/a		n/a	
Other	Y (see text)		N	
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	N		N	
Number of index nesting sites	N		N	
Monitoring at foraging sites (period: range of years)	N		N	
Conservation				
Protection under national law	Y	7	Y	7
Number of protected nesting sites (habitat preservation) (% nests)	NA		NA	
Number of Marine Areas with mitigation of threats	N		N	
N of long-term conservation projects (period: range of years)	N		N	
In-situ nest protection (eg cages)	NA		NA	
Hatcheries	NA		NA	
Head-starting	N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N	
By-catch: onboard best practices	N		N	
By-catch: spatio-temporal closures/reduction	N		N	
Other				

Table 2. Sea turtle nesting beaches in the Saint Pierre et Miquelon.

Non occurring.

Table 3. International conventions protecting sea turtles and signed by Saint Pierre et Miquelon.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK

					conserve such species and their habitat.	and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch).*
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
Convention of Carthagene (1986)	Y	Y	Y	ALL	A Caribbean agreement for the protection and enhancement of the Caribbean Sea	

Table 4. Projects and databases on sea turtles in Saint Pierre et Miquelon.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration with	Current Sponsors	Primary Contact (name and Email)
T4.1	North east atlantic	France	French fiching zones	OBSMER	At sea observer work,	2003	still going	DPMA	Public	IFREMER, MNHN,CNRS	State	DPMA

References

1 Claro et al. (2016). Interactions entre pêcheries et tortues marines en France métropolitaine et d'Outre-mer. MNHN Rapport SPN

2 Fretey J., (2008). Compte rendu de la mission luth du 16 juin au 24 juin 2008. Plan d'action pour la biodiversité à Saint-Pierre-et-Miquelon. UICN, 19 p.

3 Ouellet M. & Galois P., (2009). Les tortues marines de l'archipel de Saint-Pierre et Miquelon. Rapport de mission scientifique réalisée pour SPM Frag'îles. Amphibia-Nature, Gaspé, Québec, 25 p.

4 Bédel S., (2011). Rapport de mission du 3 au 21 octobre 2011 sur la sensibilisation à la présence des tortues marines autour de l'archipel de St-Pierre-et Miquelon : Animations scolaires, projections-débats, enquête (rencontres individuelles et téléphoniques). SPM Frag'Iles.

5 Urtizbéréa F., (2011). Studies of biodiversity and ecology of marine mammals and leatherbacks near Saint-Pierre & Miquelon (France). NAMMCO (North Atlantic Marine Mammal Commission) Working Group on Abundance. From March 7 to 11, 2011, Copenhagen, Denmark.

6 Les tortues à Saint Pierre et Miquelon – DTAM975 GTMF Poster 2015

7 Urtizbéréa F. et al. (2013). Observations de Tortues Luth de l'archipel de St. Pierre et Miquelon

St Barthelemy FWI

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This report is particularly studying anthropogenic impacts on marine turtles habitat and foraging grounds in St Barthelemy, and lists conservation actions recommended to be implemented or enhanced, so as to monitor these sites and mitigate the impacts of the climate change crisis. This report also urges France to completely and infinitely protect all species of marine turtles on its entire territory, consequently to repeal its reservation on *Chelonia mydas* and on strictly protected fauna species in all relevant Treaties, and also calls for an immediate moratorium on all species of sea turtles and their derivatives' take in the Lesser Antilles.

Section 1. RMUs: Northwestern Atlantic

1.1. Distribution, abundance, trends.

1.1.1. Presence and Nesting sites.

See Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Barthelemy FWI: occurrence, key biological data, trends, published studies, threats, long term projects (> 5 years), conservation.

See Table 2. Sea turtle nesting beaches in Saint Barthelemy FWI.

See Figure 1. Marine turtles nesting beaches, coral reefs and seagrass meadows monitoring stations in Saint Barthelemy FWI.

3 Species of marine turtles nest in Saint Barthelemy FWI : *Dermochelys coriacea*, *Eretmochelys imbricata* and *Chelonia mydas*.

Caretta caretta is most probably present and foraging in Saint Barthelemy's waters, as a healthy individual was illegally taken while foraging, and rescued, in St Martin's waters in 2017. *Caretta caretta* presence in Saint Barthelemy's waters was confirmed by one observation of fishermen in July 2019. A *caretta caretta* individual was found stranded, dead, due to her entanglement in Abandoned Lost and Otherwise Disgarded Fishing Gears (ALODFG) in Saline in 2019 (Pers.observations).

An individual *Lepidochelys olivacea* was found entangled in Grands Fonds in 2015. If the species is present or infrequently present in Saint Barthelemy's waters or if the entangled individual was drifting from further foraging grounds is unknown (Pers. Observations).[1]

[1]These data were reported in Eckert, Karen L. and Adam E. Eckert. 2019. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Revised Edition. WIDECAST Technical Report No. 19. Godfrey, Illinois. 232 pages, plus electronic Appendices. Reference 4 of this report. See also Claire Saladin, Olivier Raynaud (2019) Saint Barthelemy FWI country report for the Widecast Atlas of sea turtle nesting beaches (2019), 3 pages. Reference 23 of this report.

Nesting beaches monitoring therefore the data collected are volunteers' training and availability dependant. Margin error concerning the number and identification of marine turtle tracks can be considered low due to the size of the Island and the genuine participation of the population. (Pers. observations) It has to be noted that the monitoring efforts have significantly increased since 2016, excavations of the nests and hatching rates successes have been calculated, which will help have a more precise perspective of the marine turtle activities on Saint Barthelemy (pers.observations).

1.1.2. Marine areas.

Marine turtles and their habitats are completely protected by National Law since 1991 without exemptions in and outside of the Marine Protected Area, incorporated in the Code de l'environnement de Saint Barthelemy in 2009.2 International Treaties signed and ratified concerning marine turtles have been rigorously implemented and complied to.

Saint Barthelemy's Marine Protected Area created in 1996 by Ministerial Arrete, classifies 1200 hectares of marine reserve.3 The Agence Territoriale de l'Environnement is the Non Governmental Organization managing Saint Barthelemy's Marine Protected Area. The Agency also has law enforcement accreditation and duties.

1.2. Other biological data

☆ 2 Hawksbills were flipper tagged on Saint Barthelemy in 2015 during a mission of the Reseau Tortues Marines Guadeloupe: Antoinette et Leleka.

Antoinette: Hawksbill FWI 7811 Right Front Flipper FWI 7821 Left Front Flipper.

[2] See Code de l'Environnement de Saint Barthelemy (2009) Titre 9: Protection de la Faune et de la Flore Chapitre 1 Mesures Generales de Protection Article 911-1 and Article 911-2, see at http://www.comstbarth.fr/iso_album/code_l_ environnement_1.pdf. Reference 15 of this report.
[3] See www.reserves-naturelles.org/saint-barthelemy.

Leleka: Hawksbill FWI 17824 Right Front Flipper FWI 17825 Left Front Flipper.

The population of marine turtles of St Barthelemy is considered healthy. One marine turtle affected by fibropapillomatosis has however been observed for the first time in 2018 at a diving site, more might have been observed and reported since then (Unpublished data Agence Territoriale de l'Environnement de St Barthelemy (2019) and pers. observations).

The photo-identification blogspot indexing resident marine turtles of the Island by their foraging bay (Ti St Jean, Grand St Jean, Grand Cul de Sac, Petit Cul de Sac, Saline, Marigot and Corossol), has been developed by the Agence Territoriale de l'Environnement since 2020, and includes citizen science data.4 Phenotypical particularities have been noted: some juvenile and subadult green turtles seem to have leucistic shells.5 Saint Barthelemy's marine turtles shells chromaticity could be due to genetic variations and/or environmental parameters. Leucism has been observed in other species and correlated to congenital factors (genetic variability, hereditary genetic mutations, consanguinity or lack of genetic flow within a population), and/or to environmental factors. Environmental changes (deforestation, urbanization) could be linked to more leucistic birds in Europe for instance,6 pollution is known to possibly induce an oxidative stress at the cellular level, that could be responsible of the alteration of the melanogenesis' enzymes eumelanine and phaeomelanine, and even of the apoptosis of melanocytes. Nutritional factors were described (tyrosine deficiency in birds) as influencing feathers colors. UV rays, their possibly important refraction and reflexion on sandy floors in shallow

[4]See Agence Territoriale de l'Environnement de Saint Barthelemy, Tortues vertes de Saint-Barthélemy Photo-identification des Tortues vertes (Chelonia mydas) de Saint-Barthélemy (2021), at https://tortuesvertesstbarth.blogspot.com. Reference 7 of this report.
[5]See TSJ0015 a.k.a. Chlorox at St Jean Bay, at https://tortuesvertesstbarth.blogspot.com.
[6]See for instance Izquierdo, L.; Thomson, R.L.; Aguirre, J.I.; Díez-Fernández, A.; Faivre, B.; Figuerola, J.; Ibáñez-Álamo, D. Factors associated with leucism in the common blackbird Turdus merula. J. Avian Biol. 2018, E01778. Reference 32 of this report.

bays, where seagrasses are less abundant, could be a parameter explaining the chromaticity variability and leucism of marine turtles in St Barthelemy, as it could favor an excessive oxydation and therefore the degradation of the enzymes necessary to melanogenesis and the pigmentation of the shell (personal comment).7 The health assessment of photo-identified marine turtles was performed and is reported in paragraph 1.3.2.Threats. Marine area.

1.3.Threats.

1.3.1. Nesting sites.

Degradation of marine turtles nesting sites, climate change

Constructions are numerous in St Barthelemy, can be reducing the sand bank and be sources of pollution. Natural erosion of Saint Barthelemy's nesting beaches is also happening (pers. observations). Species of sea turtles show natal homing behavior, the high fidelity to their natal nesting beach.8 It is therefore crucial for the survival of the species to preserve sea turtles' nesting beaches. Saint Barthelemy's coastline physical features are composed of rocky shores alternating with sandy beaches generally occurring in embayments. Saint-Barthelemy exhibits two beach types: beaches backing onto coastal plains or rocky slopes, and barrier beaches bordered by a lagoon where mangroves can be found locally. The former type is the most common and is found all around the island. The latter type is less represented and can be found at five sites (Saline, Grand Cul de Sac, St Jean, Petit Cul de Sac and Toiny), where alluvium and sand

[7]See Martín-del-Campo,R.; Calderón-Campuzano, M.F.; Rojas-Lleonart, I.; Briseño-Dueñas, R.; García-Gasca, A. Congenital Malformations in Sea Turtles: Puzzling Interplay between Genes and Environment. Animals 2021, 11, 444. https://doi.org/10.3390/ ani11020444. Reference 31 of this report.
[8]See for instance Lohmann, Kenneth & Lohmann, Catherine & Brothers, J. & Putman, Nathan. (2013). Natal homing and imprinting in sea turtles. 10.1201/b13895, https://books.google.fr/books?hl=fr&lr=&id=Xf_RBQAAQBAJ&oi=fnd&pg=PA59&dq=Lohmann+2013+biology+of+sea+turtles+natal+homing+and+imprinting+books+google&ots=F61mO4S2Ip&sig=5QJqWR7eG4pUS5Pwzano-v8uo7E#v=onepage&q=Lohmann%202013%20biology%20of%20sea%20turtles%20natal%20homing%20and%20imprinting%20books%20google&f=false (Reference 42 of this report).

have filled low-lying areas. Barrier beaches are low, rarely exceeding 4 m in elevation (i.e. ranging from 1 m at Petit Cul-de-Sac to 4 m at Grande Saline), and narrow with widths ranging from 60 m (Grand Cul-de-Sac) to 300 m (Grande Saline). Beaches are mainly composed of coral sand. In the southeast (i.e. Toiny and Grand Fond), due to the presence of fringing coral reefs and to increased exposure to hurricanes, beaches are composed of cobble-sized coral debris. Constant population growth associated with the development of the tourism sector has led to increasing pressure on land. Urbanization and beach tourism development have led to the modification, i.e. clearing, entire removal or replacement, depending on coastal sites, of the indigenous vegetation. Modifying coastal systems should also be considered when studying Tropical Cyclones (TC) impacts and climate change mitigation.9 Indeed, indigenous plant species are known to promote beach resilience by protecting low-lying coastal areas (i.e. beach-dune systems and barrier beaches) and human assets (e.g. buildings, roads...) via the attenuation of waves energy and by trapping bioclastic materials. Sediment trapping by the dense branch and root system of the indigenous vegetation contributes to the development (i.e. widening and gain in elevation) of the beach ridge. The capacity of beaches to resist and adjust to climatic events also differs according to the degree of human pressure exerted on the coast. Adjustment was difficult or even impossible in those coastal systems compressed between urbanization and the sea during TC5 Irma in 2017. The lack of material transfer led to the erosion and sometimes the temporary disappearance of the beach. Without sufficient sediment stocks, the resilience of urban beaches is expected to be slow and complicated, especially in case of preexisting tendency for coastal erosion. Preexisting tendency for coastal system degradation can make recovery more difficult. Densely urbanized beachfronts also form an obstacle to coastal flow, but in return, damage to buildings is often extremely

[9]See Valentin Pillet, Virginie K.E. Duvat, Yann Krien, Raphaël Cécé, Gael Arnaud, Cécilia Pignon-Mussaud, Assessing the impacts of shoreline hardening on beach response to hurricanes: Saint-Barthélemy, Lesser Antilles, Ocean & Coastal Management, Volume 174, 2019, Pages 71-91, ISSN 0964-5691, https://doi.org/10.1016/j.ocecoaman.2019.03.021. Reference 30 of this report.

high. Several processes responsible for damage outside and inside homes located along the shore were reported: waves cause scouring of foundations and of building walls, as well as displacement of protective riprap. Failures were observed at the corners or edges of structures or in areas of flow convergence. Waves can also break shutters, doors and patio doors; materials are projected onto facades and into homes; direct flooding cause damage to building contents (walls, floor, electrical systems). A majority of the destroyed homes and damaged foundations were observed when narrow beaches and dunes were insufficiently high and wide or even non-existent to protect them. The restoration of these artificialized beaches requires the implementation of protective actions such as nourishment, which is costly at the least and must be repeated regularly, as well as nature-based defence projects (mangrove and reef restoration), with reported benefits ranging from reductions in storm damage to reductions in coastal structure costs. Hurricane Irma wave impacts were largely constructional and accretionary. During and after Irma's passage, beach tops migrated inland, fed by beach erosion. Shorelines were nourished with fresh coralline sediments. This reveals the major role played by coral reefs on beach recovery. Beach dunes and beach coastal buffers, immediately inland of the beach sand bank, either resist wave energy that exceeded the beach capacity, or supplement the beach volume and beach area through erosion. Setback guidelines were also recommended to be adopted, e.g. setback lines of approximately 50 m from the vegetation line.10

Photo-pollution An awareness document destined to hotels and villas of Saint Barthelemy was prepared by the Agence Territoriale de l'Environnement in 2018, describing the pollution threats that could force not only marine turtles, but also

[10] See Rey T, Leone F, Candela T, Belmadani A, Palany P, Krien Y, Cécé R, Gherardi M, Péroche M, Zahibo N. Coastal Processes and Influence on Damage to Urban Structures during Hurricane Irma (St-Martin & St-Barthelemy, French West Indies). Journal of Marine Science and Engineering. 2019; 7(7):215. https://doi.org/10.3390/jmse7070215. Reference 20 of this report. See also Valentin Pillet, Virginie K.E. Duvat, Yann Krien, Raphaël Cécé, Gael Arnaud, Cécilia Pignon-Mussaud, Assessing the impacts of shoreline hardening on beach response to hurricanes: Saint-Barthélemy, Lesser Antilles, Ocean & Coastal Management, Volume 174, 2019, Pages 71-91, ISSN 0964-5691, https://doi.org/10.1016/j.ocecoaman.2019.03.021. Reference 30 of this report.

nocturnal insects, bats or vegetation to alter their behavior, and means to mitigate the photo-pollution threat for wildlife.11 It seems no hatchlings or adult marine turtle were reported disoriented yet (pers. observations).

Sargassum entanglement

Sargassum entanglement of hatchlings and adult sea turtles is a risk with the increasing sargassum flux coming in Saint Barthelemy. An entangled juvenile /subadult green turtle was rescued from sargassum in Grand Cul de Sac in 2018 (pers. comment).

1.3.2. Marine areas.

Not only sea turtles show high fidelity to their natal beach, but also homing behavior, the high fidelity to their juvenile and adult foraging grounds: seasonal philopatry to their foraging grounds at their juvenile stage can be observed, adult female sea turtles, sometimes after long post-breeding migrations, also demonstrate their high fidelity to their foraging grounds.12 It is hence essential to preserve sea turtles' habitats and foraging grounds so as to adequately protect the species.

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[11]See Agence Territoriale de l'Environnement de Saint Barthelemy (2018), Note sur la pollution lumineuse à destination des Hôtels et Villas de l'île de Saint-Barthelemy, Agence Territoriale de l'Environnement de Saint Barthelemy, 2018, 5 pages. Reference 11 of the report.

[12]See Shimada T, Limpus CJ, Hamann M, et al. Fidelity to foraging sites after long migrations. J Anim Ecol. 2019;00:1–9. https://doi.org/10.1111/1365-2656.13157 (Reference 38 of this report), González Carman, V., Bruno, I., Maxwell, S. et al. Habitat use, site fidelity and conservation opportunities for juvenile loggerhead sea turtles in the Río de la Plata, Argentina. Mar Biol 163, 20 (2016). https://doi.org/10.1007/s00227-015-2795-5 (Reference 39 of this report), Mansfield, K.L., Saba, V.S., Keinath, J.A. et al. Satellite tracking reveals a dichotomy in migration strategies among juvenile loggerhead turtles in the Northwest Atlantic. Mar Biol 156, 2555–2570 (2009). https://doi.org/10.1007/s00227-009-1279-x (Reference 40 of this report), Tucker AD, MacDonald BD, Seminoff JA (2014) Foraging site fidelity and stable isotope values of loggerhead turtles tracked in the Gulf of Mexico and northwest Caribbean. Mar Ecol Prog Ser 502:267-279. https://doi.org/10.3354/meps10655 (Reference 41 of this report), see also Agence Territoriale de l'Environnement de Saint Barthelemy, Tortues vertes de Saint-Barthélemy Photo-identification des Tortues vertes (Chelonia mydas) de Saint-Barthélemy (2021), at https://tortuesvertesstbarth.blogspot.com (Reference 7 of this report).

Boat and other marine engines strikes Rescue Rehabilitation and Release of injured marine turtles has been performed.13

The photo-identification of the population of marine turtles of St Jean (Ti St jean and Grand St Jean), Grand Cul de Sac, Petit Cul de Sac, Corossol, Saline, Marigot has been performed starting 2020's confinement. The prevalence of marine turtles showing lesions of the shell and/or amputation of a flipper possibly due to chronic boat or marine engines strikes could be diagnosed and was reported. The photo-identification of marine turtles has allowed their continued monitoring (pers. comment). Individuals have been showing new lesions due to strikes on the shell and the head possibly due to foil kites or foil surfs used in shallow bays. The use of propellors protectors has also been recommended (pers. comments).14

Abandoned Lost or Otherwise Disgarded Fishing Gears (ALODFG)

The alarming volumes of ALODFG in Saint Barthelemy have been regularly reported by Coral Restoration St Barth NGO. This non infectious hazard affecting sea turtles in St Barthelemy and St Martin was also reported internationnally.15 ALODFG have been responsible of the deaths of several marine turtles in St Barthelemy, of severe necrotic lesions to a green turtle's right

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[13]See Press Release in the local newspaper of Saint Barthelemy Journal de Saint Barth of Lucky's boatstrike in Grand Cul de Sac " Bateaux Ralentissez" 14th march 2019 www.journaldesaintbarth.com/actualites/environnement/bateaux-ralentissez--201903141857.html?fbclid=IwAR0WiA6hQ-VrWjARzkB1y3Equ35zU9-Ic4dap4eJxaewQF_RZSsFsj1s1t0. Reference 5 of the report. See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 10 of this report.

[14]See Agence Territoriale de l'Environnement de Saint Barthelemy, Tortues vertes de Saint-Barthélemy Photo-identification des Tortues vertes (Chelonia mydas) de Saint-Barthélemy (2021), at https://tortuesvertesstbarth.blogspot.com. Reference 7 of the report. See Le Pelican Journal (2020), Protéger les hélices de bateau, c'est protéger les tortues, see at http://www.lepelican-journal.com/saint-martin/environnement/Proteger-les-helices-de-bateau-c-est-proteger-les-tortues-18287.html. Reference 14 of this report.

[15]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 10 of this report.

front flipper, that could be rescued and released (pers. comments), and threatens marine turtles and marine life in a general manner. ALODFG have been daily collected by the population and appropriately disposed of in "tide trays', have also been weekly collected by NGOs and volunteers during beaches and bays clean-ups. ALODFG in St Barth have been reported to be linked to the water currents, their origins identified from the Wider-Caribbean region and from the African continent. The French Ministere de la Transition Ecologique et Solidaire has implemented a program of mitigation of this threat via Megaptera NGO based in St Martin to record the positions of ALODFG around St Martin and St Barthelemy. Cooperation with the Cartagena Convention Secretariat of the Pollution from Land Based Sources and Activities Protocol (LBS Protocol) was recommended (Pers. comment).16

☆ Coral reefs threats: diseases, anthropogenic pollution, climate change

Coral reefs are habitat and foraging grounds for sea turtles. These coastal habitats are also critical to help mitigate the impacts of climate change, storing carbon, buffering the effects of floods and storms and reducing coastal erosion. The Caribbean Sea is comprised of five major basins with an average depth of ~4400 m. It has a unique biota that is distinct from tropical seas in the Pacific and Indian Ocean due to a lack of natural connectivity with these areas. This biological isolation resulted from the emergence of the Isthmus of Panama around 3 million years ago. As a consequence, the Caribbean marine biota has low taxonomic diversity and minimal ecological redundancy (i.e., the ability of species to serve the same function when species are lost) relative to other tropical seas. This makes it especially challenging for reefs to recover from acute mortality events caused by, for example, thermal bleaching and disease outbreaks. The biological isolation may also magnify Caribbean reef vulnerability to introduced

[16]See Claire Saladin (2021) Abandoned Lost or Otherwise Discarded Fishing Gear reported at Saint Barthelemy FWI, their origins and impacts, 2 pages. Reference 16 of this report. See also UN Environment Programme, What is our Pollution or LBS Protocol?, at https://www.unep.org/cep/what-our-pollution-or-lbs-protocol. (Last visited 26th April 2021)

pathogens and non-native species, compared to less isolated coral reef regions. Although these reefs have persisted in isolation for more than 3 million years, their inherent fragility has likely contributed to major declines in recent decades under increased human pressures leading to highly degraded Caribbean reefs.17 Coral reefs are critical coastal habitats and foraging grounds for marine turtles, buffering the effects of floods and storms and nursery to a wide range of marine species. The high structural complexity of coral reefs results in high hydraulic roughness and greater frictional dissipation of waves when compared to other coastal settings. The high frictional dissipation on coral reefs, in conjunction with wave breaking on the reef rim, results in high rates of wave energy dissipation over relatively short distances when compared to other coastal systems. The coastal protection service provided by coral reefs is therefore greater than many other marine ecosystems.18 Coral reefs dissipate on average 97% of the wave energy that would otherwise impact shorelines. Most (86%) of the wave energy is dissipated by the reef crest; this relatively high and narrow geomorphological area is the most critical in providing wave attenuation benefits. The reef flat dissipates approximately half of the remaining wave energy, most of the wave energy on the reef flat is dissipated in the first part of the reef flat (that is, the 150m closest to the reef crest). This means that even narrow reef flats effectively contribute to wave attenuation. After bathymetry, another critical factor in wave attenuation is bottom friction, which is a function of bottom roughness. Coral reef degradation has significant impacts on roughness. For example, the loss of branching Staghorn and Elkhorn corals (*Acropora* spp.) Caribbean-wide affects both height and roughness particularly on reef crests. The effect of the reef crest on wave reduction is nonlinear and intensifies as incident wave energy increases.

[17]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 26 of this report.

[18]See D. L. Harris, A. Rovere, E. Casella, H. Power, R. Canavesio, A. Collin, A. Pomeroy, J. M. Webster, V. Parravicini, Coral reef structural complexity provides important coastal protection from waves under rising sea levels. Sci. Adv. 4, eaao4350 (2018), DOI: 10.1126/sciadv.aao4350. Reference 25 of this report.

These effects are critical for exposure reduction; reefs are relevant for risk reduction even during extreme events. Storms are known to have negative short-term impacts on coral cover, but reefs can be resilient and recover from these impacts. When comparing coral reefs to artificial coastal defenses, the costs of building tropical breakwaters was described between US$ 456 and 188,817 per meter with a median project cost of US$ 19,791 per meter. The construction costs of structural coral reef restoration projects ranged between US$ 20 and 155,000 per meter with a median project cost of US$ 1,290 per meter. Reef conservation and restoration can be cost effective for risk reduction and adaptation. In considerations of effectiveness, coral reefs can deliver wave attenuation benefits greater than artificial structures designed for coastal defense.19 Environmental impacts of artificial breakwaters should also be considered, degrading nesting beaches and generating a poor water quality in stagnant waters behind breakwaters. Stagnant waters of poor quality are a public health concern in Caribbean islands as, in particular, potential sources of mosquitoes larvae, mosquitoes being vectors of diseases (Personnal comment).

Diseases

Even though some Caribbean reefs have managed to maintain stable coral cover, the Caribbean-wide region has lost 60%–80% of its coral cover since the 1970s. The region-wide decline has been attributed to a combination of disease, overfishing of herbivores, and an additional range of pressures resulting from human activities. In the mid-1970s, white band disease affected acroporids, which were major coral reef builders in the region. In the early 1980s mass mortality of the sea urchin Diadema spp., an important grazer of macroalgae on the reef, occurred owing to an unidentified pathogen. The severe reduction of Diadema spp., combined with a diminished herbivorous fish population due to unsustainable fishing practices, allowed fleshy algae to become increasingly

[19]See Ferrario, F. et al. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nat. Commun. 5:3794 doi: 10.1038/ncomms4794 (2014). Reference 27 of this report.

dominant at the expense of corals. Stony Coral Tissue Loss Disease that has been affecting Saint Martin and Sint Maarten's coral reefs has not been observed yet in St Barthelemy.

Reefs anthropogenic pollution:

Various human activities affect water quality providing nutrients to support the growth and increasing abundance of macro-algae on reefs, further contributing to the decline in reef health. External input of organic material to coastal environments inevitably results in microbial decomposition of some fraction of this material either in the water column, at the seafloor or in the sediments. At every depth, decomposition of organic material produces CO_2 and consumes oxygen, the former leading to lower seawater pH and aragonite saturation (Ωar).[20] Depending on the specific setting (i.e., depth, geomorphology, and hydrodynamics) as well as the amount and reactivity of the organic material, oxygen availability may reach hypoxic or even anoxic conditions while seawater pH and Ωar may reach levels that are corrosive to calcareous structures (i.e., $\Omega ar < 1$). Eutrophication, the addition of excess nutrients, may initially stimulate phytoplankton blooms in the water column that lower CO_2 and elevate oxygen, but once this material settles to the benthos, the reverse will occur with potential negative consequences for sessile benthic organisms like reef-building corals.[21] Marigot Bay, Grand Cul de Sac, Petit Cul de Sac, St Jean and Lorient were identified in April 2019 to be the bays requiring priority measures due to the presence of its sensitive ecosystems (coral reefs, marine phanerogams and their

[20]Aragonite saturation state is commonly used to track ocean acidification because it is a measure of carbonate ion concentration. When aragonite saturation state falls below 3, these organisms become stressed, and when saturation state is less than 1, shells and other aragonite structures begin to dissolve. See the definition of aragonite sea surface saturation at https://sos.noaa.gov/datasets/ocean-acidification-saturation-state/. (Last visited 20th April 2021)

[21]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 26 of this report.

associated biota) facing numerous threats and pressures.22 A 2020 Report of the Agence Territoriale de l'Environnement warned of an increase of the algae coverage, concurring with a decreasing coral coverage and the absence of sea urchins during the survey of Le Boeuf coral reef monitoring station, off of Colombier Bay. Millepora is the coral reef genus the most present at Le Boeuf and Colombier coral reefs stations.23 Even if the average coverage of the reefs of St Barthelemy by corals has been low (26%) due to the regular cyclonic swells natural impacts, an alarming decline of corals recruitment and of herbivorous sea urchins, concurring with an increased density of macro-algae and corals necrosis at Ilet Coco, were reported. Coral reefs' health was reported as stable at la Baleine du Pain de Sucre within the MPA.24

Coral bleaching events and short and long term trends of the Caribbean reefs under climate change:

Climate change has been impacting the coral reefs of the Caribbean region including the reefs of St Barthelemy during bleaching events in 1984, 1987, in 1998 when 56% of Guadeloupe's coral reefs and 59% of Martinique's coral reefs were affected, causing the death of 20 to 30% of the bleached coral reefs, and in 1999 when 50% of the reefs of Guadeloupe were affected. The most important coral bleaching event occurred in 2005, when 80% of the French Antilles reefs were affected, causing the death of 40 to 60% of the reefs the next year. The repetition of coral bleaching events in the Caribbean region is threatening the very existence of the reefs at a short-term.25 Since the industrial revolution, the oceans have taken up approximately 40% of the CO2 released to the atmosphere

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[22]See Ifrecor Comite local IFRECOR de St Barthelemy (2019) Compte rendu et proposition d'éléments pour l'élaboration du plan local d'action IFRECOR de Saint-Barthélemy, Petites Antilles 38 pages. Reference 6 of this report.

[23]See Reserve Naturelle de Saint Barthelemy (2020) Suivi de l'etat de sante des peuplements dans les reserves naturelles marines, Reserve Naturelle de Saint Barthelemy 2007 - 2020, 1 page. Reference 22 of the report.

[24]See Bouchon C .et Y. Universite des Antilles (2019), Evolution des communautés récifales de Saint Barthelemy: années 2002 a 2018, 53 pages. Reference 18 of the report.

[25]See Bouchon C .et Y. Universite des Antilles (2019), Evolution des communautés récifales de Saint Barthelemy: années 2002 a 2018, 53 pages. Reference 18 of the report.

from burning of fossil fuels and cement production. In the Caribbean, this uptake of CO_2 has resulted in increased surface seawater pCO_2 and lowered pH and aragonite saturation state (Ωar). In some areas, surface seawater Ωar has decreased in excess of 40%. This makes the Caribbean basin one of the fastest changing chemical environments under ocean acidification. As a result, conditions there have become increasingly less favorable for biological $CaCO_3$ production. While Caribbean waters are mostly still favorable for biological $CaCO_3$ production, higher pCO_2, and lower pH and Ωar have been shown to reduce calcification rates in corals and other marine calcifiers. These ocean chemistry changes have also shown to enhance the loss of $CaCO_3$ from reefs by increased carbonate dissolution. Further, the ability of physical processes, such as waves and storms, and biological organisms to erode the weakened $CaCO_3$ reef framework has also been enhanced under a lowering of pH and Ωar.26

Seagrass meadows threats: human induced pollution and fragmentation, impact of the invasive seagrass *Halophila stipulacea*, climate change, *Sargassum* strandings

Seagrass meadows are a critical habitat and foraging ground for sea turtles and also nursery grounds for many fishes and other marine wildlife species. Shallow inter- and subtidal foreshores of natural tropical sandy beaches are predominately composed of locally produced calcium carbonate ($CaCO_3$) sediments. These carbonate sediments are biogenically produced and need to be continually captured and retained within the foreshore for a beach to resist erosion and remain stable, which seagrasses are very effective at achieving.27 Amongst many of their ecosystem services, their value being estimated at US$34,000 per hectare

[26]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 26 of this report.
[27]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 21 of this report.

per year,28 seagrass meadows also help lessens the impacts of severe weather, reduce erosion and mitigate the effects of climate change by absorbing about 10 percent of the total estimated organic carbon sequestered in the Oceans each year.29 Human impacts on seagrasses ecosystems are direct, affecting seagrasses locally, and indirect, which may affect seagrass meadows far away from the sources of disturbance. Human impacts in the coastal zone are responsible for most threats to seagrass species.30 The development of human infra-structure along the coasts and waterways has led to the rapid loss of natural systems that accumulate and stabilize sediment—such as coastal dunes, seagrass meadows, and mangroves—disrupting the regular pathways of sediment transport.31 There is evidence of widespread decline in both temperate and tropical ecosystems.32 The estimated loss of seagrass from direct and indirect human impacts amounts was reported to be 33 000 km2, or 18% of the documented seagrass area, over the last two decades in a study in 2003.33 Almost 15% of seagrass species are considered threatened.34 A third of the global seagrasses were reported as

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[28]See Frederick T. Short, Beth Polidoro, Suzanne R. Livingstone, Kent E. Carpenter, Salomão Bandeira, Japar Sidik Bujang, Hilconida P. Calumpong, Tim J.B. Carruthers, Robert G. Coles, William C. Dennison, Paul L.A. Erftemeijer, Miguel D. Fortes, Aaren S. Freeman, T.G. Jagtap, Abu Hena M. Kamal, Gary A. Kendrick, W. Judson Kenworthy, Yayu A. La Nafie, Ichwan M. Nasution, Robert J. Orth, Anchana Prathep, Jonnell C. Sanciangco, Brigitta van Tussenbroek, Sheila G. Vergara, Michelle Waycott, Joseph C. Zieman, Extinction risk assessment of the world's seagrass species, Biological Conservation, Volume 144, Issue 7, 2011, Pages 1961-1971, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2011.04.010. Reference 33 of this report.

[29]See UNEP (2019), ECOSYSTEMS AND BIODIVERSITY, Seagrass—secret weapon in the fight against global heating at https://www.unep.org/news-and-stories/story/seagrass-secret-weapon-fight-against-global-heating. (Last visited 17 April 2021)

[30]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report. See also Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 24 of the report.

[31]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 21 of this report.

[32]See Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 34 of the report.

[33]See Duarte, C., Borum, J., Short, F., & Walker, D. (2008). Seagrass ecosystems: Their global status and prospects. In N. Polunin (Ed.), Aquatic Ecosystems: Trends and Global Prospects (pp. 281-294). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511751790.025. Reference 35 of this report.

[34]See Hughes, A.R., Williams, S.L., Duarte, C.M., Heck, K.L., Jr and Waycott, M. (2009), Associations of concern: declining seagrasses and threatened dependent species. Frontiers in Ecology and the Environment, 7: 242-246. https://doi.org/10.1890/080041. Reference 36 of the report.

declining worldwide, ten of the seventy-two species of seagrass being at elevated risk of extinction and three species listed as Endangered on the IUCN Red List. Twenty-two seagrass species (31%) were reported having declining populations, including all species listed as threatened (Endangered or Vulnerable) or Near Threatened, and six seagrass species listed as Least Concern. Twenty-nine of 72 species (40%) were considered as a stable population (i.e., not decreasing or increasing globally), and five species (7%), all listed as Least Concern, were showing an increasing population.35

Site studies:

Marigot Bay, Grand Cul de Sac, Petit Cul de Sac, St Jean and Lorient were identified in April 2019 to be the bays requiring priority measures due to the presence of its ecosystems facing numerous threats and pressures. Management of sources of direct anthropogenic pollution were reported as a priority, including in particular the modernization of the waste water system, the improvement of the desalinization waters' system, the reduction of the use of polluting antifouling paint. Identified polluting person or companies are being fined by the Environmental Agency of St Barthelemy and asked to upgrade to standards.36 Petit Cul de Sac mix seagrass meadow of *Thalassia testudinum* and *Syringodium filiforme* was reported as in good health in its 2020 monitoring survey, showing no fragmentations.37 St Jean seagrass meadow was reported as severely polluted by macro-algae *Chaetomorpha* spp., its seagrass meadow mainly composed of *Syringodium filiforme*, *Halophila stipulacea* and *Halodule wrightii*, *Thalassia*

[35]See Frederick T. Short, Beth Polidoro, Suzanne R. Livingstone, Kent E. Carpenter, Salomão Bandeira, Japar Sidik Bujang, Hilconida P. Calumpong, Tim J.B. Carruthers, Robert G. Coles, William C. Dennison, Paul L.A. Erftemeijer, Miguel D. Fortes, Aaren S. Freeman, T.G. Jagtap, Abu Hena M. Kamal, Gary A. Kendrick, W. Judson Kenworthy, Yayu A. La Nafie, Ichwan M. Nasution, Robert J. Orth, Anchana Prathep, Jonnell C. Sanciangco, Brigitta van Tussenbroek, Sheila G. Vergara, Michelle Waycott, Joseph C. Zieman, Extinction risk assessment of the world's seagrass species, Biological Conservation, Volume 144, Issue 7, 2011, Pages 1961-1971, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2011.04.010. Reference 33 of this report.
[36]See Ifrecor Comite local IFRECOR de St Barthelemy (2019) Compte rendu et proposition d'éléments pour l'élaboration du plan local d'action IFRECOR de Saint-Barthélemy, Petites Antilles 38 pages. Reference 6 of this report.
[37]See Reserve Naturelle de Saint Barthelemy (2020) Suivi de l'etat de sante des peuplements dans les reserves naturelles marines, Reserve Naturelle de Saint Barthelemy 2007 - 2020, 1 page. Reference 22 of the report.

testudinum having completely disappeared. Waste-waters of the watersheds (Hotel) and boat anchoring could be responsible of the degradation of the seagrass meadows of St Jean Bay (pers. comment).

Halophila stipulacea

Halophila stipulacea Fosskal is a tropical, euryhaline marine angiosperm in the family Hydrocharitaceae, that was reported in St Barthelemy.38 H. stipulacea was first reported in the Caribbean in Grenada in 2002, followed by reports from Dominica and Saint Lucia in 2007 and 2008, respectively. Since then, the seagrass has been found in Bonaire, Guadeloupe, Les Saintes, Martinique and St. Maarten (Netherlands). The invasive seagrass was not observed in Antigua in 2008 or 2010 during seagrass surveys. *H. stipulacea* was found along the northeastern coastline in small patches within Baie de Cul-de-Sac, as well as at several sites within a 4 km radius including Anse Marcel, Ilet Tintamarre, and Baie de L'Embouchure. The seagrass occurred within extensive meadows of T. testudinum and *S. filiforme* at a depth of 1–10 m. *H. stipulacea* has also been reported from the Dutch portion of Simpson Bay Lagoon. *Penicillus* spp. and *Caulerpa* sp. (Chlorophyta), and *Astichopus multifidus* (Holothuroidea) occurred alongside the invasive seagrass. *H. stipulacea* has demonstrated exceptional ecological flexibility in salinity, depth and habitat in its invasive range and a high potential for dissemination to new locations.39 The invasive seagrass has been reported as capable of rapid expansion, with the displacement of the native seagrass Syringodium filiforme beginning in 10–12 weeks, and may be able to overtake the indigenous seagrass species. Changes of the associated fauna are also occurring in *Halophila stipulacea* seagrass meadows compare to *Syringodium*

[38]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report. See also Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 34 of the report.

[39]See Willette et al. (2013) Continued expansion of the trans-Atlantic invasive marine angiosperm Halophila stipulacea in the Eastern Caribbean, Aquatic Botany 112 (2014) 98–102, http://dx.doi.org/10.1016/j.aquabot.2013.10.001. Reference 19 of the report.

filiforme meadows.40 Anthropogenic pollution and marine turtle foraging grounds degradation by boats anchors appear to favor the development of the invasive seagrass *Halophila stipulacea*.41 *Halophila stipulacea* has been reported at Colombier,42 Petit Ilet de Fourchue,43 and St Jean (pers.comment).

Grazers can structure primary producer communities in ways that have profound consequences for other organisms and ecosystem dynamics, grazers can therefore affect invasion dynamics. Cafeteria and count of the number of turtle bites experiments demonstrated that green turtles *Chelonia mydas* seem to prefer to forage on native seagrasses *Thalassia testudinum* and *Syringodium filiforme*, regardless of seagrass relative percentage covers, which consequently likely facilitate the invasion of seagrass meadows by *Halophila stipulacea*. Marine turtles seem to nonetheless forage on *H. stipulacea* when it is the only seagrass available.44 The nutritive qualities of *Halophila stipulacea* differ from *Thalassia testudinum*: the grazed leaf biomass was similar for both *T. testudinum* and *H. stipulacea*, while the grazed leaf biomass was significantly lower for *S. filiforme*. The nutritional values were significantly higher for leaf material collected from the native *T. testudinum* compared to the invasive *H. stipulacea* and the other native *S. filiforme* seagrass: nitrogen and phosphorus contents were significantly higher, and C:N ratios were significantly lower for *T. testudinum* compared to *H. stipulacea*.

[40]See Willette D, Ambrose R (2012) Effects of the invasive seagrass Halophila stipulacea on the native seagrass, Syringodium filiforme, and associated fish and epibiota communities in the Eastern Caribbean, Aquatic Botany 103; 74–82, http://dx.doi.org/10.1016/j.aquabot.2012.06.007. Reference 19 of the report.

[41]See Claire Saladin (2020). Saint Martin FWI Chapter 16. Nalovic MA, Ceriani SA, Fuentes MMPB, Pfaller JB, Wildermann NE, Cuevas E (Eds.) (2020). *Sea Turtles in the North Atlantic & Wider Caribbean Region. MTSG Regional Report 2020*. Report of the IUCN-SSC Marine Turtle Specialist Group, 2020. Reference 8 of the report.

[42]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report. See also Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 34 of the report.

[43]See Bouchon C .et Y. Universite des Antilles (2019), Evolution des communautés récifales de Saint Barthelemy: années 2002 a 2018, 53 pages. Reference 18 of the report.

[44]See Whitman E, Heithaus M, Garcia Barcia L, Brito D, Rinaldi C, Kiszka J, Effect of seagrass nutrient content and relative abundance on the foraging behavior of green turtles in the face of a marine plant invasion, MARINE ECOLOGY PROGRESS SERIES Vol. 628: 171–182 (2019), https://doi.org/10.3354/meps13092, and supplementary material. Study in Malendure Guadeloupe, reference 17 of this report. See also Christianen et al. (2019) Megaherbivores may impact expansion of invasive seagrass in the Caribbean, Journal of Ecology;107:45–57, DOI: 10.1111/1365-2745.13021. Study in Lac Bay Bonaire Dutch West Indies, reference 28 of this report.

The soluble sugars contents in *T. testudinum* leaves were measured as significantly higher compared to *H. stipulacea* and *S. filiforme* leaves, which can explain why marine turtles overall prefer to forage on *Thalassia testudinum*.45

Climate change

Climate change impacts on seagrass meadows have been studied and were reported to potentially exacerbate anthropogenic pressures impacts, in particular less ecologically resilient seagrass meadow species. Rising sea temperatures could alter the growth rates and physiological functions of seagrass marine phanerogams and modify the species present in favor of the most resilient ones. A potential change in their abundance and distribution has also been reported. Rising sea levels could also have an impact on the photosynthetic activities of deep see seagrass meadow species and generate a change in their distribution. *Halophila* spp. and *Halodule* spp. are species more tolerant to the lack of light and could be favored to the detriment of *Thalassia* spp. and *Cymodocea* spp. requiring more light. Ocean level rise could also generate a regression of intertidal and deep seagrass meadows. Reproductive capacities of some seagrass meadows species, requiring to touch the surface of the water for their sexual reproduction, could also be impacted (*Enhalus acorides*). Modification of the tides cycles could also cause a reduction of light and an increase exposition of intertidal and shallow seagrasses to UV. Increased sea surface temperatures could also fragilise seagrass meadows by causing their foliar necrosis, as well as an increase of their respiration. Climate change is also predicted to cause more frequent and more intense rainfalls, inducing a decrease in salinity and an increase of nutrients in the coastal areas, that could threaten estuarine marine phanerogams. Some studies also described that seagrass meadows could beneficiate of the Oceans' acidification, increasing the availability of CO2 and bicarbonates for photosynthesis. Oceans' acidification could also cause the loss of phenolic

[45]See Christianen et al. (2019) Megaherbivores may impact expansion of invasive seagrass in the Caribbean, Journal of Ecology;107:45–57, DOI: 10.1111/1365-2745.13021. Study in Lac Bay Bonaire Dutch West Indies, reference 28 of this report.

substances, protector of marine and estuarine phanerogams leaves, increasing the pressure of herbivorous species, the mortality and decomposition of seagrass meadows. Saturation of the photosynthesis could also generate an increased competition between phanerogams and macro-algae. Oceans' pH modification could cause a change of the seagrass leaves' epibiontes: calcifying organisms like encrusted coralline algae, foraminifers, bryozoaires, polychetes, could be declining due to the reduction of calcification. Increase of CO2 could stimulate the photosynthesis of epiphyte algae.46

Sargassum strandings

Sargassum pelagic strandings, that could also originate from climate change, have been severely impacting coastal seagrass meadows, causing a diminution of their upper distribution, the bleaching of the plants covered by sargassum influx, and a switch to an algae ecosystem.47

Site studies:

Four stations of seagrass meadows in St Barthelemy were selected and studied in 2017 and 2018, with the aim to develop a seagrass meadow monitoring method: Colombier (*Thalassia testudinum*, *Syringodium filiforme*, *Halophila stipulacea*), Grand Cul de Sac (*Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii*), Petit Cul de Sac (*Thalassia testudinum*, *Syringodium filiforme*) and Marigot (*Thalassia testudinum*, *Syringodium filiforme*). The potential anthropogenic pressures gradient was estimated based on the proximity and intensity of anthropogenic perturbations, four criterions were considered: turbidity, organic matter, nutrients and

[46]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report.
[47]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report.

pollutants.48 Petit Cul de Sac was indexed as a seagrass meadow affected by moderate anthropogenic pressures (watershed waste-waters), as Grand Cul de Sac (watershed waste-waters and nautical activities) and Colombier (nautical activities). Marigot was listed as a site affected by a high level of anthropogenic pressures due to the volumes of watershed waste-waters being discharged at the site. Structural and morphological features of each site were recorded, physiological parameters including ratios of stable isotopes δ13C et δ15N, proportion of nutriments N and P, and traces of metallic elements Mn, Fe, Zn, Pb, Cd, Cr, Cu, Ni and Hg, in particular, were measured and analyzed. Biotic parameters were studied as well as abiotic parameters including sediment and water column of the samples characteristics. The measures of metallic element traces in Thalassia testudinum rhizomes on St Barthelemy is summarized in Figure 2, in Thalassia testudinum leaves in Figure 3. Figure 4 indexes contents in δ15N, N and P in Thalassia testudinum rhizomes.

Content in trace metallic element Mn Fe and Zn showed higher concentrations linked to the gradient of anthropogenic pressures. Cu element values showed inter-annual variations and were not linked to the gradient of anthropogenic pressures. There are no significant differences linked to the gradient of anthropogenic pressures of content in Cr and Ni. Hg was not detectable. Mn Ni and Cd were more abondant in leaves than rhizomes of *Thalassia testudinum*. Colombier showed concentrations of metallic trace element in the same ranges as Marigot, indexed as a bay with severe anthropogenic pressures. Colombier is a bay highly frequented by boats, which can explain such concentrations in metallic trace elements in its seagrass meadow of *Thalassia testudinum*. There are no defined thresholds of trace elements in seagrasses to refer to (pers. comment).

[48]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.

Thresholds were estimated for *Thalassia testudinum*, depending on the anthropogenic pressures gradient:

Pristine conditions were defined as: 0,8 < δ15N < 2,5 ‰; N < 1,8%; P < 0,2%; Mn < 50 µg.g-1; Pb < 0,75 µg.g-1; Fe < 100 µg.g-1; Zn < 20 µg.g-1.

Under severe anthropogenic pollutions seagrass meadow samples would show measures in the ranges of : δ15N > 4 ‰; N > 2%; P > 0,25%; Mn > 100 µg.g-1; Pb > 1 µg.g-1; Fe > 200 µg.g-1; Zn > 25 µg.g-1.

30 % of the seagrass meadows studied were showing signs of grazing from the indigenous herbivorous fauna. Sea turtle are intense grazers that are able to modify the profile of the seagrass meadows of a Bay.49 Sea tutles density could be estimated at an average of 15-20 turtles per hectare in Ti St Jean Bay, 6-10 turtles per hectare in Grand Cul de Sac, an average of 5 sea turtles per hectare in Petit Cul de Sac, and 1-3 sea turtles per hectare in Corossol for instances (Personnal observations, paragragh 1.5. Research of this report).

☆ Threats for the species and conservation efforts performed at a regional perspective

At a regional perspective, overharvesting and legal gaps concerning sea turtles have been identified and have been threatening the conservation efforts performed.50 Humber et al. 2014 described the Wider Caribbean as the second region in the World responsible for the direct take of sea turtles with 16 countries allowing their take in their Economic Exclusive Zones, representing one third (34.6%) of estimated takes in the World with an average of 14 640 turtles slaughtered per year. Although the extent of sea turtle take in the Caribbean

[49]See Christianen MJA et al. 2014 Habitat collapse due to overgrazing threatens turtle conservation in marine protected areas. Proc. R. Soc. B 281: 20132890. http://dx.doi.org/10.1098/rspb.2013.2890. Reference 37 of this report.
[50]See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164.

region seem underestimated.51 The public health risks associated with the consumption of sea turtle specimen ("meat" and eggs) have been thoroughly reported, and therefore sea turtle take and quotas of sea turtle take are not supported (personal comment).52 The appropriate protection on their migratory paths of marine turtles is urgently needed. Furthermore, illegal international trade has been reported in all the countries of the Lesser Antilles allowing sea turtle take: St Kitts and Nevis, Grenada, the British Virgin Islands, Montserrat, Dominica and St Lucia. Where sea turtle take is prohibited in the Lesser Antilles: Aruba, Curacao, USVI, Trinidad and Tobago, St Vincent and the Grenadines, St Martin FWI reported international illegal trade, the status of Martinique being "unknown".53 It is strongly suspected that the legal take authorized in a minority of countries of the Lesser Antilles has been easing illegal international trade in the region. An immediate moratorium on marine turtles and their derivatives' take in the Lesser Antilles is therefore sharply recommended. Recommendations so as to move towards secured, healthy and economically sustainable fishery practices at the global scale have been published.54

[51]See Humber et al. "So excellent a fish: a global overview of legal marine turtle fisheries" Diversity Distrib., 2014, 20, 579–590. See the alarming report of Haiti Ocean Project NGO of more than 1000 sea turtles slaughtered per month at one village of Haiti from April to October at https://www.juno7.ht/haiti-1000-tortues-tuees-chaque-mois-a-grand-boucan/. Considering the fact that sea turtle and other endangered marine life slaughter happens year round at all villages of Haiti, Humber et al. (2014) figures of sea turtle take in the Caribbean Region seem underestimated. Reference 43 of this report.

[52]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 16 of this report. See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. Reference 12 of this report.

[53]See Eckert, Karen L. and Adam E. Eckert. 2019. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Revised Edition. WIDECAST Technical Report No. 19. Godfrey, Illinois. 232 pages, plus electronic Appendices. Reference 4 of this report. See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. The article reported of international illegal trade coming from Ste Lucia going to Martinique.

[54]See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164.

1.4. Conservation.

Coral reefs restoration programs

NGO "Reef of Life" is leading the project of renaturalisation of the St Jean's Caille using the Biorock™ Technology further described herein. NGO "Ouanaolo Reef" has been leading the restoration project of Pointe Milou's coral reef St Barth Project "Arti-Reef", also using the electrolytic mineral accretion technic, and the project "Eden Reef" around the Eden Rock site.55 NGO "Coral Restoration St Barth" has also supported the conservation and restoration of St Barthelemy's coral reefs. Coral'substratum enhancement with electricity consists in a mesh plate disposed on the coral reef at the shore break point where a low voltage is diffusing (6 Volts). Water hydrolysis chemical reaction creates a calcium carbonate $CaCO_3$ sediment on the metal structure. $CaCO_3$ cement is 3 times denser than concrete, strengthens the structure and provides directly the elements necessary to corals to grow. At the site of La Caille de St Jean and Lorient for instance, coral reef coverage was reported to be less than 5%, which favors erosion of the opposite coastline and weakens protection in case of climatic events. The technique was reported in St Barthelemy to, within 6 months, support stony corals conservation by enhancing their growth, inducing a greater number of corals symbiotic algae zooxanthelles, occurring 3 to 5 times faster than in natural conditions, strengthening their calcification therefore their resilience to climatic events e.g. rising sea temperatures during the hottest months of the year or hurricanes, and by fighting against coral infectious agents. The device in St Jean was reported to grow of 13 cm per year on average, to have resisted to the two major hurricanes Gonzalo and Irma. More research has been proposed on St Jean's Caille by NGO "Reef of Life".56 Coral reefs nurseries are also ongoing conservation projects at St Barthelemy (pers. observations).57 The

[55]See NGO "Ouanalao Reef" Projects at www.ouanalaoreef.com.
[56]See NGO "Reef of Life" Projects at www.reef-of-life.com/biorock.
[57]See for instances these peer reviewed articles that described the coral substrate stabilization and enhancement technic, its published advantages and disadvantages: Ceccarelli DM, McLeod IM, Bostro¨mEinarsson L, Bryan SE, Chartrand KM, Emslie MJ, et al. (2020) Substrate stabilisation and small structures in coral restoration: State of knowledge, and considerations for management and implementation. PLoS ONE 15(10): e0240846.

possible treatment of the Soft Coral Tissue Loss Disease via the coral substrate electrolytic accretion technic is recommended to be tested and peer-reviewed.

Coastline vegetation restoration program

Coast-line restoration projects have been managed by several NGOs on Saint Barthelemy, at Saline Beach, Gouverneur, Petit Cul de Sac, and Grands Fonds for instance. Although parallel construction projects altering the back of some beaches have been also ongoing (Agence Territoriale de l'Environnement de St Barthelemy unpublished data): at Saline, Toiny, Grand Cul de Sac, Marigot, Lorient, St Jean, Anse des Cayes and Flamands. To mitigate this threat, stabilization of the beaches has been performed by adding wood posts retaining the sand, in French "ganivelles", at Saline. The local NGO "Make St Barth Green Again" in collaboration with the Environmental Agency of St Barthelemy has been restoring Saline Beach Dune, also a natural protection for St Barthelemy's inhabitants in case of hurricanes and sea level rise, particularly eroded after Hurricane Irma in September 2017. Wood posts imported from Poitou in France have been installed since 2018 and seeds of native species of Saint Barthelemy, as Ipomoea pes caprae ou "Patate de mer" for instance, have been planted. This project also includes tree planting on Saline.58 Restoration of the coastline's vegetation has also been performed by the local NGO "Coral Restoration Saint Barth".59 A native species seeds bank was created in 2017 by the Environmental Agency of St Barthelemy in partnership with local NGOs "In St Barth Experience" and "Coral Restoration St Barth", volunteers, day care children of "les Zandolis" and thanks to the donation of the town of Coutiches in the North of France. Revegetation of beaches, restoration of the mangrove of St Jean, are

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https://doi.org/10.1371/journal.pone.024084 (Reference 43 of this report) and Bostro¨m-Einarsson L, Babcock RC, Bayraktarov E, Ceccarelli D, Cook N, Ferse SCA, et al. (2020) Coral restoration – A systematic review of current methods, successes, failures and future directions. PLoS ONE 15(1): e0226631. https://doi.org/10.1371/journal.pone.0226631 (Reference 44 of this report).

[58]See for instance the Dune of Saline Restoration Project of NGO "Make St Barth Green again"description at www.greenstbarths.com/saline-beach-dune-restoration-1-week-of-works-in-videos-and-photos/.

[59]See www.coral-restoration-stbarth.com.

long term projects, also joyfully implemented by volunteers and sometimes together with schools of Saint Barthelemy.60

Monitoring of coral reefs and seagrass meadows

The monitoring of seagrass meadows and coral reefs stations have been performed since 2002 by the Environmental Agency of St Barthelemy in partnership with several organizations and institutions.

Recommendations

Abrogation of France's reservation on Chelonia mydas sea turtles take in all relevant international Treaties

The complete and infinite protection of green turtles Chelonia mydas is nonexistent at the international scale due to France's reservation on the species. France's reservation on Chelonia mydas implies that France tolerates the unhealthy and unsecure fishery practice that is the take of sea turtles or their derivatives in a general manner. France's reservation on Chelonia mydas is also, in reality, contradictory with the conservation actions thoroughly implemented, as it entails that France tolerates that sea turtles that are completely protected by Law in Saint Barthelemy's E.E.Z., could be harvested a few nautical miles away in a neighbouring island, in another Party's E.E.Z., where the practice could be allowed, annihilating the conservation efforts performed and the entire protection of marine turtles assured so that the species can thrive again. It is therefore firmly recommended that France sends the unbiased message of its commitment to marine turtles entire protection by implementing the complete and infinite prohibition of all species of sea turtles and their derivatives' take on

[60]See Restoration of the coastline's vegetation guidelines of the Agence Territoriale de l'Environnement de ST Barthelemy at https://agencedelenvironnement.fr/portfolio/re-vegetalisation-de-saint-barthelemy-apres-irma/ . See also the restoration of the St Jean lagoon' mangrove project at https://agencedelenvironnement.fr/portfolio/nettoyage-de-letant-de-st-jean/.

its entire territory and by repealing its reservation on Chelonia mydas and on strictly protected fauna species in all relevant Treaties.61

Nesting marine turtles flipper-tagging campaign

Due to the alarming levels of take of marine turtles and many marine species (manatees, nurse sharks for instances) reported in the Caribbean region including at Haiti, and due to the fact that fishermen or marine turtle harvesters, including Haitian sea turtle takers, have been reported to be more susceptible to release their catch when the marine turtle is identified by flipper tags, it has been strongly recommended to urgently implement a flipper tagging campaign of nesting marine turtles on Saint Barthelemy FWI.62

Implementation of CITES Decision 18.211 paragraph g) via the Mt DNA registration of the resident and nesting sea turtles of St Barthelemy in the CITES sea turtle shell bank

CITES Decision 18.211 paragraph g) urged Parties to "Collect samples of marine turtles for DNA analysis, including from seized specimens, to determine species involved and populations of origin and provide these to forensic and other research institutions capable of reliably determining the origin or age of the samples in support of, for example, research, investigations and prosecutions;".63 This report recommends the implementation of CITES

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[61]See Table 3 of this report. See Claire Saladin (2020) SAINT BARTHELEMY FWI Chapter 14 In: Nalovic MA, Ceriani SA, Fuentes MMPB, Pfaller JB, Wildermann NE, Cuevas E (Eds.) (2020). Sea Turtles in the North Atlantic & Wider Caribbean Region. MTSG Regional Report 2020. Report of the IUCN-SSC Marine Turtle Specialist Group, 2020. Reference 8 of this report. See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. Reference 9 of this report.

[62]Flipper tagging is a common practice in the Wider-Caribbean, including in Florida, and has also proven to be very informative in marine turtle nesting, foraging ecology and migratory patterns studies. Cases of fibropapillomatosis linked to flipper tags have not been confirmed by Widecast colleagues. There are no peer-reviewed article to date reporting of flipper tagging as a trigger of marine turtles fibropapillomatosis. (pers. observations). See Humber et al. "So excellent a fish: a global overview of legal marine turtle fisheries" Diversity Distrib., 2014, 20, 579–590. See the alarming report of Haiti Ocean Project NGO of more than 1000 sea turtles slaughtered per month at one village of Haiti from April to October at https://www.juno7.ht/haiti-1000-tortues-tuees-chaque-mois-a-grand-boucan/.

[63]See CITES COP18 18.211, at para. g.

Decision 18.211 paragraph g) on St Barthelemy via the development of a protocol of sampling of St Barthelemy resident and nesting sea turtles.

Coral reefs and seagrass meadows enhanced conservation via the renewal of waste waters of the watersheds management and monitoring of the seawater chemistry changes

Measurements of selected stations seawater pCO2, pH and surface seawater Ωar could be included into the coral reefs monitoring. Under current global socioeconomic conditions, future model projections for the wider Caribbean suggest that average (± standard error) sea surface temperature could increase by 1.76 ± 0.39◦C during the 21st century, but with different warming trends in summer and winter. Average surface seawater pH and Ωar could decrease by 58% and 32%, respectively. Eutrophication and organic matter input can be the main drivers of acidification of reef waters or exacerbating the long-term effect of rising atmospheric CO2. Management efforts addressing water quality can assist in lowering global acidification effects at the reef scale, as the local and global acidification impacts combine and are intrinsically coupled. Both ocean warming and acidification will pose increasing threats to the ability of Caribbean reefs to sustain themselves and recover from future acute stress events unless imminent actions are taken at both the local, regional and global scale.64

Assessment of the distribution and monitoring of Halophila stipulacea in St Barthelemy

An enhanced mangroves restoration program

Mangroves are sea turtle habitats, ideal nursery grounds for groupers, snappers for exemple, protective ecosystems for smaller fishes, coastlines natural buffer

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[64]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 26 of this report.

from sea level rise, crucial for carbon sequestration. Mangroves are indeed a significant global carbon store and sink, with the largest average carbon stocks per unit area of any terrestrial or marine ecosystem. The global average carbon stock of mangroves is around 1,000 tonnes of carbon per hectare, including soil carbon. The bulk of mangrove carbon is held in the soil, ranging from about 83% to almost 99% of the carbon stored in mangroves. A variety of factors affect the effectiveness of mangroves as carbon stores and sinks, such as the hydrology (tidal inundation, strength and frequency) salinity (freshwater availability), tropical cyclone frequency, nutrient availability and climate. Larger carbon stocks tend to be found in equatorial areas, areas of lower soil salinity, higher rainfall, and in sites with infrequent cyclones. Conversion of mangroves for coastal development can release stored carbon that has been accumulating in place for thousands of years back into the air, resulting in exceptionally high carbon dioxide emissions. Emissions resulting from mangrove losses make up nearly one fifth of global emissions from deforestation. Climate change impacts on mangroves are expected to be linked to rising sea levels restricting their habitat to half of the tidal range. In some locations, the mangroves may be able to retreat landward but this will depend on the availability of suitable habitat for them to move into, and many coastal lowlands, as in St Barthelemy, are now suffering from coastal squeeze as they have been modified to the extent that this cannot happen. Increased intensity and frequency of storms will also potentially increase pressure through damage, tree mortality, stress, and changes in sediment surface elevation through erosion, deposition, and compression. By 2100, an estimated 10-15% of mangroves could be lost to climate change. The impact of projected temperature increase, the direct effects of carbon dioxide increase, and changes in rainfall patterns are hard to predict, but in some cases may even be beneficial, increasing mangrove productivity and biodiversity particularly at higher latitudes. The benefits of carbon dioxide increase however could be reduced if there are also negative impacts from changes in salinity, humidity and nutrients and, where rainfall is projected to decrease rather than increase, there could be reduced productivity and biodiversity and greater relative subsidence, as less sediment is deposited. Amongst many of their ecosystem services, mangroves also maintain surrounding water quality by filtering riverine and tidal waters of sediments, minerals, contaminants and nutrients. Mangrove trees and associated plants have a high tolerance for a wide range of salinities and contamination levels and perform an effective service in biofiltration and waste processing. However, critical thresholds for salinity, heavy metals, chlorine containing organic compounds and sediments do exist, beyond which mangrove die-back will occur.65

1.5. Research

The research projects recommended include but are not limited to:

Marine turtles chromaticity variation in St Barthememy research project

The statistical analysis of the photo-identification data could be performed so as to investigate a link of several parameters with marine turtles shells chromaticity variations or aberrations.

∞ The influence of UV rays could be studied. Methods of the study could include but are not limited to: the categorization of chromaticity variations, the study of transects of selected bays so as to identify a correlation of, for instance, the pourcentage of coverage by seagrass meadows of the transects, the species of seagrass meadows of the Bay and of the transects, the UV dose of the transects, the UV dose of the transect depending on the transect's floor type (sand, seagrass meadow of low density, seagrass meadow of high density, species of marine phanerogam present), the depth of the transects, the density in sea turtles of the transect and of the Bay, the pourcentage of grazed seagrass meadow observed in

[65] See UNEP (2014). The Importance of Mangroves to People: A Call to Action. van Bochove, J., Sullivan, E., Nakamura, T. (Eds). United Nations Environment Programme World Conservation Monitoring Centre, Cambridge. 128 pp. Reference 29 of the report.

the transect or in the Bay, the average temperature of the transects, with shell chromaticity variation.

∞ Genetics research could be associated to the project.

∞ A nutritional deficiency hypothesis could also be explored, in particular at Ti St Jean Bay.

Marine phanerogams preferences of *Chelonia mydas* in Saint Barthelemy

A "count of number of bites" experiment could study the food preferences of *Chelonia mydas* in selected transects of Bays of Saint Barthelemy where *Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii* and/or *Halophila stipulacea* are observed. Results could be correlated to the pourcentage of invasion of the transect of study or of the Bay by *Halophila stipulacea*.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Barthelemy FWI.

Topic	*C. mydas*	Ref #	*D. coriacea*	Ref #	*E. imbricata*	Ref #	*C. caretta*	Ref #	*L. olivacea*	Ref #
Occurrence										
Nesting sites	Y 15	1;2	Y 2	1;2	Y 17	1;2	N	2;3	N	2;3
Pelagic foraging grounds	Y Cf Fig 1	1;2;3;4	n/a	1;2;3;4	Y Cf. Fig 1	1;2;3;4	Y?	2;3	Y?	2;3
Benthic foraging grounds	Y Cf Fig 1	1;2;3;4	n/a	1;2;3;4	Y Cf Fig 1	1;2;3;4	Y?	2;3	Y?	2;3
Key biological data										
Nests/yr: recent average (range of years): rate based on crawls observed	2.25 (1982-2018)	2	0,4 (1982-2018)	2	3,75 (1982-2018)	2	n/a		n/a	
Nests/yr: recent order of magnitude	0 - 17	2	0 - 3	2	0 - 18	2	n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	1;2	0	1;2	0	1;2	n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	15	2	2	2	17	2	n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	0.15 (1982-2018)	1;2	0.20 (1982-2018)	1;2	0.22 (1982-2018)	1;2	n/a		n/a	
Total length of nesting sites (km)	6.400	2	1,155	2	6,725	2	n/a		n/a	
Nesting females / yr	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Nests / female season	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Female remigration interval (yrs)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	

Sex ratio: hatchlings (F / Tot)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Sex ratio: juveniles (F / Tot)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Sex ratio: Adults (F / Tot)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Min adult size, CCL or SCL (cm)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Age at maturity (yrs)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Clutch size (n eggs)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Emergence success (hatchlings/egg)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Nesting success (Nests/ Tot emergence tracks)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Trends										
Recent trends (last 20 yrs) at nesting sites (range of years): data subject to volunteers availability variable factor	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	1982	1;2	1982	1;2	1982	1;2	n/a		n/a	
Published studies	Y	1	Y	1	Y	1	n/a		n/a	
Growth rates	N	1;2	N	1;2	N	1;2	n/a		n/a	
Genetics	N	1;2	N	1;2	N	1;2	n/a		n/a	
Stocks defined by genetic markers	N	1;2	N	1;2	N	1;2	n/a		n/a	
Remote tracking (satellite or other): Antoinette and Leleka see Table 4	N	1;2	N	1;2	Y	1;2	n/a		n/a	
Survival rates	N	1;2	N	1;2	N	1;2	n/a		n/a	
Population dynamics	n/a	1;2	n/a	1;2	n/a	1;2	n/a		n/a	

Foraging ecology (diet or isotopes)	N	1;2	N	1;2	N	1;2	n/a		n/a	
Capture-Mark-Recapture	N	1;2	N	1;2	N	1;2	n/a		n/a	
Threats										
Bycatch: small scale / artisanal	Y	2	Y	2	Y	1;2	Y	2	Y	2
Bycatch: industrial	N	2	N	2	N	1;2	N	2	N	2
Bycatch: quantified?	N	2	N	2	N	1;2	N	2	N	2
Intentional killing or exploitation of turtles	N	2	N	2	N	1;2	N	2	N	2
Egg poaching	N	2	N	2	N	1;2	N	2	N	2
Egg predation	N	2	N	2	N	1;2	N	2	N	2
Photopollution	Y	2	Y	2	Y	1;2	N	2	N	2
Boat strikes	Y	2;5	Y	2;5	Y	2;5	Y	2;5	Y	2;5
Nesting habitat degradation erosion, contructions reducing the sand bank	Y	2	Y	2	Y	2	N	2	N	2
Foraging habitat degradation	Y	2;4	Y	2;4	Y	2;4	Y	2	Y	2
Other coral reefs bleaching, coral reefs diseases, sargassum entanglement. Climate change (storms and hurricanes damaging coral reefs, sea level rise reducing the sand bank). Sea Turtle harvest authorized in the neighboring Islands EEZ where Sea Turtles migrate.	Y	2;6;7; 8;9;10	Y	2;6;7; 8;9;10	Y	2;6;7; 8;9;10	Y	2;6;7; 8;9;10	Y	2;6;7;8;9; 10
Long-term projects	Y	1	Y	1	Y	1	Y	1	Y	1
Monitoring at nesting sites	Y	1;2	Y	1;2	Y	1;2	n/a	2	n/a	2

Number of index nesting sites	15	1;2	2	1;2	17	1;2	n/a	2	n/a	2
Monitoring at foraging sites	N but relevant information reported	1;2	N but relevant information reported	1;2	N but relevant information reported	1;2	N but relevant information reported	1;2;3	N but relevant information reported	1;2;3
Conservation										
Protection under national law	Y	1;2;4; 6;11	Y	1;2;4; 6;11	Y	1;2;4; 6;11	Y	1;2;6; 11	Y	1;2;6 ;11
Number of protected nesting sites (habitat preservation)	15	1;2;11	2	1;2;11	17	1;2;1 1	n/a	1;2	n/a	1;2
Number of Marine Areas with mitigation of threats	1	1;Fig 1	1	1;Fig 1	1	1;Fig 1	1	1;Fig1	1	1;Fi g1
Long-term conservation projects (number)	2	1;2;4; 9;10	2	1;2;4; 9;10	2	1;2;4; 9;10	2	1;2;4; 9;10	2	1;2;4 ;9;10
In-situ nest protection (eg cages)	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
Hatcheries	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
Head-starting	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
By-catch: fishing gear modifications (eg, TED, circle hooks)	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
By-catch: onboard best practices	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
By-catch: spatio-temporal closures/reduction	N	1;2	N	1;2	N	1;2	n/a	2	n/a	2
Other: St Barthelemy's Environmental Agency accredited and responsible for law enforcement concerning environmental matters. Nesting Beaches monitoring dependent on Volunteers availability	Y	1;2	Y	1;2	Y	1;2	Y	2	Y	2

Table 2. Sea turtle nesting beaches in Saint Barthelemy FWI.

Nesting site	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #
Chelonia mydas		Long	Lat	Long	Lat	Long	Lat			
Colombier	0,03 (1982-2018)	-62,869184	17,921572	-62,868090	17,923990	-62,868420	17,922935	0,310	100	1;2
Public	0,03 (1982-2018)	-62,852872	17,904408	-62,852321	17,903015	-62,852330	17,904000	0,165	100	1;2
Shell Beach	0 (1982-2018)	-62,849304	17,892951	-62,847509	17,892135	-62,848260	17,892716	0,225	100	1;2
Gouverneur	0,25 (1982-2018)	-62,834078	17,884311	-62,831396	17,885270	-62,832599	17,884957	0,305	100	1;2
Saline	0,50 (1982-2018)	-62,823641	17,886835	-62,819493	17,888240	-62,821608	17,887708	0,485	100	1;2
Grand Fond	0,08 (1982-2018)	-62,809775	17,890790	-62,808052	17,892238	-62,808982	17,891680	0,280	100	1;2
Toiny	0,35 (1982-2018)	-62,799455	17,896612	-62,795530	17,897630	-62,797217	17,897440	0,450	100	1;2
Petit Cul de Sac	0,03 (1982-2018)	-62,797161	17,906498	-62,794166	17,905650	-62,795894	17,905427	0,400	100	1;2
Grand Cul de Sac	0,08 (1982-2018)	-62,803070	17,913018	-62,800876	17,908366	-62,802244	17,908770	0.360 + 0.150	100	1;2
Marechal	0,05 (1982-2018)	-62,804810	17,912734	-62,803301	17,913196	-62,803835	17,912866	0,185	100	1;2
Marigot	0 (1982-2018)	-62,808941	17,910341	-62,809619	17,910944	-62,809363	17,910650	0,100	100	1;2
Lorient	0,10 (1982-2018)	-62,827877	17,908257	-62,821398	17,907737	-62,823792	17,906658	0,815	100	1;2
St Jean	0,05 (1982-2018)	-62,840950	17,905595	-62,832747	17,904040	-62,837642	17,903098	0.615 + 0,300	100	1;2
Anse des Cayes	0,40 (1982-2018)	-62,845028	17,913801	-62,842863	17,909861	-62,844025	17,911653	0,545	100	1;2
Flamands	0,25 (1982-2018)	-62,860105	17,919709	-62,854218	17,919815	-62,857234	17,918955	0,670	100	1;2
Bonhomme	0,05 (1982-2018)	-62,851709	17,930811	-62,851122	17,931160	-62,851409	17,930995	0,100	100	1;2
Fregate	0,03 (1982-2018)	-62,835654	17,938585	-62,832098	17,940206	-62,834650	17,939396	0.185 + 0.080	100	1;2
Erethmochelys imbricata										
Colombier	0.03 (1982-2018)	-62,869184	17,921572	-62,868090	17,923990	-62,868420	17,922935	0,310	100	1;2
Public	0,03 (1982-2018)	-62,852872	17,904408	-62,852321	17,903015	-62,852330	17,904000	0,165	100	1;2
Shell Beach	0,05 (1982-2018)	-62,849304	17,892951	-62,847509	17,892135	-62,848260	17,892716	0,225	100	1;2
Gouverneur	0,35 (1982-2018)	-62,834078	17,884311	-62,831396	17,885270	-62,832599	17,884957	0,305	100	1;2
Saline	0,55 (1982-2018)	-62,823641	17,886835	-62,819493	17,888240	-62,821608	17,887708	0,485	100	1;2
Grand Fond	0,18 (1982-2018)	-62,809775	17,890790	-62,808052	17,892238	-62,808982	17,891680	0,280	100	1;2
Toiny	0,70 (1982-2018)	-62,799455	17,896612	-62,795530	17,897630	-62,797217	17,897440	0,450	100	1;2

Petit Cul de Sac	0,03 (1982-2018)	-62,797161	17,906498	-62,794166	17,905650	-62,795894	17,905427	0,400	100	1;2
Grand Cul de Sac	0,18 (1982-2018)	-62,803070	17,913018	-62,800876	17,908366	-62,802244	17,908770	0.360 + 0.150	100	1;2
Marechal	0,15 (1982-2018)	-62,804810	17,912734	-62,803301	17,913196	-62,803835	17,912866	0,185	100	1;2
Marigot	0,05 (1982-2018)	-62,808941	17,910341	-62,809619	17,910944	-62,809363	17,910650	0,100	100	1;2
Lorient	0,40 (1982-2018)	-62,827877	17,908257	-62,821398	17,907737	-62,823792	17,906658	0,815	100	1;2
St Jean	0,65 (1982-2018)	-62,840950	17,905595	-62,832747	17,904040	-62,837642	17,903098	0.615 + 0,300	100	1;2
Anse des Cayes	0,10 (1982-2018)	-62,845028	17,913801	-62,842863	17,909861	-62,844025	17,911653	0,545	100	1;2
Flamands	0,20 (1982-2018)	-62,860105	17,919709	-62,854218	17,919815	-62,857234	17,918955	0,670	100	1;2
Bonhomme	0,10 (1982-2018)	-62,851709	17,930811	-62,851122	17,931160	-62,851409	17,930995	0,100	100	1;2
Fregate	0,03 (1982-2018)	-62,835654	17,938585	-62,832098	17,940206	-62,834650	17,939396	0.185 + 0.080	100	1;2
Dermochelys coriacea										
Colombier	0 (1982-2018)	-62,869184	17,921572	-62,868090	17,923990	-62,868420	17,922935	0,310	100	1;2
Public	0 (1982-2018)	-62,852872	17,904408	-62,852321	17,903015	-62,852330	17,904000	0,165	100	1;2
Shell Beach	0 (1982-2018)	-62,849304	17,892951	-62,847509	17,892135	-62,848260	17,892716	0,225	100	1;2
Gouverneur	0 (1982-2018)	-62,834078	17,884311	-62,831396	17,885270	-62,832599	17,884957	0,305	100	1;2
Saline	0,25 (1982-2018)	-62,823641	17,886835	-62,819493	17,888240	-62,821608	17,887708	0,485	100	1;2
Grand Fond	0 (1982-2018)	-62,809775	17,890790	-62,808052	17,892238	-62,808982	17,891680	0,280	100	1;2
Toiny	0 (1982-2018)	-62,799455	17,896612	-62,795530	17,897630	-62,797217	17,897440	0,450	100	1;2
Petit Cul de Sac	0 (1982-2018)	-62,797161	17,906498	-62,794166	17,905650	-62,795894	17,905427	0,400	100	1;2
Grand Cul de Sac	0 (1982-2018)	-62,803070	17,913018	-62,800876	17,908366	-62,802244	17,908770	0.360 + 0.150	100	1;2
Marechal	0 (1982-2018)	-62,804810	17,912734	-62,803301	17,913196	-62,803835	17,912866	0,185	100	1;2
Marigot	0 (1982-2018)	-62,808941	17,910341	-62,809619	17,910944	-62,809363	17,910650	0,100	100	1;2
Lorient	0 (1982-2018)	-62,827877	17,908257	-62,821398	17,907737	-62,823792	17,906658	0,815	100	1;2
St Jean	0 (1982-2018)	-62,840950	17,905595	-62,832747	17,904040	-62,837642	17,903098	0.615 + 0,300	100	1;2
Anse des Cayes	0 (1982-2018)	-62,845028	17,913801	-62,842863	17,909861	-62,844025	17,911653	0,545	100	1;2
Flamands	0,15 (1982-2018)	-62,860105	17,919709	-62,854218	17,919815	-62,857234	17,918955	0,670	100	1;2
Bonhomme	0 (1982-2018)	-62,851709	17,930811	-62,851122	17,931160	-62,851409	17,930995	0,100	100	1;2
Fregate	0 (1982-2018)	-62,835654	17,938585	-62,832098	17,940206	-62,834650	17,939396	0.185 + 0.080	100	1;2

Table 2.1. Saint Barthelemy's Sea Turtle crawls, nests or hatching nests observed per species per nesting beach between 1982 and 2018.

Nesting Beach/Species	***Chelonia mydas***	***Eretmochelis imbricata***	***Dermochelis coriacea***	**Indeterminate**
Colombier				1
Public				1
Shell Beach		1		
Gouverneur	2	4		6
Saline	4	5	5	12
Grand Fond		2		3
Toiny	3	10		8
Petit Cul de Sac				1
Grand Cul de Sac		2		3
Marechal		2		2
Marigot		1		
Lorient		6		4

St Jean		12		2
Anse des Cayes	7	1		2
Flamands	4	3	3	2
Bonhomme		1		2
Fregate				1
total	20	50	8	50

Table 2.2. Saint Barthelemy's Sea Turtle data per year per species between 1982 and 2018.

Year \ Species	**DC**	**CM**	**EI**	**Indeterminate : 50% CM 50 % EI**
1982	1	-	-	-
1992	-	-	1	-
2001	-	1	3	-
2002	-	-	2	-
2003	-	2	-	-
2004	-	-	1	3
2005	-	3	1	3
2006	-	-	-	3

Year \ Species	**DC**	**CM**	**EI**	**Indeterminate : 50% CM 50 % EI**
2007	-	-	1	1
2008	-	-	2	3
2009	3	1	4	5
2010	-	4	3	13
2011	1	-	2	6
2012	1	1	4	2
2013	-	4	4	1
2014	2	-	3	4
2015	-	-	2	2
2016	-	3	15	3
2017	-	-	2	-
2018	-	1	-	1
total	8	20	50	50
% nests/year during the 20 years	0,4	2,25	3,75	Data included by counting 50% CM and 50% EI

Table 3. International conventions protecting sea turtles and signed by Saint Barthelemy FWI.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	Y (France, European Union)	Y	Y	all	CITES or Washington Convention 1972 governs the international trade in threatened and endangered species, which are listed in three appendices to the Convention. The Convention requires parties to prohibit trade in listed species except in accordance with the provisions of the Convention.	All species of Sea Turtles are listed in CITES Appendix I. Appendix I includes endangered species for which trade in specimens must be strictly regulated; Their trade with a commercial primary purpose is prohibited.
CMS	Y (France, European Union)	Y	Y	all. Reservation concerning Chelonia mydas since 07.01.1990 applicable on France and its oversea Departments and Territories	The Bonn Convention 1979, or the Convention on the Conservation of Migratory Species of Wild Animals, seeks to conserve terrestrial, aquatic, and avian migratory species throughout their range.	All species of Sea Turtles are on Appendix I of the CMS.Parties that are a Range State to a migratory species listed in Appendix I shall endeavor to strictly protect them by: prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them. Cheloniidae C.spp and Dermochelyidae D.spp are also listed on Appendix II of the CMS. They are therefore protected by its provisions.
CBD	Y (France, European Union)	Y	Y	all	The Convention on Biological Diversity 1992 provides for the conservation and sustainable use of biological diversity, including with regard to access and sharing of the benefits arising out of the use of genetic resources.	CBD applies to the sustainable Management of St Barthelemys natural resources including Sea Turtles. Scientific Studies on Sea Turtles planning on the use of their genetic resources therefore require the declaration to the French Ministry of Environment.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CAR-SPAW	Y (France)	Y	Y	all	The Protocol of the Carthagena Convention 1990 for Specially Protected Areas and Wildlife in the Caribbean Region calls upon its signatories to identify and protect threatened and endangered species of fauna and flora through national law, including the taking, possession, and killing of these species. In addition, parties are to adopt cooperative measures to protect species listed on one of three Annexes to the Protocol, which contain threatened or endangered plant species (Annex I); threatened or endangered animal species (Annex II); and animal and plant species that are not threatened or endangered but which require special measures to ensure their protection (Annex III). A variety of species, including mangroves and seagrass, are listed in Annex III.	All Sea Turtles Species present on Saint Barthelemy are listed on Annex II of the CAR SPAW Protocol (Last Revision 2016). Total protection and recovery to the species of Sea Turtles listed in Annex II are ensured by prohibiting the taking, possession or killing, the incidental taking, possession or killing or commercial trade of Sea Turtles, their eggs, parts or products; and prohibiting of the disturbance of Sea Turtles, particularly during periods of breeding, incubation, estivation or migration, as well as other periods of biological stress.
Berne Convention	Y (France, European Union)	Y	Y	all. Reservation concerning the Appendix II "Strictly protected species" and concerning Chelonia mydas	The Bern Convention 1979 is a European Treaty aiming at ensuring conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species specified in appendices.	All species of Sea Turtles are listed in Appendix II of the Berne Convention. Chapter II provides for the protection of the habitat of Wild Fauna and Flora especially the species listed in Appendix I and II. Chapter III provides for the protection of Species. Chapter III Article 6 calls for State Parties to take the appropriate administrative and legislative measures to provide complete protection to all Species of Sea Turtles and ensure the prohibition of capture keeping and killing, damage of breeding and resting sites, disturbance, possession of eggs, internal trade of animals alive or dead. Chapter IV pertaining to migratory species, specifically provides for cooperation between Parties.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
UNCLOS	Y (France, European Union)	Y	Y	all	The Law of the Sea Convention 1982 defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. The Convention defines different areas from the baseline : internal waters, territorial waters, archipelagic waters, the contiguous zone, the exclusive economic zone, the continental shelf and the Area.	The Convention provides the legal framework for marine and maritime activities, establishes obligations for safeguarding the marine environment and provides freedom of scientific research on the high seas, respecting the Common Heritage of Mankind Principle. The First Intergovernmental Conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction has been convened pursuant to General Assembly resolution 72/249. The conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, in particular, together and as a whole, marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity-building and the transfer of marine technology are provided for in the ABNJ Treaty President's Aid to Negotiations UNGA A/Conf.232/2019/1 that has been prepared following the First Session of the Conference in September 2018 in NYC USA.
RAMSAR Convention	Y (France)	Y	Y	all	The Ramsar Convention 1971 provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Parties of the RAMSAR Convention specifically call for the halt	Saint Barthelemy didn't designate its Marine Protected Area as a RAMSAR site, but still is binded to the RAMSAR Convention as an Oversea Territory of France.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
					of poaching and of harvesting of Sea Turtles in Resolution XIII-24 2019.	

Table 4. Projects and databases on sea turtles in Saint Barthelemy FWI.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Suivi Scientifique des pontes des Tortues de Mer a Saint Barthelemy FWI/Sea Turte Nesting Season Monitoring at Saint Barthelemy FWI	Sea Turtles ; Females ; Nesting ; Nest ; Monitoring ; Volunteers	1982	ongoing	Agence Territoriale de l'Environnement Saint Barthelemy	Non Governmental Agency	https://agencedelenvironnement.fr/bilan-de-ponte-tortues-marines-1982-2016/	N	Sebastien Greaux sebastien.greaux@agence-environnement.fr	Karl Questel karl.questel@agence-environnement.fr

T4.2	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Widecast Atlas of Sea Turtles Nesting Beaches	Sea Turtles ; Nesting beach ; Atlas : Wider Caribbean; WIdecast	2016	2020	Widecast	International NGO	https://www.widecast.org/Resources/Docs/Atlas/19_Eckert_and_Eckert_(2019)_Atlas_of_Caribbean_Sea_Turtle_Nesting.pdf; http://seamap.env.duke.edu/widecast/	N	Claire Saladin clairesaladin@hotmail.com	Sebastien Greaux sebastien.greaux@agence-environnement.fr
T4.3	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Photo identification of *Chelonia Mydas* of Saint Barthelemy FWI	Sea Turtles; *Chelonia Mydas*; *Eretmochelys imbricata*; photo-identification; citizen science	2020	ongoing	Agence Territoriale de l'Environnement Saint Barthelemy	NGO	See the sea turtle photo identification blogspot at https://tortuesvertesstbarth.blogspot.com	N	Karl Questel karl.questel@agence-environnement.fr	Claire Saladin clairesaladin@hotmail.com
T4.4	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	CITES	sea turtles ; protected species; fauna and flora; trade ; illegal trade ; caribbean ; poaching	1978	ongoing	Direction de l'environnement, de l'aménagement et du logement de la Guadeloupe DEAL Guadeloupe	Governmental Agency	Y	N	pb.rn.deal-guadeloupe @ developpement-durable.gouv.fr	Sebastien Greaux sebastien.greaux@agence-environnement.fr
T4.5	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Suivi Scientifque des Recifs Coralliens Herbiers et Mangroves de St Barthelemy	coral reefs; seagrass meadows; mangrove; sea turtle; St	2002	ongoing	IFRECOR/Universite des Antilles/Agence Territoriale de l'Environnement	Governmental Agency/ NGO	Y	N	Sebastien Greaux sebastien.greaux@agence-environnement.fr	See IFRECOR See Universite des Antilles

					Barthelemy.								
T4.6	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Nesting Beaches stabilisation and revegetation	Nesting beaches ; climate change; erosion; sea turtle ; native species; St Barthelemy	2018	ongoing	Local NGOS (Make St Barth Green again, Coral Restoration St Barth, In St Barth Experience) in partnership with the Agence Territoriale de l'Environnement St Barthelemy, volunteers, primary schools and daycare.	NGOs	Y	Y	Sebastien Greaux sebastien.greaux@agence-environnement.fr	See Coral Restoration Saint Barth NGO
T4.7	Caribbean/ NorthWest Atlantic	Saint Barthelemy FWI	Caribbean	Marine debris impacts mitigation	Sea Turtles ; marine life ; marine debris ; regional pollution ; transatlantic pollution; St Barthelem	2018	ongoing	Coral Restoration St Barth / ATE	NGOs	n/a	N	Sebastien Greaux sebastien.greaux@agence-environnement.fr	See Coral Restoration Saint Barth NGO

					y; ALDFG; ghost nets; entanglem ent								
T4.8	Caribbean/ NorthWest Atlantic	Saint Barthele my FWI	Caribbea n	IUCN SSC MTSG regional report	Sea Turtles; Saint Barthelem y; IUCN	2019; 2021	ongoing	IUCN SSC MTSG	IGO	https://www.iucn-mtsg.org/regional-reports	N	Claire Saladin clairesaladin @hotmail.c om	
T4.9	Caribbean/ NorthWest Atlantic	Saint Barthele my FWI	Caribbea n	SWOT	Sea Turtles; Saint Barthelem y; telemetry; nesting beaches	2019	2020	Ocean Society, IUCN SSC MTSG, Duke University	NGO IGO Universi ty	Y	N	Claire Saladin clairesaladin @hotmail.c om	Sebastien Greaux sebastien. greaux@a gence-environne ment.fr

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
T4.1	N	n/r	Cf Table 2	1982	ongoing	n/r	n/r	Y Antoinette Hawksbill FWI 7811 Right Front Flipper FWI 7821 Left Front Flipper. Leleka Hawksbill FWI 17824 Right Front FlipperFWI 17825 Left Front Flipper	n/a	N	N	1;2

T4.2	Y See the Widecast Atlas (2019)	n/r	See the Widecast Atlas (2019)	Sea turtle's data included from 1982	Sea Turtle's data included until 2016	n/r	n/r	n/r	n/r	n/r	n/r	4
T4.3	Y See the Blogspot linked to the ATE's website	n/r	See the Blogspot linked to the ATE's website	2020	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	7
T4.4	N	n/r	n/a	n/a	n/a	n/r	n/r	n/r	n/r	n/r	n/r	n/r
T4.5	n/a	n/r	All. Priority measures reported as needed for Marigot; Grand Cul de Sac; Petit Cut de Sac; St Jean; Lorient.	2019	n/a	n/r	n/r	n/r	n/r	n/r	n/r	6;12;18; 22

T4.6	n/a	n/r	Restoration of the Dune and of the coastline's vegetation of Saline in particular. See Word doc of this report.	2018	n/a	n/r	n/r	n/r	n/r	n/r	n/r	8
T4.7	N	n/r	2018	2018	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	14; n/a
T4.8	Y See IUCN SSC MTSG St Barthelemy report	n/r	See IUCN SSC MTSG St Barthelemy FWI report	2019	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	8;ongoing
T4.9	Y see references	n/r	See references	2019	2020	n/r	Y	n/r	n/a	N	N	5

Table Supplementary 2. *Thalassia testudinum* rhizomes content in metallic trace element (Mn, Fe, Zn, Pb, Cd, Cr, Cu, Ni et Hg) (µg.g-1) (average ± standard deviation). Samples were analysed at 3 stations of Saint Barthelemy FWI in 2018. ND Non Detectable as concentrations are inferior to the detection threshold (< 0,01 µg.g-1). Stations are listed following the increased gradient of anthropogenic pressures.[66]

Station	Mn	Fe	Zn	Pb	Cd	Cr	Cu	Ni	Hg
Colombier	14,33± 6,34	486,6± 215,52	20,1± 3,58	0,32± 0,20	0,02± 0,01	0,52± 0,25	4,02± 1,80	1,59± 0,66	ND
Petit Cul de Sac	2,84± 0,72	206,92± 58,89	11,15± 3,26	0,72± 1,17	0,05± 0,01	0,45± 0,19	2,18± 0,81	0,27± 0,14	ND
Marigot	34,79	351,70	20,67	0,22	0,03	0,61	2,71	1,7	ND

Table Supplementary 3. *Thalassia testudinum* leaves content in trace metallic element (Cr, Cd, Ni, Cu, Hg) (µg.g-1) at 3 stations of St Barthelemy FWI in 2017 / 2018 (average ± standard deviation). Stations are indexed following the increased gradient of anthropogenic pressures. ND: Non Detectable, concentrations were inferior to the detection threshold (< 0,01 µg.g-1).[67]

Station	Cr	Cd	Ni	Cu	Hg
Colombier	0,40±0,07 / 0,37±0,09	0,06±0,05 / 0,04±0,01	4,66±2,84 / 3,53±1,37	2,39±0,45 / 1,80±0,46	ND
Petit Cul de Sac	0,24±0,10 /0,39±0,11	0,06±0,02 / 0,15±0,04	2,82±1,18 / 3,77±0,35	0,58±0,22 / 2,87±0,71	ND
Marigot	0,63±0,41 / 0,43±0,25	0,11±0,01 / 0,42±0,08	3,49±0,64 / 5,66±0,91	1,44±0,09 / 2,75±0,45	ND

[66]See Chart 21 page 124 of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report.
[67]See Chart 23 page 126 of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report.

Table Supplementary 4. Values of stable isotope δ15N (‰) and nutriments N and P (%) in *Thalassia testudinum* rhizomes of 3 stations on Saint Barthelemy (average ± standard deviation). Stations are listed by the gradient of anthropogenic pressures.68

Station	**δ15N**	**N**	**P**
Petit Cul de Sac	2,17 ±1,06	0,64 ±0,26	0,14 ±0,06
Colombier	1,90 ±1,04	1,02 ±0,31	0,14 ±0,05
Marigot	4,87 ±2,16	0,77 ±0,26	0,14

[68]See Chart 20 page 123 of of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 24 of this report.

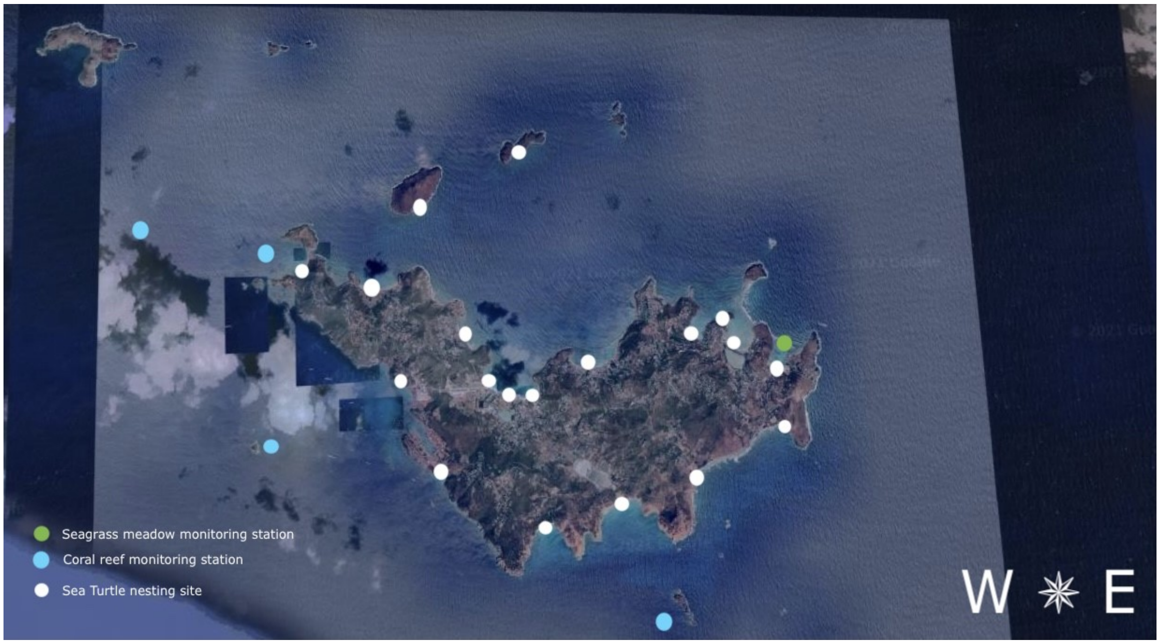

Figure 1. Marine turtles nesting beaches, coral reefs and seagrass meadows monitoring stations of Saint Barthelemy FWI (source map Google Earth).

St. Lucia

Craig Henry[1], Emma Doyle[2], Vincent Clarke[3], Saphira Hunt[4]

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The data presented represents data collected in the PSEPA only (see Fig. 2) and does not include sites in Saint Lucia (Fig. 1) considered to be other major nesting areas. Use this link for additional information on PSEPA Turtle nesting summary - https://we.tl/t-k0WuhTRAjT. Resources are required to undertake consistent data collection at the other nesting areas (Reference Doc. #8).

Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Lucia.

Topic	***E. imbricata***	**Ref #**	***D. coriacea***	**Ref #**
Occurrence				
Nesting sites	Y	#1- #5	Y	#1- #5
Pelagic foraging grounds	n/a		n/a	
Benthic foraging grounds	n/a		n/a	
Key biological data				
Nests/yr: recent average (range of years)	(2015-2019)	#1- #5	(2015-2019)	#1- #5
Nests/yr: recent order of magnitude	100-200	#1- #5	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	3	#1- #5	n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	153 (2010-2014)	#1- #5	n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a	
Total length of nesting sites (km)	2.6	#1- #5	n/a	
Nesting females / yr	31	#1- #5	n/a	
Nests / female season	5	#1- #5	n/a	
Female remigration interval (yrs)	2.3	#1- #5	n/a	
Sex ratio: hatchlings (F / Tot)	0.64	#1- #5	n/a	

Sex ratio: juveniles (F / Tot)	0.52	#1- #5	n/a	
Sex ratio: Adults (F / Tot)	0.40	#1- #5	n/a	
Min adult size, CCL or SCL (cm)	72 CCL	#1- #5	86 SCL	#1- #5
Age at maturity (yrs)	25-30	#1- #5	n/a	
Clutch size (n eggs)	98.2	#1- #5	n/a	
Emergence success (hatchlings/egg)	0.82	#1- #5	n/a	
Nesting success (Nests/ Tot emergence tracks)	0.4	#1- #5	n/a	
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)				
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	n/a		n/a	
Published studies				
Growth rates	Y	#1 - #5	N	
Genetics	N		N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	Y	#1 - #5	N	
Survival rates	N		N	
Population dynamics	N		N	
Foraging ecology (diet or isotopes)	Y	#1 - #5	N	
Capture-Mark-Recapture	Y	#1 - #5	N	

Threats				
Bycatch: small scale / artisanal	n/a		n/a	
Bycatch: industrial	n/a		n/a	
Bycatch: quantified?	n/a		n/a	
Intentional killing or exploitation of turtles	Y	#6& #7	n/a	
Egg poaching	Y	#1 - #5	Y	#1 - #5
Egg predation	Y	#1 - #5	Y	#1 - #5
Photopollution	n/a	#1 - #5	N/a	
Boat strikes	Y	#1 - #5	Y	#1 - #5
Nesting habitat degradation	Y	#1 - #5	Y	#1 - #5
Foraging habitat degradation	Y	#1 - #5	N	
Other				
Long-term projects				
Monitoring at nesting sites	Y	#1 - #5		
Number of index nesting sites	3	#1 - #5		
Monitoring at foraging sites	Y	#1 - #5		
Conservation				
Protection under national law	N		Y	
Number of protected nesting sites (habitat preservation)			0	
Number of Marine Areas with mitigation of threats	0		2	

Long-term conservation projects (number)	>1	#1 - #5	0	
In-situ nest protection (eg cages)	N			
Hatcheries	N			
Head-starting	N			
By-catch: fishing gear modifications (eg, TED, circle hooks)	N			
By-catch: onboard best practices	N			
By-catch: spatio-temporal closures/reduction	N			
Other	Y (see text)		N	

Table 2. Sea Turtle Nesting Beaches in Saint Lucia.

Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #
			Long	Lat	Long	Lat	Long	Lat			
y	(2015 - 2019)						13.724872	-60.932809	0.1		#1-#5
Y							13.728872	-60.943705	1.75		#1-#5
Y							13.742082	-60.938176	1.71		#1-#5
N									0.1		#1-#5
Y									1.75		#1-#5
N									1.71		#1-#5
N									0.1		#1-#5

Y									1.75		#1-#5
Y									1.71		#1-#5

Table 3. International conventions protecting sea turtles and signed by Saint Lucia.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Inter-American Convention for the protection of sea turtles	Y	Y	Y	ALL	Protection, Monitoring and tagging	Covers Sea turtles in the Caribbean
SPAW protocol	Y	Y	Y	ALL	Protection, Monitoring and tagging	Covers Sea turtles in the Caribbean

Table 4. Projects and databases on sea turtles in Saint Lucia.

RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration
CM-PSEPA	Saint Lucia	Psepa, Vieux Fort Saint Lucia, West Indies	PSEPA Turtle Monitoring Programme	Nesting, Saint Lucia, Female, PSEPA,	2015	On-going	Saint Lucia National Trust	NGO	GOSL, OAS, GCFI, SPAW-RAC, Department Of Fishieries
EI - PSEPA	Saint Lucia	Psepa, Vieux Fort Saint Lucia, West Indies	PSEPA Turtle Monitoring Programme		2015	On-going	Saint Lucia National Trust	NGO	GOSL, OAS, GCFI, SPAW-RAC, Department Of Fishieries ,
DC- PSEPA	Saint Lucia	Psepa, Vieux Fort Saint Lucia, West Indies	PSEPA Turtle Monitoring Programme		2015	On-going	Saint Lucia National Trust	NGO	GOSL, OAS, GCFI, SPAW-RAC, Department of Fisheries

Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Database available	Name of Database	Names of sites included (matching Table B)	Beginning of the time series	End of the time series	Track information	Nest information
	n/a	Craig Henry, craighenri4@fmail.com	Y	PSEPA		2015	2019	Y/N	Y
	n/a	Craig Henry, craighenri4@fmail.com	Y	PSEPA				Y/N	Y
	n/a	Craig Henry, craighenri4@fmail.com	Y	PSEPA				Y/N	Y

Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	Ref #
N	N	N	N	#1-#5
N	N	N	N	#1-#5
N	N	N	N	#1-#5

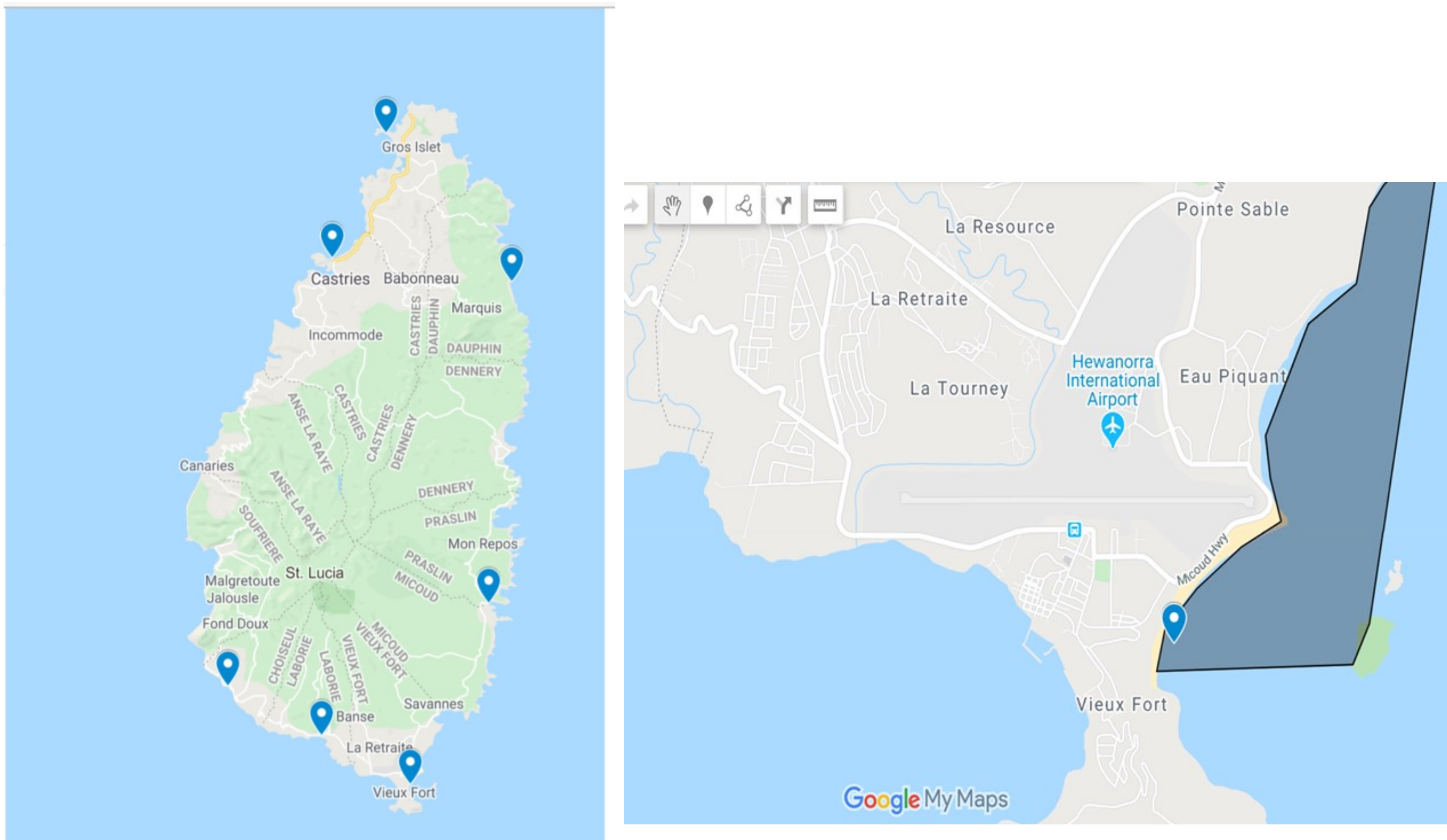

Figure 1. Map of Saint Lucia major marine turtle nesting areas.

References

1 PSEPA Sea Turtle Monitoring Programme 2015

2 PSEPA Sea Turtle Monitoring Programme 2016

3 PSEPA Sea Turtle Monitoring Programme 2017

4 PSEPA Sea Turtle Monitoring Programme 2018

5 PSEPA Sea Turtle Monitoring Programme 2019

6 Press Release Turtle Poaching 2017

7 Press Release Turtle Poaching 2018

8 Saint Lucia Map- Turtle Nesting Sites

St Martin FWI

Claire Saladin, DVM PhD

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This document reports of the urgent need of actions to preserve marine turtles habitats and foraging grounds, which would also significantly strengthen the mitigation of the climate crisis impacts in St Martin FWI, and lists several projects recommended to be enhanced or implemented in that matter. Environmental anthropogenic degradations have been suspected to co-trigger marine turtles fibropapillomatosis, an infectious neoplastic and contagious disease affecting marine turtles, that this report starts to study in Saint Martin FWI. Moreover, this report urges France to completely and infinitely protect all species of marine turtles on its entire territory, consequently to abrogate its reservation on *Chelonia mydas* and on strictly protected fauna species in all relevant Treaties, and calls for an immediate moratorium on all species of sea turtles and their derivatives' take in the Lesser Antilles.

1. RMU: Northwestern Atlantic

1.1. Distribution, abundance, trends

1.1.1. Presence and Nesting sites

See Table 1. Main Table. Marine turtles of Saint Martin FWI: occurrence, key biological data, trends, published studies, threats, long term projects (> 5 years), conservation.

See Table 2. Marine turtles nesting beaches of Saint Martin FWI.

See Figure 1. Marine turtles nesting beaches, coral reefs and seagrass meadows monitoring stations of Saint Martin FWI.

❧ 3 species of sea turtles nest in Saint Martin FWI: *Chelonia mydas*, *Eretmochelys imbricata* and *Dermochelys coriacea*.

❧ 2 major nesting sites are located outside of the Marine Protected Area:

Baie Longue and Baie aux Prunes are green turtles major nesting beaches located outside of the Marine Protected Area (MPA).

Lagon was considered a major nesting beach of the Critically Endangered *Eretmochelys imbricata* on Saint Martin FWI in the previous MTSG report, located on Tintamarre Island within the MPA. Although, Lagon beach is considered a minor nesting site for *Eretmochelys imbricata* in this report.

❧ One important leatherback nesting site to note is located outside of the Marine Protected Area on a beach where commercial activities are particularly developed : Orient Bay. A suggestion of a leatherback conservation and research project is described paragraph 1.5. Research.

❧ *Caretta caretta* is present and foraging in Saint Martin FWI's waters: an individual was found alive in Grand Case in 2017 after a poacher speared her while she was foraging. The individual *Caretta caretta* could be saved and released. Poacher was prosecuted. (pers.observations).

An individual of *Lepidochelys olivacea*, amputated of both its front flippers was found alive stranded on St Martin FWI in 2018. Due to the absence of long term rescue centre on St Martin and the fact that to relocate this individual to the Aquarium of Guadeloupe, where it could have become a "Sea Turtle Ambassador", was considered too time and resources consuming, the individual was released back in the water by the Reserve Naturelle de St Martin (pers. observations).[69]

Statistics included in this report are based on volunteers' data collected at marine turtle nesting beaches every year twice a week from April to October.[70] Sea turtle nesting season monitoring is based and dependent on volunteers training and availability. The number of tracks on Baie Longue in particular might be underestimated as nesting significantly occurs outside of the monitoring time (pers. observations).

1.1.2.Marine areas

Marine turtles and their habitat are completely protected by National Law since 1991 without exemptions in and outside of the Marine Protected Area.71 International Treaties signed and ratified concerning sea turtles have been rigorously implemented and complied to. Saint Martin's Marine Protected Area created in 1998 by Ministerial Arrete classifies 3060 hectares of the Island. St Martin's MPA is composed of 2900 hectares of marine reserve, 154 hectares of coast lines and 198 hectares of wetlands. Saint Martin's Marine Protected Area is also classified as a Wetland of International importance under the RAMSAR

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[69]See Eckert, Karen L. and Adam E. Eckert. 2019. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Revised Edition. WIDECAST Technical Report No. 19. Godfrey, Illinois. 232 pages, plus electronic Appendices. Reference 17 of this report. See also Saladin Claire, Chalifour Julien, Saint Martin FWI country report for the Widecast nesting beaches Atlas (2019), 3 pages. Reference 64 of this report.

[70]See references 1,2,3,4,5,6,7,8,9,10,25,33,34 of the report.

[71]See the Arrete Prefectoral concerning Sea Turtles in Guadeloupe Saint Martin and Saint Barthelemy www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000354849&categorieLien=id. superseded by the Arrete Ministeriel of 2005 Reference 13 of the report at https://www.legifrance.gouv.fr/eli/arrete/2005/10/14/DEVN0540395A/jo/texte at https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000424977. See reference 27 of the report Code de l'Environnement Article L415-3 at https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000038846323/.

Convention and a Marine Protected Area listed under the CAR-SPAW Protocol.72 The MPA is managed by the Reserve Naturelle de St Martin, a Non Governmental Organisation. The Agency is accredited and responsible of Law enforcement concerning environmental matters within the MPA.

This report describes and recommends studies and conservation projects in and outside of the Marine Protected Area of Saint Martin FWI.

1.2. Other biological data

2 immature Green Turtles have been equipped with satellite tags in 2015 at Tintamarre Island : Sasha and Joe have been tracked foraging Tintamarre Island seagrasses for 157 and 307 days respectively.[73]

16.1. Distribution, abundance, trends.

16.1.1. Presence and Nesting sites.

1.3.Threats

1.3.1. Nesting sites

- Reduction of the Sand Bank due to natural erosion and constructions

The brutal change in population numbers of Saint Martin in the 80s and in economic activities, led to the rapid and uncontrolled urbanization of low-lying coastal areas, including barrier beaches, and to the reclamation of inner lagoons

[72] See http://www.reserves-naturelles.org/saint-martin. The Reserve Naturelle de Saint Martin is in charge of the management of the terrestrial and marine sites listed as a protected area. The Conservatoire du Littoral is the agency in charge of sites handed over by the French Government. There was a scission of the Reserve Naturelle de Saint Martin and the Conservatoire du Littoral in 2019, the clear borders of each agencies have been needed to be appropriately defined. (pers. observations)

[73] See the satellite tracks of Sasha and Joe, Reference 24 of the report, at http://www.seaturtle.org/tracking/index.shtml?tag_id=139068a&dyn=1557790645 and http://www.seaturtle.org/tracking/index.shtml?tag_id=139067. Courtesy of the Reseau Tortues Marines Guadeloupe.and SeaTurtle.org.

for infrastructure development (Dutch international and French domestic airports), tourist development and housing purposes. This led to the clearing or removal of the coastal indigenous vegetation mostly made of *Coccoloba uvifera*, which has generally been replaced by introduced species, mainly coconut trees. This has exacerbated human vulnerability to cyclone-generated waves. In general, buildings have been established on upper beaches, i.e. at a very short distance from the sea, which has encouraged the construction of protection structures, which have then contributed to the modification of physical processes.74 A highly engineered beach profile involves an unvegetated disturbed foreshore ecosystem with little or no biogenic sand production and highly mobile sediments. Such a regime results in a beach vulnerable to erosion and, therefore, requires regular engineering nourishments of the beach foreshore system to maintain its form. An alternative regime, a natural self-sustaining foreshore ecosystem with seagrass and calcifying macro-algae fronting a stable beach, forms a self-stabilizing and self-nourishing system.75 Three beach types could be distinguished depending on the level of disruption of physical processes by coastal development, namely natural (limited if no disturbance), partially disturbed and highly disturbed (on Saint Martin FWI and Sint Maarten DWI).76 Species of sea turtles show natal homing behavior, the high fidelity to their natal nesting beach.77 It is therefore crucial for the survival of the species to preserve

[74]See Virginie Duvat, Valentin Pillet, Natacha Volto, Yann Krien, Raphaël Cécé, Didier Bernard , High human influence on beach response to tropical cyclones in small islands: Saint-Martin Island, Lesser Antilles. Geomor (2018), doi:10.1016/j.geomorph.2018.09.029. Reference 46 of this report.

[75]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121/uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 36 of this report.

[76]See Virginie Duvat, Valentin Pillet, Natacha Volto, Yann Krien, Raphaël Cécé, Didier Bernard , High human influence on beach response to tropical cyclones in small islands: Saint-Martin Island, Lesser Antilles. Geomor (2018), doi:10.1016/j.geomorph.2018.09.029. Reference 46 of this report.

[77]See for instance Lohmann, Kenneth & Lohmann, Catherine & Brothers, J. & Putman, Nathan. (2013). Natal homing and imprinting in sea turtles. 10.1201/b13895, https://books.google.fr/books?hl=fr&lr=&id=Xf_RBQAAQBAJ&oi=fnd&pg=PA59&dq=Lohmann+2013+biology+of+sea+turtles+natal+homing+and+imprinting+books+google&ots=F61mO4S2Ip&sig=5QJqWR7eG4pUS5Pwzano-v8uo7E#v=onepage&q=Lohmann%202013%20biology%20of%20sea%20turtles%20natal%20homing%20and%20imprinting%20books%20google&f=false (Reference 71 of this report).

sea turtles' nesting beaches. Study of the health of Saint Martin FWI's nesting sites has been performed in 2015 by the Reseau Tortues Marines Guadeloupe: constructions reducing the sand bank and altering the beach vegetation have been reported, as lightings susceptible to disorientate sea turtles and their hatchlings.78 After this mission, construction projects have been damaging nesting beaches (e.g. Happy Bay) (pers. observations (2017)). Natural erosion is also happening on St Martin causing the disappearance of the beach (e.g. Bell Beach). Illegal constructions and illegal sand mining on nesting sites are observed and actions are taken in this regard by the appropriate authorities (e.g. Red Bay (2018)) (pers. observations).

❖ Climate change The study of the impacts on Saint-Martin Island (French and Dutch sides) of the most intense series of TCs ever recorded in the Lesser Antilles79 confirmed the major control exerted by high magnitude low frequency climate events on sedimentary coastal systems. These TCs, especially category 5 TC Irma, generated complex and interlinked erosional and accretional processes. Importantly, they caused marked shoreline retreat on most sites, with the minimum NSM value reaching – 166.45 m on the highly-exposed coast of the island, and marked (up to 2 m in height) beach lowering. Seven weeks after the cyclones hit the island, their erosional impacts were still proved, first, by marked erosion scarps cut into upper beaches (0.30 to 0.80 m-high) and sand dunes (up to 4 m high), and second, by the exhumation of the root system of the destroyed indigenous vegetation, where it occurred, over a 5 to 40 m distance, depending on the setting. In areas having little if no vegetation, scour holes and soil scouring were widespread, extending from the upper beach to inland areas over distances ranging from 5 to 20 m. On the most affected beach site, wave attack led to the formation of a 1.20 m-deep and 15 m-long trough extending transversally through the barrier beach. While erosion predominated in beach and upper beach areas, sand accumulation prevailed in inland areas as a result of overwash,

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[78]See Antoine Chabrolle Manager of the Reseau de Tortues Marines de Guadeloupe study scoring the health status of Saint Martin's Sea Turtles nesting beaches described in Reference 8 of this report, CHALIFOUR J. (2015) : Suivi des tortues marines en ponte et en alimentation : Année 2015, RNN Saint-Martin, 17 pages.

[79]See Virginie Duvat, Valentin Pillet, Natacha Volto, Yann Krien, Raphaël Cécé, Didier Bernard , High human influence on beach response to tropical cyclones in small islands: Saint-Martin Island, Lesser Antilles. Geomor (2018), doi:10.1016/j.geomorph.2018.09.029. Reference 46 of this report.

where no obstacle, neither natural (i.e. dense vegetation) nor human-built (i.e. buildings and engineered structures), obstructed the sediment transport pathways. Extensive sand sheets (reaching up to 135 m from the inferred 'pre-cyclone' vegetation line) indicating significant sediment transfer from the foreshore and beaches to inner land areas were the most common feature observed. At two sites, barrier beach overwashing by the cyclonic waves occurred, which caused sediment deposition in inner lagoons. Importantly, on the highly-exposed, back- reef beaches, the transfer of coral debris to the coast caused the formation of crescent-shaped deposits and of beach ridges at the base of the beach and on the upper beach, respectively, and also led to beach extension along the shoreline. These results showed that the most intense TCs, beyond driving important changes in the configuration of beaches and barrier beaches, have constructional impacts on some beach sites.

❁ Photopollution80 Disorientation of hatchlings due to construction site lights at Baie Longue seem to have happened once (pers. observations). The photo-pollution threat on Saint Martin FWI seem very moderate. Recommendations on the mitigation of the photo-pollution threat on Saint Martin are described in the Research paragraph 1.5.

❁ Sargassum entanglement Sargassum entanglement of hatchlings and adult sea turtles is a risk with the increasing sargassum flux coming on Saint Martin. Entangled hatchlings have been described on Cul de Sac's shore. They were not reported to the Reserve Naturelle de Saint Martin so as to get rescued nor helped out of the seaweed by the public there (pers. comment).

1.3.2. Marine areas

Not only sea turtles show high fidelity to their natal beach, but also homing behavior, the high fidelity to their juvenile and adult foraging grounds: seasonal philopatry to their foraging grounds at their juvenile stage can be observed, adult female sea turtles, sometimes after long post-breeding migrations, also demonstrate their high fidelity to their foraging grounds.81 It is hence essential

[80]See Antoine Chabrolle Manager of the Reseau de Tortues Marines de Guadeloupe study scoring the health status of Saint Martin's Sea Turtles nesting beaches described in Reference 8 of this report, CHALIFOUR J. (2015) : Suivi des tortues marines en ponte et en alimentation : Année 2015, RNN Saint-Martin, 17 pages.
[81]See Shimada T, Limpus CJ, Hamann M, et al. Fidelity to foraging sites after long migrations. J Anim Ecol. 2019;00:1–9. https://doi.org/10.1111/1365-2656.13157 (Reference 67 of this report), González Carman, V., Bruno, I., Maxwell, S. et al. Habitat use, site fidelity and conservation opportunities for juvenile loggerhead sea turtles in the Río de la Plata, Argentina. Mar Biol 163, 20 (2016). https://doi.org/10.1007/s00227-015-2795-5

to preserve sea turtles' habitats and foraging grounds so as to adequately protect the species.

✤ Boat strikes A sudden increase of deadly sea turtle boat strikes has been observed since 2019.82 The use of propellors protectors was recommended via a local newspaper and via a discussion forum of the "Cruisers and Boaters" community of SXM (pers. observations (2019)).83 Informative signs have been placed at strategic points around the island (pers. observations). The implementation of governmental signs is recommended, at the most frequented sites like marinas (e.g. Marina Fort Louis), precisely indicating the speed limit, recalling the advise to lift up the boat's engine(s) in the marina, and the procedure to follow in case of a sea turtle boat strike or encounter with an injured sea turtle. Clarification of the fact that the harassment of sea turtles is forbidden by law, but that to help an injured sea turtle will not be considered as the harassment of the endangered species, is also suggested in this report. Although, the severity of the lesions observed on sea turtles that suffered from a boatstrike, at spots where the speed limit is normally significantly reduced by Law (5 nautical knots within 300 meters of the shore), and where sea turtles are reasonably able to dive off the boat's propellors in a timely manner, in waters deep enough for the turtles to swim away from the boat, could be indicative of the will of a few people to deliberately hurt marine turtles (pers. observations). The increase of patrols at sea has therefore been strongly recommended to relevant authorities.

✤ Sea turtles'diseases Fibropapillomatosis, an infectious neoplastic disease sharing genomic drivers and therapeutic vulnerabilities with human cancers,84 is

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(Reference 68 of this report), Mansfield, K.L., Saba, V.S., Keinath, J.A. et al. Satellite tracking reveals a dichotomy in migration strategies among juvenile loggerhead turtles in the Northwest Atlantic. Mar Biol 156, 2555–2570 (2009). https://doi.org/10.1007/s00227-009-1279-x (Reference 69 of this report), Tucker AD, MacDonald BD, Seminoff JA (2014) Foraging site fidelity and stable isotope values of loggerhead turtles tracked in the Gulf of Mexico and northwest Caribbean. Mar Ecol Prog Ser 502:267-279. https://doi.org/10.3354/meps10655 (Reference 70 of this report), see Reseau Tortues Marines Guadeloupe, SEATURTLE.ORG 2015 http://www.seaturtle.org/tracking/index.shtml?tag_id=139068a and http://www.seaturtle.org/tracking/index.shtml?tag_id=139067 (Reference 24 of this report).

[82]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 16 of the report.

[83]See Le Pelican Journal (2020), Protéger les hélices de bateau, c'est protéger les tortues, see at http://www.lepelican-journal.com/saint-martin/environnement/Proteger-les-helices-de-bateau-c-est-proteger-les-tortues-18287.html. Reference 26 of the report.

[84]See Duffy D.J., Schnitzler C., Karpinski L., Thomas R., Whilde J., et al. (2018) Sea turtle fibropapilloma tumors share genomic drivers and therapeutic vulnerabilities with human cancers, COMMUNICATIONS BIOLOGY | (2018)1:63, DOI: 10.1038/s42003-018-0059-x. Reference 42 of this report.

affecting sea turtles around the island of St Martin.85 No studies have been performed yet on the island. Research recommendations are further precised in paragraph 1.5. Research.

❦ Coral reefs threats: diseases, anthropogenic pollution, climate change

The Caribbean Sea is comprised of five major basins with an average depth of ~4400 m. It has a unique biota that is distinct from tropical seas in the Pacific and Indian Ocean due to a lack of natural connectivity with these areas. This biological isolation resulted from the emergence of the Isthmus of Panama around 3 million years ago. As a consequence, the Caribbean marine biota has low taxonomic diversity and minimal ecological redundancy (i.e., the ability of species to serve the same function when species are lost) relative to other tropical seas. This makes it especially challenging for reefs to recover from acute mortality events caused by, for example, thermal bleaching and disease outbreaks. The biological isolation may also magnify Caribbean reef vulnerability to introduced pathogens and non-native species, compared to less isolated coral reef regions. Although these reefs have persisted in isolation for more than 3 million years, their inherent fragility has likely contributed to major declines in recent decades under increased human pressures leading to highly degraded Caribbean reefs.86 Coral reefs are critical coastal habitats and foraging grounds for marine turtles, buffering the effects of floods and storms and nursery to a wide range of marine species. The high structural complexity of coral reefs results in high hydraulic roughness and greater frictional dissipation of waves when compared to other coastal settings. The high frictional dissipation on coral reefs, in conjunction with wave breaking on the reef rim, results in high rates of wave energy dissipation over relatively short distances when compared to other coastal systems. The

[85]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 16 of this report.

[86]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 52 of this report.

coastal protection service provided by coral reefs is therefore greater than many other marine ecosystems.87 Coral reefs dissipate on average 97% of the wave energy that would otherwise impact shorelines. Most (86%) of the wave energy is dissipated by the reef crest; this relatively high and narrow geomorphological area is the most critical in providing wave attenuation benefits. The reef flat dissipates approximately half of the remaining wave energy, most of the wave energy on the reef flat is dissipated in the first part of the reef flat (that is, the 150m closest to the reef crest). This means that even narrow reef flats effectively contribute to wave attenuation. After bathymetry, another critical factor in wave attenuation is bottom friction, which is a function of bottom roughness. Coral reef degradation has significant impacts on roughness. For example, the loss of branching Staghorn and Elkhorn corals (*Acropora* spp.) Caribbean-wide affects both height and roughness particularly on reef crests. The effect of the reef crest on wave reduction is nonlinear and intensifies as incident wave energy increases. These effects are critical for exposure reduction; reefs are relevant for risk reduction even during extreme events. Storms are known to have negative short-term impacts on coral cover, but reefs can be resilient and recover from these impacts. When comparing coral reefs to artificial coastal defenses, the costs of building tropical breakwaters was described between US$ 456 and 188,817 per meter with a median project cost of US$ 19,791 per meter. The construction costs of structural coral reef restoration projects ranged between US$ 20 and 155,000 per meter with a median project cost of US$ 1,290 per meter. Reef conservation and restoration can be cost effective for risk reduction and adaptation. In considerations of effectiveness, coral reefs can deliver wave attenuation benefits greater than artificial structures designed for coastal defense.88 Environmental impacts of artificial breakwaters should also be considered, degrading nesting beaches and generating a poor water quality in

[87]See D. L. Harris, A. Rovere, E. Casella, H. Power, R. Canavesio, A. Collin, A. Pomeroy, J. M. Webster, V. Parravicini, Coral reef structural complexity provides important coastal protection from waves under rising sea levels. Sci. Adv. 4, eaao4350 (2018), DOI: 10.1126/sciadv.aao4350. Reference 53 of this report.
[88]See Ferrario, F. et al. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nat. Commun. 5:3794 doi: 10.1038/ncomms4794 (2014). Reference 55 of this report.

stagnant waters behind breakwaters. Stagnant waters of poor quality are a public health concern in Caribbean islands as, in particular, potential sources of mosquitoes larvae. (Personnal comment). Adverse impacts of artificialized coastlines and artificial breakwaters were reported in 2020: urbanized coasts such as Grand Case, Nettle Bay and Orient Bay showed strong sensitivity to hurricane effects. During Hurricane Irma's landfall on Saint-Martin, large waves broke on defensive walls and building facades, as well as transverse and longitudinal protective riprap. Wave reflection enhanced erosion and caused a variety of damage: undermined foundations, broken water pipes, seawalls collapsed along with habitable structures. Shoreline protection structures were too low and inadequate to absorb the surge. For instance, coastal erosion reached 15 m near the leeward side of the breakwaters in Nettle Bay. Many ripraps were displaced by wave action and erosion processes. These heavy stone blocks caused widespread damage to residential housing and hotels, which resulted in a significant increase in repair costs. Some buildings that were gutted by the sea trapped significant volumes of sand (1 to 2 m3) and boulders weighing over a ton.89

Diseases:

Even though some Caribbean reefs have managed to maintain stable coral cover, the Caribbean-wide region has lost 60%–80% of its coral cover since the 1970s. The region-wide decline has been attributed to a combination of disease, overfishing of herbivores, and an additional range of pressures resulting from human activities. In the mid-1970s, white band disease affected acroporids, which were major coral reef builders in the region. In the early 1980s mass mortality of the sea urchin Diadema spp., an important grazer of macroalgae on the reef, occurred owing to an unidentified pathogen. The severe reduction of

[89]See Rey T, Leone F, Candela T, Belmadani A, Palany P, Krien Y, Cécé R, Gherardi M, Péroche M, Zahibo N. Coastal Processes and Influence on Damage to Urban Structures during Hurricane Irma (St-Martin & St-Barthélemy, French West Indies). *Journal of Marine Science and Engineering*. 2019; 7(7):215. https://doi.org/10.3390/jmse7070215. Reference 66 of this report.

Diadema spp., combined with a diminished herbivorous fish population due to unsustainable fishing practices, allowed fleshy algae to become increasingly dominant at the expense of corals. Stony Coral Tissue Loss Disease has been observed on Tintamarre and le Rocher Creole. Tintamarre reefs are home of the critically endangered hawksbill turtle, Lagon located on Tintamarre is a significant nesting site of *Eretmochelys imbricata* on Saint Martin FWI. Le Rocher Creole in Grand Case Bay is a sea turtle foraging ground, Grand Case beach is a nesting site.90

Reefs anthropogenic pollution:

Various human activities affect water quality providing nutrients to support the growth and increasing abundance of macro-algae on reefs, further contributing to the decline in reef health. External input of organic material to coastal environments inevitably results in microbial decomposition of some fraction of this material either in the water column, at the seafloor or in the sediments. At every depth, decomposition of organic material produces CO2 and consumes oxygen, the former leading to lower seawater pH and aragonite saturation (Ωar).91 Depending on the specific setting (i.e., depth, geomorphology, and hydrodynamics) as well as the amount and reactivity of the organic material, oxygen availability may reach hypoxic or even anoxic conditions while seawater pH and Ωar may reach levels that are corrosive to calcareous structures (i.e., Ωar <1). Eutrophication, the addition of excess nutrients, may initially stimulate phytoplankton blooms in the water column that lower CO2 and elevate oxygen, but once this material settles to the benthos, the reverse will occur with potential negative consequences for sessile benthic organisms like reef-building corals.92

[90]See reference 44 of this report The Reserve Naturelle de Saint Martin quarterly Journal of July 2019 at https://reservenaturelle-saint-martin.com/journaux-pdf/2019/journal35.pdf

[91]Aragonite saturation state is commonly used to track ocean acidification because it is a measure of carbonate ion concentration. When aragonite saturation state falls below 3, these organisms become stressed, and when saturation state is less than 1, shells and other aragonite structures begin to dissolve. See the definition of aragonite sea surface saturation at https://sos.noaa.gov/datasets/ocean-acidification-saturation-state/. (Last visited 20th April 2021)

[92]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and

The deep sea coral reef station of la Basse Espagnole showed a decline of 61,9% of its coral cover within a year, concurrently to an increase of macro-algae coverage, that has quadrupled within the same timeline at that site, and a decrease of the biomass' reefs of 10,8%. The alarming increase of macro-algae at La Basse Espagnole deep sea coral reef station indicates the severe contamination of waters of that site by nitrates and phosphates (eutrophication).93 Watersheds with high marine turtle disease rates have been reported to tend to have high Nitrogen-footprint values as well as chronic and widespread macro-algae.94

More than half of Pinel's seabed is colonised by Acropora palmata and Acropora cervicornis, listed as critically endangered on the IUCN Red List. At the eastern side of the north beach, colonies of Acropora palmata have been showing strong signs of growth. *Millepora complanata*, *Millepora alcicornis*, *Montasrea* sp., *Palythoa caribaeorum* and *Porites porites*, spherical colonies of *Diploria* sp., *Colpophyllia natans* or *Porites astreoides*, as well as gorgonian corals *Gorgonacea* sp. as *Dendrogyra cylindrus* or *Annella mollis* and sponges can be observed. Although coral reefs, mix seagrass meadows and sand were the three main habitats constituting Pinel's seabed in a survey in 2007, Pinel's seabed was mainly constituted of mix seagrass meadows and soft macro-algae *Sargassum, Turbinaria* and *Dictyota* in 2013. This trend is observed all around St Martin: marine phanerogams seem to have developed since 2007, when coral reefs health seem to deteriorate, concurrently to an increase of algae coverage. Cyanobacteria were reported to cover a large portion of the seabed from east to west of Pinel's path, indicating a stress of the seabed due to an enrichment in organic matters. The presence of filamentous algae was also reported, at the west side of Petite Clef, sign of an increase in organic matters of the site (eutrophication). The presence of calcareous macro-algae was also

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socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 52 of this report.

[93]See reference 38 of the report Chalifour J. (2021) Fiche synthétique Suivi Reserve de la Station Recifale de la Basse Espagnole October 2020, 1 page.

[94]See Van Houtan KS, Hargrove SK, Balazs GH (2010) Land Use, Macroalgae, and a Tumor-Forming Disease in Marine Turtles. PLoS ONE 5(9): e12900. doi:10.1371/journal.pone.0012900. Reference 56 of this report.

reported. An inappropriate watersheds waste waters management, from Chevrise pond and from Pinel islet restaurants, concurring with a degradation of the mangrove of Cul de Sac, have been reported to possibly be responsible of the pollution and degradation of Pinel coral reefs. Sand mining in the Bay de Cul de Sac was also authorized for the construction of hotels, generated increased turbidity, which damaged Pinel's coral reefs.95

Coral bleaching events and short and long term trends of the Caribbean reefs under climate change:

Climate change has been impacting the coral reefs of the Caribbean region including the reefs of St Martin FWI during bleaching events in 1984, 1987, in 1998 when 56% of Guadeloupe's coral reefs and 59% of Martinique's coral reefs were affected, causing the death of 20 to 30% of the bleached coral reefs, and in 1999 when 50% of the reefs of Guadeloupe were affected. The most important coral bleaching event occurred in 2005, when 80% of the French Antilles reefs were affected, causing the death of 40 to 60% of the reefs the next year. The repetition of coral bleaching events in the Caribbean region is threatening the very existence of the reefs at a short-term.96 Since the industrial revolution, the oceans have taken up approximately 40% of the CO2 released to the atmosphere from burning of fossil fuels and cement production. In the Caribbean, this uptake of CO2 has resulted in increased surface seawater pCO2 and lowered pH and aragonite saturation state (Ωar). In some areas, surface seawater Ωar has decreased in excess of 40%. This makes the Caribbean basin one of the fastest changing chemical environments under ocean acidification. As a result, conditions there have become increasingly less favorable for biological CaCO3 production. While Caribbean waters are mostly still favorable for biological CaCO3 production, higher pCO2, and lower pH and Ωar have been shown to

[95]See Schmitt A (2013) Cartographie des habitats épibenthiques de l'ilet Pinel et de leurs états de santé, 54 pages. Reference 29 of this report.
[96]See Bouchon C .et Y. Universite des Antilles (2019), Evolution des communautés récifales de Saint Barthelemy: années 2002 a 2018, 53 pages. Reference 16 of the report.

reduce calcification rates in corals and other marine calcifiers. These ocean chemistry changes have also shown to enhance the loss of CaCO3 from reefs by increased carbonate dissolution. Further, the ability of physical processes, such as waves and storms, and biological organisms to erode the weakened CaCO3 reef framework has also been enhanced under a lowering of pH and Ωar.97

❦ Seagrass meadows threats: human induced pollution and fragmentation, impact of the invasive seagrass *Halophila stipulacea*, climate change, sargassum strandings

Seagrass meadows are a critical habitat and foraging ground for sea turtles and also nursery grounds for many fishes and other marine wildlife species. Shallow inter- and subtidal foreshores of natural tropical sandy beaches are predominately composed of locally produced calcium carbonate (CaCO3) sediments. These carbonate sediments are biogenically produced and need to be continually captured and retained within the foreshore for a beach to resist erosion and remain stable, which seagrasses are very effective at achieving.98 Amongst many of their ecosystem services, their value being estimated at US$34,000 per hectare per year,99 seagrass meadows also help lessens the impacts of severe weather, reduce erosion and mitigate the effects of climate change by absorbing about 10 percent of the total estimated organic carbon sequestered in the Oceans each

[97]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 52 of this report.
[98]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 36 of this report.
[99]Frederick T. Short, Beth Polidoro, Suzanne R. Livingstone, Kent E. Carpenter, Salomão Bandeira, Japar Sidik Bujang, Hilconida P. Calumpong, Tim J.B. Carruthers, Robert G. Coles, William C. Dennison, Paul L.A. Erftemeijer, Miguel D. Fortes, Aaren S. Freeman, T.G. Jagtap, Abu Hena M. Kamal, Gary A. Kendrick, W. Judson Kenworthy, Yayu A. La Nafie, Ichwan M. Nasution, Robert J. Orth, Anchana Prathep, Jonnell C. Sanciangco, Brigitta van Tussenbroek, Sheila G. Vergara, Michelle Waycott, Joseph C. Zieman, Extinction risk assessment of the world's seagrass species, Biological Conservation, Volume 144, Issue 7, 2011, Pages 1961-1971, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2011.04.010. Reference 65 of this report.

year.100 Human impacts on seagrasses ecosystems are direct, affecting seagrasses locally, and indirect, which may affect seagrass meadows far away from the sources of disturbance. Human impacts in the coastal zone are responsible for most threats to seagrass species.101 The development of human infra-structure along the coasts and waterways has led to the rapid loss of natural systems that accumulate and stabilize sediment—such as coastal dunes, seagrass meadows, and mangroves—disrupting the regular pathways of sediment transport.102 There is evidence of widespread decline in both temperate and tropical ecosystems.103 The estimated loss of seagrass from direct and indirect human impacts amounts was reported to be 33 000 km2, or 18% of the documented seagrass area, over the last two decades in a study in 2003.104 Almost 15% of seagrass species are considered threatened.105 A third of the global seagrasses were reported as declining worldwide, ten of the seventy-two species of seagrass being at elevated risk of extinction and three species listed as Endangered on the IUCN Red List. Twenty-two seagrass species (31%) were reported having declining populations, including all species listed as threatened (Endangered or Vulnerable) or Near Threatened, and six seagrass species listed as Least Concern. Twenty-nine of 72 species (40%) were considered as a stable

[100]See UNEP (2019), ECOSYSTEMS AND BIODIVERSITY, Seagrass—secret weapon in the fight against global heating at https://www.unep.org/news-and-stories/story/seagrass-secret-weapon-fight-against-global-heating. (Last visited 17 April 2021)

[101]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report. See also Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 49 of the report.

[102]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 36 of this report.

[103]See Duarte, C. (2002). The future of seagrass meadows. Environmental Conservation, 29(2), 192-206. doi:10.1017/S0376892902000127. Reference 49 of the report.

[104]See Duarte, C., Borum, J., Short, F., & Walker, D. (2008). Seagrass ecosystems: Their global status and prospects. In N. Polunin (Ed.), Aquatic Ecosystems: Trends and Global Prospects (pp. 281-294). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511751790.025. Reference 50 of the report.

[105]See Hughes, A.R., Williams, S.L., Duarte, C.M., Heck, K.L., Jr and Waycott, M. (2009), Associations of concern: declining seagrasses and threatened dependent species. Frontiers in Ecology and the Environment, 7: 242-246. https://doi.org/10.1890/080041. Reference 51 of the report.

population (i.e., not decreasing or increasing globally), and five species (7%), all listed as Least Concern, were showing an increasing population.106

Site studies:

✤ Baie Blanche Tintamarre seagrass meadows is mix, mainly composed of *Thalassia testudinum* (29%) and *Syringodium filiforme* (70%). The invasive seagrass *Halophila stipulacea* was observed on one radial (1%) during a study performed in 2016,107 with an estimated growth rate of 1,81 cm/j-1.108 The study of 10% of the seagrass meadow of Baie Blanche Tintamarre in 2016 also showed a fragmentation of the native seagrass meadow due to scars created by boat anchors. A quarter of the boats frequenting Tintamarre Bay have been reported to anchor directly onto the seabed. Interruption of the seagrass meadow of less than 2 meters ("mitages") were rare (1% of the study area), whereas larger interruptions of the seagrass meadows of more than 2 meters ("fragmentations") represented 9% of the study area. 128 scars (0,012/m2) due to boat anchors were reported, some of them showing a dynamic of repairs by native seagrass species. The seagrass meadow dynamic appeared to be rapidly changing during the study, showing a change of the total density, of the distribution of the seagrass species, in particular of Syringodium filiforme, and signs of repairs of the boat anchors scars. Tintamarre seagrass meadow was scored 2 "good health status" as a mix seagrass meadow of *Thalassia testudiunum* and *Syringodium filiforme* with non to little presence of macro-algae. Although, inappropriate direct boat anchoring into the seagrass meadow of Tintamarre is a chronic stress affecting the seabed and can favor the invasion of the Bay by *Halophila stipulacea*.

✤ Pinel seagrass meadows study is described in paragraph Conservation 1.4. of the report.

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[106]See Frederick T. Short, Beth Polidoro, Suzanne R. Livingstone, Kent E. Carpenter, Salomão Bandeira, Japar Sidik Bujang, Hilconida P. Calumpong, Tim J.B. Carruthers, Robert G. Coles, William C. Dennison, Paul L.A. Erftemeijer, Miguel D. Fortes, Aaren S. Freeman, T.G. Jagtap, Abu Hena M. Kamal, Gary A. Kendrick, W. Judson Kenworthy, Yayu A. La Nafie, Ichwan M. Nasution, Robert J. Orth, Anchana Prathep, Jonnell C. Sanciangco, Brigitta van Tussenbroek, Sheila G. Vergara, Michelle Waycott, Joseph C. Zieman, Extinction risk assessment of the world's seagrass species, Biological Conservation, Volume 144, Issue 7, 2011, Pages 1961-1971, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2011.04.010. Reference 65 of this report.
[107]See reference 15 of this report Bousquet C. (2016), Évaluation de l'impact de la fréquentation sur l'herbier de phanérogames de Tintamarre, Saint-Martin, 77 pages.
[108]See Moisan (2014) Premiere etude de l'herbier Halophila stipulacea dans les eaux de Saint-Martin (FWI), 37 pages. Reference 20 of the report.

✤ The Simpson Bay Lagoon is a sea turtle habitat and foraging ground, and also home to mangroves. Located outside of St Martin's MPA and both on Saint Martin and Sint Maarten, boat traffic is particularly high on this site, generating all the threats for the species due to this activity. Anthropogenic pollution is very probably also originating from the residences and businesses located around the Lagoon. (pers. observations)

Halophila stipulacea

Halophila stipulacea Fosskal is a tropical, euryhaline marine angiosperm in the family Hydrocharitaceae. *H. stipulacea* was first reported in the Caribbean in Grenada in 2002, followed by reports from Dominica and Saint Lucia in 2007 and 2008, respectively. Since then, the seagrass has been found in Bonaire, Guadeloupe, Les Saintes, Martinique and St. Maarten (Netherlands). The invasive seagrass was not observed in Antigua in 2008 or 2010 during seagrass surveys. *H. stipulacea* was found along the northeastern coastline in small patches within Baie de Cul-de-Sac, as well as at several sites within a 4 km radius including Anse Marcel, Ilet Tintamarre, and Baie de L'Embouchure. The seagrass occurred within extensive meadows of *T. testudinum* and *S. filiforme* at a depth of 1–10 m. *H. stipulacea* has also been reported from the Dutch portion of Simpson Bay Lagoon. *Penicillus* spp. and *Caulerpa* sp. (Chlorophyta), and *Astichopus multifidus* (Holothuroidea) occurred alongside the invasive seagrass. *H. stipulacea* has demonstrated exceptional ecological flexibility in salinity, depth and habitat in its invasive range and a high potential for dissemination to new locations.109 The invasive seagrass has been reported as capable of rapid expansion, with the displacement of the native seagrass *Syringodium filiforme* beginning in 10–12 weeks, and may be able to overtake the indigengous seagrass species. Changes of the associated fauna are also occurring in *Halophila stipulacea* seagrass meadows

[109]See Willette et al. (2013) Continued expansion of the trans-Atlantic invasive marine angiosperm Halophila stipulacea in the Eastern Caribbean, Aquatic Botany 112 (2014) 98–102, http://dx.doi.org/10.1016/j.aquabot.2013.10.001. Reference 22 of the report.

compare to *Syringodium filiforme* meadows.110 Anthropogenic pollution is a primary parameter reported as directly influencing the health of Saint Martin's native seagrasses. The waste waters pipes system has been reported as requiring a major renewal on Saint Martin FWI.111 Sea turtle foraging ground degradation by boats anchors also appear to favor the development of the invasive seagrass *Halophila stipulacea*. *Halophila stipulacea* taking over 60 species of native seagrass in particular sea turtles' foraging ground *Thalassia testudinum* was studied on Saint Martin in 2014, reporting the expansion of the invasive seagrass at 5 sites on the French side of the island (+1 reported on the Dutch side): Pinel and Cul de Sac, Wilderness, Tintamarre, Coralita, Orient Bay, le Sec de Grand Case (French side of the island outside of the MPA) and Gregory's shipwreck (Dutch side of the island).112 Grazers can structure primary producer communities in ways that have profound consequences for other organisms and ecosystem dynamics, grazers can therefore affect invasion dynamics. Cafeteria and count of the number of turtle bites experiments demonstrated that green turtles *Chelonia mydas* seem to prefer to forage on native seagrasses *Thalassia testudinum* and S*yringodium filiforme*, regardless of seagrass relative percentage covers, which consequently likely facilitate the invasion of seagrass meadows by *Halophila stipulacea*. Marine turtles seem to nonetheless forage on *H. stipulacea* when it is the only seagrass available.113 The nutritive qualities of *Halophila stipulacea* differ from *Thalassia*

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[110]See Willette D, Ambrose R (2012) Effects of the invasive seagrass Halophila stipulacea on the native seagrass, Syringodium filiforme, and associated fish and epibiota communities in the Eastern Caribbean, Aquatic Botany 103; 74–82, http://dx.doi.org/10.1016/j.aquabot.2012.06.007. Reference 30 of the report.

[111]See Moisan (2014) Premiere etude de l'herbier Halophila stipulacea dans les eaux de Saint-Martin (FWI), 37 pages. Reference 20 of this report.

[112]See Willette et al. (2013) Continued expansion of the trans-Atlantic invasive marine angiosperm Halophila stipulacea in the Eastern Caribbean, Aquatic Botany 112 (2014) 98–102. See reference 30 of this report Willette D, Ambrose R (2012) Effects of the invasive seagrass Halophila stipulacea on the native seagrass, Syringodium filiforme, and associated fish and epibiota communities in the Eastern Caribbean, Aquatic Botany 103; 74–82. See reference 20 of this report Moisan (2014) Premiere etude de l'herbier Halophila stipulacea dans les eaux de Saint-Martin (FWI), 37 pages. Reference 22 of this report.

[113]See Whitman E, Heithaus M, Garcia Barcia L, Brito D, Rinaldi C, Kiszka J, Effect of seagrass nutrient content and relative abundance on the foraging behavior of green turtles in the face of a marine plant invasion, MARINE ECOLOGY PROGRESS SERIES Vol. 628: 171–182 (2019),

testudinum: the grazed leaf biomass was similar for both *T. testudinum* and *H. stipulacea*, while the grazed leaf biomass was significantly lower for *S. filiforme*. The nutritional values were significantly higher for leaf material collected from the native *T. testudinum* compared to the invasive *H. stipulacea* and the other native *S. filiforme* seagrass: nitrogen and phosphorus contents were significantly higher, and C:N ratios were significantly lower for *T. testudinum* compared to *H. stipulacea*. The soluble sugars contents in *T. testudinum* leaves were measured as significantly higher compared to *H. stipulacea* and *S. filiforme* leaves, which can explain why marine turtles overall prefer to forage on *Thalassia testudinum*.114

Climate change

Climate change impacts on seagrass meadows have been studied and were reported to potentially exacerbate anthropogenic pressures impacts, in particular less ecologically resilient seagrass meadow species. Rising sea temperatures could alter the growth rates and physiological functions of seagrass marine phanerogams and modify the species present in favor of the most resilient ones. A potential change in their abundance and distribution has also been reported. Rising sea levels could also have an impact on the photosynthetic activities of deep see seagrass meadow species and generate a change in their distribution. *Halophila* spp. and *Halodule* spp. are species more tolerant to the lack of light and could be favored to the detriment of *Thalassia* spp. and *Cymodocea* spp. requiring more light. Ocean level rise could also generate a regression of intertidal and deep seagrass meadows. Reproductive capacities of some seagrass meadows species, requiring to touch the surface of the water for their sexual reproduction, could also be impacted (*Enhalus acorides*). Modification of the tides cycles could also cause a reduction of light and an increase exposition of intertidal and shallow

https://doi.org/10.3354/meps13092, and supplementary material. Study in Malendure Guadeloupe, reference 28 of this report. See also Christianen et al. (2019) Megaherbivores may impact expansion of invasive seagrass in the Caribbean, Journal of Ecology;107:45–57, DOI: 10.1111/1365-2745.13021. Study in Lac Bay Bonaire Dutch West Indies, reference 31 of this report.

[114]See Christianen et al. (2019) Megaherbivores may impact expansion of invasive seagrass in the Caribbean, Journal of Ecology;107:45–57, DOI: 10.1111/1365-2745.13021. Study in Lac Bay Bonaire Dutch West Indies, reference 31 of this report.

seagrasses to UV. Increased sea surface temperatures could also fragilise seagrass meadows by causing their foliar necrosis, as well as an increase of their respiration. Climate change is also predicted to cause more frequent and more intense rainfalls, inducing a decrease in salinity and an increase of nutrients in the coastal areas, that could threaten estuarine marine phanerogams. Some studies also described that seagrass meadows could beneficiate of the Oceans' acidification, increasing the availability of CO2 and bicarbonates for photosynthesis. Oceans' acidification could also cause the loss of phenolic substances, protector of marine and estuarine phanerogams leaves, increasing the pressure of herbivorous species, the mortality and decomposition of seagrass meadows. Saturation of the photosynthesis could also generate an increased competition between phanerogams and macro-algae. Oceans' pH modification could cause a change of the seagrass leaves' epibiontes: calcifying organisms like encrusted coralline algae, foraminifers, bryozoaires, polychetes, could be declining due to the reduction of calcification. Increase of CO2 could stimulate the photosynthesis of epiphyte algae.115

Sargassum strandings

Sargassum pelagic strandings, that could also originate from climate change, have been severely impacting coastal seagrass meadows, causing a diminution of their upper distribution, the bleaching of the plants covered by sargassum influx, and a switch to an algae ecosystem.116

Sea turtle poaching

Sea Turtle poaching happened on the island of St Martin in and outside of the MPA. It is difficult to assess the extent of the practice and if there is an organized

[115]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.
[116]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.

poaching scheme including transfer of harvested sea turtles to neighboring islands or if there are opportunistic takes. Law is thoroughly enforced on the matter. Rescue Rehab and Release has been performed.117

✤ Threats for the species and the conservation efforts performed at a regional perspective

At a regional perspective, overharvesting and legal gaps concerning sea turtles were identified and have been threatening the conservation efforts performed.118 Humber et al. 2014 described the Wider Caribbean as the second region in the World responsible for the direct take of sea turtles with 16 countries allowing their take in their Economic Exclusive Zones, representing one third (34.6%) of estimated takes in the World with an average of 14 640 marine turtles slaughtered per year. Although the extent of sea turtle take in the Caribbean region seems underestimated.119 The public health risks associated with the consumption of sea turtle specimen ("meat" and eggs) have been thoroughly reported, therefore sea turtle take and sea turtle take quotas are not supported (personal comment).120 The appropriate protection on their migratory paths of

[117]See The Rescue Rehab and Release of Gaia the Green Turtle that was speared in Orient Bay in 2013 Press Release at www.reservenaturelle-saint-martin.com/fr/node/472, www.tortuesmarinesguadeloupe.org/remise-a-leau-de-gaia-une-jeune-tortue-verte-rescapee/, www.guadeloupe.franceantilles.fr/actualite/environnement/gaia-la-tortue-miraculee-233661.php. Gaia's Rescue Rehab and Release was performed by Julien Chalifour from the Reserve Naturelle de Saint Martin with Veterinarian Dr Claire Saladin on St Martin FWI and thanks to the supervision and coordination of Nicolas Maslach Director of the Reserve Naturelle de Saint Martin. So as to transfer Gaia to Guadeloupe for further treatment after the emergency veterinary care performed on Saint Martin collaboration was established with the Reseau Tortues Marines Guadeloupe and Veterinarian Dr Frederic Leveque. Gaia could be released 3 weeks after rescue in the Reserve Cousteau in Guadeloupe at Malendure Bay. The Direction de l'Environnement, de l'Amenagement et du Logement de Guadeloupe issued in a timely manner the CITES permit necessary for Gaia's transfer.

[118]See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. Reference 12 of this report.

[119]See Humber et al. "So excellent a fish: a global overview of legal marine turtle fisheries" Diversity Distrib., 2014, 20, 579–590. See the alarming report of Haiti Ocean Project NGO of more than 1000 sea turtles slaughtered per month at one village of Haiti from April to October at https://www.juno7.ht/haiti-1000-tortues-tuees-chaque-mois-a-grand-boucan/. Considering the fact that sea turtle and other endangered marine life slaughter happens year round at all villages of Haiti, Humber et al. (2014) figures of sea turtle take in the Caribbean Region seem underestimated. Reference 43 of this report.

[120]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 16 of this report. See Claire Saladin (2020)

marine turtles is urgently needed. Furthermore, illegal international trade has been reported in all of the countries of the Lesser Antilles allowing sea turtle take: St Kitts and Nevis, Grenada, the British Virgin Islands, Montserrat, Dominica and St Lucia. Where sea turtle take is prohibited, Aruba, Curacao, USVI, Trinidad and Tobago, St Vincent and the Grenadines, St Martin FWI reported international illegal trade, the status of Martinique being "unknown".121 It is highly suspected that the legal take authorized in a minority of countries of the Lesser Antilles has been easing illegal international trade in the region. An immediate moratorium on marine turtles and their derivatives' take in the Lesser Antilles is therefore sharply recommended. Recommendations so as to move towards secured, healthy and economically sustainable fishery practices at the global scale have been published.122

1.4. Conservation

Monitoring of sea turtle foraging grounds and habitats: coral reefs and seagrass meadows of Saint Martin FWI

The monitoring of coral reefs and seagrass meadows stations by the Reserve Naturelle de St Martin has been performed twice a year at 8 coral reef stations and 3 seagrass meadows stations since 2018: Pinel coral reef and seagrass meadows station, Grand Case seagrass meadows station, Rocher Creole coral reef and seagrass meadows station, Rocher Pelican coral reef station, Galion

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International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. Reference 12 of this report.

[121]See Eckert, Karen L. and Adam E. Eckert. 2019. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Revised Edition. WIDECAST Technical Report No. 19. Godfrey, Illinois. 232 pages, plus electronic Appendices. Reference 4 of this report. See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. The article reported of international illegal trade coming from Ste Lucia going to Martinique.

[122]See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164.

coral reef station, Fish Pot coral reef station, Chicot coral reef station, Caye Verte coral reef station and La Basse Espagnole coral reef station.

✤ Four stations of mix seagrass meadows of *Thalassia testudinum* and Syringodium filiforme on St Martin were selected and extensively studied in 2017 and 2018, with the aim to develop a seagrass meadow monitoring method: Grand Case, le Rocher Creole, Tintamarre and Galion. Galion seagrass meadow is also composed of *Halophila stipulacea* and *Halodule wrightii*. The potential anthropogenic pressures gradient was estimated based on the proximity and intensity of anthropogenic perturbations, four criterions were considered: turbidity, organic matter, nutrients and pollutants.123 Tintamarre was indexed as a site showing little anthropogenic pressures, Grand Case was indexed as a seagrass meadow moderately affected by anthropogenic pressures (watershed waste-waters), le Rocher Creole was indexed as a site moderately affected by anthropogenic pressures (nautical activities). Galion was indexed as a site severely affected by anthropogenic pressures due to watershed waste-waters. Structural and morphological features of each site were recorded, physiological parameters including ratios of stable isotopes δ13C et δ15N, proportion of nutriments N and P, and traces of metallic elements Mn, Fe, Zn, Pb, Cd, Cr, Cu, Ni and Hg, in particular, were measured and analyzed. Biotic parameters were studied as well as abiotic parameters including sediment and water column of the samples characteristics. The measures of metallic element traces in *Thalassia testudinum* rhizomes on St Martin is summarized in Figure 2, in *Thalassia testudinum* leaves in Figure 3. Figure 4 describes the content in δ15N, N and P of rhizomes of *Thalassia testudinum*.

[123]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d’outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.

Content in trace metallic element Mn Fe and Zn showed higher concentrations linked to the gradient of anthropogenic pressures. Cu element values showed inter-annual variations and were not linked to the gradient of anthropogenic pressures. There are no significant differences linked to the gradient of anthropogenic pressures of content in Cr and Ni. Hg was not detectable. Mn Ni and Cd were more abondant in leaves than rhizomes of Thalassia testudinum. On Saint Martin, Tintamarre showed very low pollution in trace metallic elements tested both in 2017 and 2018 in Thalassia testudinum rhizomes and leaves. Although, juvenile marine turtles affected by fibropapillomatosis are foraging at Tintamarre (Pers. observations). Galion showed in particular the highest Mn, Fe and Zn concentrations. Rocher Creole showed intermediate concentrations of Mn Fe and Zn, with Zn and Pb concentrations in the same range or higher than the severely polluted Galion Bay. Hg2+, Cr6+, and Cd2+ are considered generally the most toxic to human and animal cells. Cu2+ and Zn2+ have a large range in toxicity but are considered less toxic when compared to Hg Cr and Cd. Chronic exposure of marine turtles to these inorganic pollutants, a possible mixture effect with organic pollutants, could also be considered. The measurements of cytotoxic compounds concentrations in marine turtles blood and scutes could also be performed.[124] See paragraph 1.5. Research of the report. There are no defined thresholds of trace elements in seagrasses to refer to. (pers. comment). Thresholds were estimated for *Thalassia testudinum*, depending on the anthropogenic pressures gradient:

Pristine conditions were defined as: 0,8 < δ15N < 2,5 ‰; N < 1,8%; P < 0,2%; Mn < 50 µg.g-1; Pb < 0,75 µg.g-1; Fe < 100 µg.g-1; Zn < 20 µg.g-1.

[124]See Finlayson KA, Leusch FDL, van de Merwe JP. Cytotoxicity of organic and inorganic compounds to primary cell cultures established from internal tissues of Chelonia mydas. Sci Total Environ. 2019 May 10;664:958-967. doi: 10.1016/j.scitotenv.2019.02.052. Reference 57 of the report.

Under severe anthropogenic pollutions seagrass meadow samples would show measures in the ranges of : δ15N > 4 ‰; N > 2%; P > 0,25%; Mn > 100 µg.g-1; Pb > 1 µg.g-1; Fe > 200 µg.g-1; Zn > 25 µg.g-1.

Foliar necrosis of *Thalassia testudinum* was not correlated to the gradient of anthropogenic pressures. 30 % of the seagrass meadows studied were showing signs of grazing from the indigenous herbivorous fauna.125 Tintamarre is a renowned sea turtle foraging ground, which is a parameter that is recommended to also be taken into consideration for the enhanced management of the seagrass meadow of the Bay.126 Nonetheless, sea turtle density could be estimated at an average of 2-5 turtles per hectare at Tintamarre (pers.observations).

✤ Artificial coral reefs have been implemented at Tintamarre and Anse Marcel. (Pers. observations).

✤ Pinel is home to the monospecific seagrass meadows of *Thalassia testudinum*, as well as mix marine phanerogams meadows of *Thalassia testudinum* and *Syringodium filiforme* that are considered in good health. At the north side of Pinel, a monospecific fragmented seagrass meadow of Syringodium filiforme showed signs of boat anchoring and was considered in a medium health status. Anchorage buoys probably contribute to the good health of Pinel's seagrass meadows. A patch of *Halophila stipulacea* was nonetheless reported in 2013 close to the monospecific seagrass meadow of *Thalassia testudium*. The Baie de Cul de Sac close by, being invaded by *Halophila stipulacea*, has been recommended to be closely monitored.127

[125]See Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.
[126]See also Christianen MJA et al. 2014 Habitat collapse due to overgrazing threatens turtle conservation in marine protected areas. Proc. R. Soc. B 281: 20132890. http://dx.doi.org/10.1098/rspb.2013.2890. Reference 32 of this report.
[127]See reference 29 of this report Schmitt A (2013) Cartographie des habitats épibenthiques de l'ilet Pinel et de leurs états de santé, 54 pages.

Several research projects also precised the health status of coral reefs and seagrass meadows of Saint Martin FWI and are described in paragraph 1.3.2.Threats. Marine areas. of this report.

Recommendations

The conservation projects located within or without the MPA could include but are not limited to:

Nesting Marine Turtles Flipper-tagging campaign

Due to the alarming levels of take of marine turtles and many marine species (manatees, nurse sharks for instances) reported in the Caribbean region including at Haiti, and due to the fact that fishermen or marine turtle harvesters, including Haitian sea turtle takers, have been reported to be more susceptible to release their catch when the marine turtle is identified by flipper tags, it has been strongly recommended to urgently implement a flipper tagging campaign of nesting marine turtles on Saint Martin FWI.128

Abrogation of France's reservation on *Chelonia mydas* sea turtles take in all relevant international Treaties

The complete and infinite legal protection of green turtles *Chelonia mydas* is non existent at the international scale due to France's reservation on the species. France's reservation on *Chelonia mydas* implies that France tolerates the unhealthy and unsecure fishery practice that is the take of sea turtles or their derivatives in a general manner. France's reservation on *Chelonia mydas* is also, in reality, contradictory with the conservation actions thoroughly implemented, as it

[128]Flipper tagging is a common practice in the Wider-Caribbean, including in Florida, and has also proven to be very informative in marine turtle nesting, foraging ecology and migratory patterns studies. Cases of fibropapillomatosis linked to flipper tags have not been confirmed by Widecast colleagues. There are no peer-reviewed article to date reporting of flipper tagging as a trigger of marine turtles fibropapillomatosis. (pers. observations). See Humber et al. "So excellent a fish: a global overview of legal marine turtle fisheries" Diversity Distrib., 2014, 20, 579–590. See the alarming report of Haiti Ocean Project NGO of more than 1000 sea turtles slaughtered per month at one village of Haiti from April to October at https://www.juno7.ht/haiti-1000-tortues-tuees-chaque-mois-a-grand-boucan/.

implies that France tolerates that sea turtles that are completely protected by Law in Saint Martin's E.E.Z., could be harvested a few nautical miles away in a neighbouring island, in another Party's E.E.Z., where the practice could be allowed, annihilating the conservation efforts performed and the entire protection of marine turtles assured so that the species can thrive again. It is therefore firmly recommended that France sends the unbiased message of its commitment to marine turtles entire protection by implementing the complete and infinite prohibition of all species of sea turtles and their derivatives' take on its entire territory and by repealing its reservation on *Chelonia mydas* and on strictly protected fauna species in all relevant Treaties.129

Implementation of CITES Decision 18.211 paragraph g) via the Mt DNA registration of the resident and nesting sea turtles of St Martin FWI in the CITES sea turtle shell bank

CITES Decision 18.211 paragraph g) urged Parties to "Collect samples of marine turtles for DNA analysis, including from seized specimens, to determine species involved and populations of origin and provide these to forensic and other research institutions capable of reliably determining the origin or age of the samples in support of, for example, research, investigations and prosecutions;".130 This report recommends the implementation of CITES Decision 18.211 paragraph g) on St Martin via the development of a protocol of sampling of St Martin's resident and nesting sea turtles.

Halophila stipulacea monitoring program

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[129]See Table 3 of this report. See Claire Saladin (2020) SAINT MARTIN FWI Chapter 16 In: Nalovic MA, Ceriani SA, Fuentes MMPB, Pfaller JB, Wildermann NE, Cuevas E (Eds.) (2020). Sea Turtles in the North Atlantic & Wider Caribbean Region. MTSG Regional Report 2020. Report of the IUCN-SSC Marine Turtle Specialist Group, 2020. Reference 14 of this report. See Claire Saladin (2020) International Environmental Law and Sea Turtles: Anatomy of the Legal Framework and Trade of Sea Turtles in the Lesser Antilles, Journal of International Wildlife Law & Policy, 23:4, 301-333, DOI: 10.1080/13880292.2020.1872164. Reference 12 of this report.
[130]See CITES COP18 Decision 18.211 at para. g.

Coral reefs enhanced conservation via the renewal of waste waters of the watersheds management and monitoring of the seawater chemistry changes

Measurements of selected stations seawater pCO2, pH and surface seawater Ωar could be included into the coral reefs monitoring. Under current global socioeconomic conditions, future model projections for the wider Caribbean suggest that average (± standard error) sea surface temperature could increase by 1.76 ± 0.39°C during the 21st century, but with different warming trends in summer and winter. Average surface seawater pH and Ωar could decrease by 58% and 32%, respectively, relative to conditions observed in 2015. Eutrophication and organic matter input can be the main drivers of acidification of reef waters or exacerbating the long-term effect of rising atmospheric CO2. Management efforts addressing water quality can assist in lowering global acidification effects at the reef scale, as the local and global acidification impacts combine and are intrinsically coupled. Both ocean warming and acidification will pose increasing threats to the ability of Caribbean reefs to sustain themselves and recover from future acute stress events unless imminent actions are taken at both the local, regional and global scale.131

An enhanced mangroves restoration program, including the Simpson Bay Lagoon mangroves

Mangroves are sea turtle habitats, ideal nursery grounds for groupers, snappers for exemple, protective ecosystems for smaller fishes, coastlines natural buffer from sea level rise, crucial for carbon sequestration. Mangroves are indeed a significant global carbon store and sink, with the largest average carbon stocks per unit area of any terrestrial or marine ecosystem. The global average carbon stock of mangroves is around 1,000 tonnes of carbon per hectare, including soil

[131]See Andreas J. Andersson, Alexander A. Venn, Linwood Pendleton, Angelique Brathwaite, Emma F. Camp, Sarah Cooley, Dwight Gledhill, Marguerite Koch, Samir Maliki, Carrie Manfrino, Ecological and socioeconomic strategies to sustain Caribbean coral reefs in a high-CO2 world, Regional Studies in Marine Science, Volume 29, 2019, 100677, ISSN 2352-4855, https://doi.org/10.1016/j.rsma.2019.100677. Reference 52 of this report.

carbon. The bulk of mangrove carbon is held in the soil, ranging from about 83% to almost 99% of the carbon stored in mangroves. A variety of factors affect the effectiveness of mangroves as carbon stores and sinks, such as the hydrology (tidal inundation, strength and frequency) salinity (freshwater availability), tropical cyclone frequency, nutrient availability and climate. Larger carbon stocks tend to be found in equatorial areas, areas of lower soil salinity, higher rainfall, and in sites with infrequent cyclones. Conversion of mangroves for coastal development can release stored carbon that has been accumulating in place for thousands of years back into the air, resulting in exceptionally high carbon dioxide emissions. Emissions resulting from mangrove losses make up nearly one fifth of global emissions from deforestation. Climate change impacts on mangroves are expected to be linked to rising sea levels restricting their habitat to half of the tidal range. In some locations, the mangroves may be able to retreat landward but this will depend on the availability of suitable habitat for them to move into, and many coastal lowlands are now suffering from coastal squeeze as they have been modified to the extent that this cannot happen. Increased intensity and frequency of storms will also potentially increase pressure through damage, tree mortality, stress, and changes in sediment surface elevation through erosion, deposition, and compression. By 2100, an estimated 10-15% of mangroves could be lost to climate change. The impact of projected temperature increase, the direct effects of carbon dioxide increase, and changes in rainfall patterns are hard to predict, but in some cases may even be beneficial, increasing mangrove productivity and biodiversity particularly at higher latitudes. The benefits of carbon dioxide increase however could be reduced if there are also negative impacts from changes in salinity, humidity and nutrients and, where rainfall is projected to decrease rather than increase, there could be reduced productivity and biodiversity and greater relative subsidence, as less sediment is deposited. Amongst many of their ecosystem services, mangroves also maintain surrounding water quality by filtering riverine and tidal waters of sediments, minerals, contaminants and nutrients. Mangrove trees and associated plants have a high tolerance for a wide range of salinities and contamination levels and perform an effective service in biofiltration and waste processing. However, critical thresholds for salinity, heavy metals, chlorine containing organic compounds and sediments do exist, beyond which mangrove die-back will occur.132 In 2013, the Cul de Sac mangrove canopy was vigorous. About seven months before Irma (2017/02/25) a large portion of the mangrove cover was dying due to multiple human-induced stress factors, in particular obstruction of the water flow. About 14 months after Irma (2018/10/28), whilst most of the mangrove vegetation early recovered over the island of Saint Martin, a large portion of mangroves in Cul de Sac disappeared, replaced by water surface.133 Saint Martin's mangrove preservation and restoration program is therefore recommended to be significantly strengthened, as the associated educative program in partnership with the schools of Saint Martin.

Stabilisation and restoration of the coastline's vegetation of sea turtles nesting sites

The assessment and restoration of the coastline, in particular of the nesting beaches of *Eretmochelys imbricata*, listed as critically endangered on the IUCN Red List, are recommended. The conservation project could include the development of an educative program in partnership with schools of Saint Martin. Furthermore, the study of human influences on beach response to tropical cyclones on Saint Martin showed that where the indigenous or mixed shrubby, i.e. dense, vegetation has been conserved, forming a continuous and relatively wide (>30-50 m) formation along the shoreline, it acted as a buffer, limiting the penetration of the cyclonic waves inland and contributing to the vertical accretion of coastal systems. Where the first vegetation line was either destroyed

[132]See UNEP (2014). The Importance of Mangroves to People: A Call to Action. van Bochove, J., Sullivan, E., Nakamura, T. (Eds). United Nations Environment Programme World Conservation Monitoring Centre, Cambridge. 128 pp. Reference 45 of the report.

[133]See R. Walcker, C. Laplanche, M. Herteman, L. Lambs, F. Fromard. Damages caused by hurricane Irma in the human-degraded mangroves of Saint Martin (Caribbean). Scientific Reports, Nature Publishing Group, 2019, 9, pp.18971. 10.1038/s41598-019-55393-3 . hal-02997244. Reference 47 of this report.

or severely damaged by the cyclonic waves, which occurred over a distance of 10 to 30 m depending on the site, a second vegetation line resisted and buffered the cyclonic waves. It therefore prevented the propagation of marine inundation and of associated sediment deposition in inner land areas, while also causing substantial sediment trapping. This led to the formation of elevated (i.e. reaching up to 1.70 m in height) beach ridges along the shoreline. In contrast, where the native vegetation has been removed and replaced by introduced woody species (mostly coconut trees), the latter generally suffered total destruction, which, together with the absence of undergrowth, caused extensive marine inundation and sediment deposition across inland areas. In this case, no beach ridge formed, the spreading of sediment limiting vertical accretion. In addition, while the dense branch and root system of the indigenous vegetation limited soil scouring on natural coasts, modified areas having introduced and sparse vegetation suffered intense and extensive soil scouring. A vegetated foreshore ecosystem is also the most effective in preventing beach erosion and, therefore, increase the resistance of coastal areas to storm surges and flooding. Switching disturbed beach systems to natural self-sustaining ecosystems for coastal defense requires financial investments. The restoration of degraded coastal buffering areas, i.e. the morphological-ecological features that were altered by human development implies beach nourishment where the beach budget is in deficit, and vegetation replantation on both the upper beach and back-beach. Indigenous vegetation should be replanted wherever it was cleared, given its resistance to cyclonic winds and waves, and its capacity to trap sediments and contribute to coastal systems' upward growth.134.

[134]See James, Rebecca; Silva Casarín, R. (Rodolfo); van Tussenbroek, B.I. (Brigitta); Escudero-Castillo, M. (Mireille); Mariño-Tapia, I. (Ismael); Herman, P M J; et al. (2018): Data presented in the paper "Maintaining Tropical Beaches with Seagrass and Algae: A Promising Alternative to Engineering Solutions". 4TU.ResearchData. Dataset. https://doi.org/10.4121/uuid:a5f07774-9a90-4aa2-ae03-690da7d36a77. Reference 36 of this report. See also Virginie Duvat, Valentin Pillet, Natacha Volto, Yann Krien, Raphaël Cécé, Didier Bernard , High human influence on beach response to tropical cyclones in small islands: Saint-Martin Island, Lesser Antilles. Geomor (2018), doi:10.1016/j.geomorph.2018.09.029. Reference 46 of this report.

1.5. Research

The research projects recommended to be implemented on Saint Martin FWI include but are not limited to:

❖ Fibropapillomatosis research and treatment program

Marine turtles are sentinel species, indicators of their environment's health. Fibropapillomatosis is an infectious neoplastic disease affecting sea turtles globally and is observed all around the island of St Martin. The likely main etiologic agent chelonid alphaherpesvirus 5 (ChHV5) can affect all species of marines turtles, was found in samples of normal skin, tumors, ocular nasal and cloacal swabs of tumored and non tumored marine turtles, in tumored or non tumored visceral organs of tumored turtles135 and is thought to be horizontally transmitted at foraging grounds between marine turtles.136 No studies of this disease have been performed yet on the island of Saint Martin FWI. Although, research is essential so as to attempt to identify the infectious agent(s)137 and co-triggers of the disease affecting Saint Martin's marine turtles.138 Wildlife pathogens have shown to exacerbate the effects of environmental degradation, habitat loss, and the climate emergency on population levels, potentially leading to local and global extinctions. As the risk of extinction increases for a given species, the detrimental effects of disease on the population worsen. Anthropogenic activities are stressing habitats, and the rapid environmental changes induced by these activities are likely increasing cancer rates in wildlife

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[135]See for instance Chaves et al. (2017) Examining the Role of Transmission of Chelonid Alphaherpesvirus 5EcoHealth. 2017-05 | journal-article, DOI: 10.1007/s10393-017-1248-7. Reference 61 of this report.
[136]See Jones K, Burgess G, Budd AM, Huerlimann R, Mashkour N, Ariel E (2020) Molecular evidence for horizontal transmission of chelonid alphaherpesvirus 5 at green turtle (Chelonia mydas) foraging grounds in Queensland, Australia. PLoS ONE 15(1): e0227268. https://doi. org/10.1371/journal.pone.0227268. Reference 60 of this report.
[137]See for instances Quackenbush et al. (1998), Three Closely Related Herpesviruses Are Associated with Fibropapillomatosis in Marine Turtles, VIROLOGY 246, 392–399 (1998) ARTICLE NO. VY989207, 8 pages, Reference 62 of this report; and Ng TF, Manire C, Borrowman K, Langer T, Ehrhart L, Breitbart M. Discovery of a novel single-stranded DNA virus from a sea turtle fibropapilloma by using viral metagenomics. J Virol. 2009 Mar;83(6):2500-9. doi: 10.1128/JVI.01946-08, Reference 63 of this report.
[138]See K. Jones, E. Ariel, G. Burgess, M. Read, A review of fibropapillomatosis in green turtles (Chelonia mydas), The Veterinary Journal (2015), http://dx.doi.org/doi:10.1016/j.tvjl.2015.10.041. Reference 59 of this report.

populations. Human-induced perturbations of inshore marine environments have also been implicated as a co-trigger of the FP tumor epizootic in green sea turtles. Environmental changes are thought to be key to conferring oncogenicity upon ChHV5-infected turtles, potentially through compromising or modulating the turtles' ability to respond to the viral infection.139 Eutrophic coastal ecosystems may promote herpesvirus infections among herbivores : disease and Nitrogen-footprints were reported as elevated where macroalgae is chronic and widespread. Green turtles are thought to consume nonnative macroalgae which likely sequester environmental N as arginine. Arginine is known to regulate herpesviruses and contribute to tumor formation. In many chronic diseases, Arg is involved in cell inflammation and immune dysfunction and in promoting viral tumors. But Arg is specifically important for herpesviruses which are linked to FP tumors. Experiments showed that herpes does not grow without Arg, as Arg is a key building block of the viral envelope that facilitates localization, fusion, and entrance to host cell nuclei.140 Pollution of the bays by watersheds waste waters, industrial wastes, boats chemicals and wastes, invasive macroalgae, organic and inorganic compounds polluting sediment, sand and/or seagrass meadows of sea turtles foraging grounds are hypothetical co-triggers of the disease on Saint Martin FWI. Chronic exposure to, and mixture toxicity effects of, environmental stressors could be investigated. In vitro bioassays demonstrated the toxicity of heavy metals on marine turtles skin fibroblasts and internal organs cells for instance, inorganic contaminants, such as Zn, Cd, Cr, Hg, and Cu were identified as posing a potential risk to sea turtle populations around the world. Skin cells of marine turtles have been demonstrated to be the most sensitive organ to these cytotoxic compounds.141 Biomonitoring and

[139]See Yetsko, K., Farrell, J.A., Blackburn, N.B. *et al.* Molecular characterization of a marine turtle tumor epizootic, profiling external, internal and postsurgical regrowth tumors. *Commun Biol* **4,** 152 (2021). https://doi.org/10.1038/s42003-021-01656-7. Reference 55 of this report.

[140]See Van Houtan KS, Hargrove SK, Balazs GH (2010) Land Use, Macroalgae, and a Tumor-Forming Disease in Marine Turtles. PLoS ONE 5(9): e12900. doi:10.1371/journal.pone.0012900. Reference 56 of this report.

[141]See Finlayson KA, Leusch FDL, van de Merwe JP. Cytotoxicity of organic and inorganic compounds to primary cell cultures established from internal tissues of Chelonia mydas. Sci Total Environ. 2019 May 10;664:958-967. doi: 10.1016/j.scitotenv.2019.02.052. Reference 57 of this report.

research of trace element exposure in the blood and scutes of sea turtles could also provide data so as to understand fibropapillomatosis co-triggers on Saint Martin.142 The surgical treatment of affected individuals is also recommended, to the extent possible, as the disease can be lethal and is contagious between sea turtles. Being time consuming and costly, governmental cooperation is vital to mitigate this threat for the survival of the species. As marine turtles fibropapillomatosis is an infectious neoplastic disease, sharing genomic drivers with human cancers, it is firmly recommended that the disease is taken in charge primarily by Veterinary Doctors.143 Furthermore, in a general manner, the systematic physical examination and/or complete autopsy of a stranded sea turtle has been recommended so as to appropriately diagnose the cause of the sea turtle's stranding or death. The additional data thus collected could significantly cover some knowledge gaps of the disease (personal observations).

❖ Saint Martin's Leatherback Research Program The leatherback research program of St Martin could include but is not limited to:

➾ The increase monitoring of leatherback turtles nests on Saint Martin FWI. The monitoring program could involve businesses and inhabitants of the Bay. Excavation of the nests could be performed so as to precisely measure hatching successes of Saint Martin's leatherback turtles population. Nests protection could be performed so as to increase hatching success, when relevant. Other threats for Saint Martin's leatherback turtles needed to be mitigated could also be identified at the excavation of the nests, samples taken in case of low hatching rates or suspicion of an infection of the nest, and screening, for the presence of fungi in particular, performed.

[142]See C.A. Villa, I. Bell, C. Madden Hof, C.J. Limpus, C. Gaus, Elucidating temporal trends in trace element exposure of green turtles (Chelonia mydas) using the toxicokinetic differences of blood and scute samples, Science of The Total Environment, Volume 651, Part 2, 2019, Pages 2450-2459, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2018.10.092. Reference 58 of this report.
[143]See Mashkour N, Jones K, Kophamel S, Hipolito T, Ahasan S, Walker G, et al. (2020) Disease risk analysis in sea turtles: A baseline study to inform conservation efforts. PLoS ONE 15(10): e0230760. https://doi.org/10.1371/journal. pone.0230760. Reference 16 of this report.

⇨ The assessment of the impact of human activities on the leatherbacks nesting beaches in particular on Orient Bay.

⇨ The implementation of a scientific partnership with the community of inhabitants and businesses of Orient Bay for the monitoring and conservation of leatherback turtles so as to enhance nests monitoring and sustainable development of the Bay including for instance the use of sea turtle friendly lighting and the appropriate disposal of beach furnitures.

⇨ The implementation of an Orient Bay sustainable beach cleaning program in partnership with the Collectivite de Saint Martin and/or local NGOs.

❖ Development of a partnership with businesses and hotels of nesting sites for the enhancement of sea turtle monitoring and conservation

❖ Assessment and modernisation of the management of anthropogenic pollution on Saint Martin FWI At a watershed scale, precise measures of the bays pollutants origins and levels, study of the pollution originating at construction sites and at marinas including for instance the study of the chemicals used on boats could be performed. Preservation and restoration of Saint Martin seagrass meadows, coral reefs and mangroves are imperative and directly linked to the management of anthropogenic pollutions and the waste water system. Cooperation with the Collectivite de Saint Martin and relevant authorities for this study and project has been suggested.

❖ Research on the fishermen indigenous community of St Martin FWI The study of the fishery practices on St Martin, including the description and valorisation of the history of the fishermen indigenous community of St Martin is recommended.

❖ Study of the Simpson Bay lagoon biodiversity The Simpson Bay Lagoon is a sea turtle habitat and foraging ground, a special ecosystem including mangroves, also unique due its management being shared between Saint Martin and Sint Maarten. The study of its biodiversity is necessary and may lead to its improved governance. Precise data are needed so as to effectively manage this ecosystem. Mangroves are natural soil stabilisers and filters, buffer coastlines from storm surges, tides, waves and current, as coastal habitats are accountable of 14% of the carbon sequestration by the global Ocean, are storing three to five times more carbon in their soil than tropical rainforests and are essential for the good health of Saint Martin's population.

⚜ Saint Martin's sea turtle nesting sites photo-pollution research program To continue the study performed by the Reseau Tortues Marines Guadeloupe in 2015 reporting the need to mitigate the photo-pollution threat on Saint Martin, research on lightings on nesting beaches could include the measurement of the photo-pollution described in 2015 and the development of a partnership with residents and hotels particularly on the major nesting sites of Baie Longue and Baie aux Prunes in the Low-Lands as well as a partnership with residents and businesses on the Leatherback nesting site of Orient Bay for the implementation of sea turtle friendly lightings.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Saint Martin FWI.

Topic	*E. imbricata*	Ref #	*D. coriacea*	Ref #	*C. mydas*	Ref #	*C. caretta*	Ref #	*L. olivacea*	Ref #
Occurrence										
Nesting sites	Y (17)	1;25;2;3;4;5;6;7;8;9;10;14;15;17;33;34;64	Y (4)	1;25;2;3;4;5;6;7;8;9;10;14;33;34;64	Y (17)	1;25;2;3;4;5;6;7;8;9;10;14;33;34;64	N	1;25;2;3;4;5;6;7;8;9;10;14;15;17;18;33;34;64	N	1;25;2;3;4;5;6;7;8;9;10;14;15;17;18;33;34;64
Oceanic foraging areas	U	n/a	U	n/a	U	n/a	U	n/a	U	n/a
Neritic foraging areas	Y	14;17;64	Y	14;17;64	Y	14;17;64	Y	14;17;18;64	U	14;17;18;64
Key biological data :										
Nests/yr: recent average (range of years)	67 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	1 - 2 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	122 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r
Nests/yr: recent order of magnitude	29 - 106 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	0 - 6 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	8 - 225 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0 (Tintamarre Lagon 19,85 crawls per year)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	0	1;25;2;3;4;5;6;7;8;9;10;14;33;34	2 (Baie Longue #78 crawls/year and #43 crawls/year/km); (Baie aux	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r

					Prunes #23 crawls/year and #19 crawls/year/km)					
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	17	1;25;2;3;4;5;6;7;8;9;10;14;33;34	4	1;25;2;3;4;5;6;7;8;9;10;14;33;34	15	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r
Nests/yr at "major" sites: recent average (range of years)	n/r	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	51 (2009 - 2018)	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r
Nests/yr at "minor" sites: recent average (range of years)	8 (2009 - 2018) at 9 index beaches	1;25;2;3;4;5;6;7;8;9;10;14;33;34	0 - 1 (2009 - 2018) at 4 nesting beaches	1;25;2;3;4;5;6;7;8;9;10;14;33;34	3 (2009 - 2018) at 9 index beaches	1;25;2;3;4;5;6;7;8;9;10;14;33;34	n/r	n/r	n/r	n/r
Total length of nesting sites (km)	14.1	14	5,475	14	16,160	14	n/r	n/r	n/r	n/r
Nesting females / yr	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Nests / female season (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Female remigration interval (yrs) (N)	U	n/r	U	n/r	Hypothesis of a 2-3 years remigration pattern	1;2;3;4;5;6;7;8;9;10;33;34	n/r	n/r	n/r	n/r
Sex ratio: Hatchlings (F / Tot) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Sex ratio: Immatures (F / Tot) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Sex ratio: Adults (F / Tot) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Min adult size, CCL or SCL (cm)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Age at maturity (yrs)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Clutch size (n eggs) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Emergence success (hatchlings/egg) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Nesting success (Nests/ Tot emergence tracks) (N)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r

Trends										
Recent trends (last 20 yrs) at nesting sites (range of years)	U	n/r	U	n/r	U	n/r	n/r	n/r	n/r	n/r
Recent trends (last 20 yrs) at foraging grounds (range of years)	U	n/r	U	n/r	U	n/r	U	n/r	U	n/r
Oldest documented abundance: nests/yr (range of years)	2009	1;25;2;3;4;5;6;7;8;9;10;14;15;17;33;34	2009	1;25;2;3;4;5;6;7;8;9;10;14;15;17;33;34	2009	1;25;2;3;4;5;6;7;8;9;10;14;15;17;33;34	n/r	n/r	n/r	n/r
Published studies										
Growth rates	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Genetics	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Stocks defined by genetic markers	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Remote tracking (satellite or other)	N	n/r	N	n/r	Y	24	N	n/r	N	n/r
Survival rates	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Population dynamics	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Foraging ecology	N	n/r	N	n/r	Y	24;n/a	N	n/r	N	n/r
Capture-Mark-Recapture	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Disease risks analysis	Y	16	Y	16	y	16	Y	16	Y	16
Illegal and legal take impacts	Y	12	Y	12	Y	12	Y	12	Y	12
Threats	***Eretmochelys imbricata***	Ref #	***Dermochelys coriacea***	Ref #	***Chelonia mydas***	Ref #	***Caretta caretta***	Ref #	***Lepidochelys olivacea***	Ref #
Bycatch: presence of small scale / artisanal fisheries?	Y	n/a	Y	n/a	Y	n/a	Y	n/a	Y	n/a
Bycatch: presence of industrial fisheries?	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Bycatch: quantified?	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Intentional killing of turtles	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12
Take. Illegal take of turtles	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12	Y	23;14;17;64;12
Take. Permitted/legal take of turtles	N	11;12;13;14;27;64	N	11;12;13;14;27;64	N	11;12;13;14;27;64	N	11;12;13;14;27;64	N	11;12;13;14;27;64
Take. Illegal take of eggs	N	n/a	N	n/a	N	n/a	n/r	n/r	n/r	n/r

Take. Permitted/legal take of eggs	N	11;12;13; 14;27;64	N	11;12;13; 14;27;64	N	11;12;13; 14;27;64	n/r	n/r	n/r	n/r
Coastal Development. Nesting habitat degradation	Y	14;20;8	Y	14;20;8	Y	14;20;8	n/r	n/r	n/r	n/r
Coastal Development. Photopollution	Y	14;8	Y	14;8	Y	14;8	n/r	n/r	n/r	n/r
Coastal Development. Boat strikes	Y	16;26	Y	16;26	Y	16;26	Y	16;26	Y	16;26
Egg predation	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Pollution (waste waters, macroalgae, debris ALODFG, heavy metals ...)	Y	n/a;37;3 8	Y	n/a;37;3 8	Y	n/a;37;3 8	Y	n/a;37; 38	Y	n/a;37;38
Pathogens : Fibropapillomatosis, Soft Coral Tissue Loss Disease	Y	16;14;44	Y	16;14;44	Y	16;14;44	Y	16;14;4 4	Y	16;14;44
Climate change	Y	14;46;20	Y	14;46;20	Y	14;46;20	Y	14;20	Y	14;20
Foraging habitat degradation	Y	14;16;29; 20;22	Y	14;16;29; 20;22	Y	14;16;29; 20;22	Y	14;16;2 9;20;22	Y	14;16;29;2 0;22
Sargassum entanglement of hatchlings juveniles and adults; invasive seagrass species *Halophila stipulacea*?	Y	14	Y	14	Y	14;28	Y	14	Y	14
Long-term projects (>5yrs)										
Monitoring at nesting sites (period: range of years)	2009 - ongoing	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	2009 - ongoing	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	2009 - ongoing	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	n/r	n/r	n/r	n/r
Number of index nesting sites	9	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	3	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	9	1;25;2;3; 4;5;6;7;8; 9;10;14;1 5;17;33;3 4;64	n/r	n/r	n/r	n/r
Monitoring at foraging sites (period: range of years)	Y	26;n/a	Y	26;n/a	Y	24; 26; n/a	Y	26;n/a	Y	26;n/a
Conservation										
Protection under national law	Y	11;12;13; 14;27;64	Y	11;12;13; 14;27;64	Y	11;12;13; 14;27;64	Y	11;12;1 3;14;27; 64	Y	11;12;13;1 4;27;64

Number of protected nesting sites (habitat preservation) (% nests)	17 (100 %)	11;12;13;14;27;64	4 (100 %)	11;12;13;14;27;64	17 (100 %)	11;12;13;14;27;64	n/r	11;12;13;14;27;64	n/r	11;12;13;14;27;64
Number of Marine Areas with mitigation of threats	1	14;64	1	14;64	1	14;64	1	14;64	1	14;64
N of long-term conservation projects (period: range of years)	6 (2009 - ongoing)	1;25;2;3;4;5;6;7;8;9;10;14;15;17;19;20;21;22;23;16;26;29;30;35;38;39;40;41;64	6 (2009 - ongoing)	1;25;2;3;4;5;6;7;8;9;10;14;15;17;19;20;21;22;23;16;26;29;30;35;38;39;40;41;64	6 (2009 - ongoing)	1;25;2;3;4;5;6;7;8;9;10;14;15;17;19;20;21;22;23;16;26;29;30;35;38;39;40;41;64	5 (2009 - ongoing)	19;20;21;22;23;16;26;29;30;35;38;39;40;41;64	5 (2009 - ongoing)	19;20;21;22;23;16;26;29;30;35;38;39;40;41;64
In-situ nest protection (eg cages)	Y (when relevant)	n/a	Y (when relevant e.g. Orient Bay)	n/a	Y (when relevant)	n/a	N	n/r	N	n/r
Hatcheries	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Head-starting	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
By-catch: fishing gear modifications (eg, TED, circle hooks)	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
By-catch: onboard best practices	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
By-catch: spatio-temporal closures/reduction	N	n/r	N	n/r	N	n/r	N	n/r	N	n/r
Mock Clutch Translocation	N	n/r	N	n/r	N	n/r	n/r	n/r	n/r	n/r
MPA's Officers in charge of the enforcement of environmental law	Y	14;64	Y	14;64	Y	14;64	Y	14;64	Y	14;64
Monitoring of nesting sites dependent of volunteers training and availability	Y	14	Y	14	Y	14	n/r	n/r	n/r	n/r

Table 2. Sea Turtle nesting beaches of Saint Martin FWI.

Nesting site	MPA status	Index site	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Central point		Length (km)	% Monitored	Reference #
Dermochelys coriacea												
Baie aux Prunes	N	Y	0 - 1 (2009-2018)	- 63.153061	18.062287	- 63.147230	18.070683	- 63.149161	18.066291	1.210	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Blanche	Y	Y	0 (2009-2018)	- 62.988232	18.114496	- 62.987781	18.118025	- 62.987828	18.116461	0.400	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Longue	N	Y	0 - 1 (2009-2018)	- 62.988232	18.114496	- 63.139136	18.055593	- 63.145183	18.059644	1.810	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Rouge	N	Y	0 (2009-2018)	- 63.135328	18.071323	- 63.120692	18.071692	- 63.129901	18.068726	1.600+ 0,085+0.050	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Coralita	Y Waters N Private Beach	Y	0 (2009-2018)	- 63.013745	18.060934	- 63.012857	18.063400	- 63.013770	18.062429	0.570	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Gallion	Y	Y	0 (2009-2018)	- 63.016818	18.068207	- 63.016308	18.078486	- 63.020256	18.073060	1.610	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Grandes Cayes	Y	Y	0 (2009-2018)	- 63.020083	18.112421	- 63.018694	18.111041	- 63.019543	18.111368	0.745	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Lagon	Y	Y	0 - 1 (2009-2018)	- 62.986702	18.114450	- 62.982826	18.115724	- 62.985166	18.115532	0.395	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Petites Cayes	Y	Y	0 (2009-2018)	- 63.032173	18.122530	- 63.030494	18.122805	- 63.031378	18.122471	0.195	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel western site	Y waters N beach	N	0 (2009-2018)	- 63.017048	18.105535	- 63.015539	18.105058	- 63.016253	18.105640	0.265	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel northern site	Y waters	N	0 (2009-2018)	- 63.015604	18.107751	- 63.013998	18.107378	- 63.014855	18.107573	0.185	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34

	N beach											
Pinel eastern site	Y waters N beach	N	0 (2009-2018)	- 63.014349	18.104920	- 63.013859	18.105598	- 63.014231	18.105298	0.125	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Anse Marcel	Y Waters N Private Beach	N	0 (2009-2018)	- 63.042450	18.114003	- 63.038734	18.115444	- 63.040150	18.114149	0.430	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Bell Beach disappearance of the Sand bank	N	N	0 (2009)	- 63.046712	18.116255	- 63.045554	18.115893	- 63.046124	18.115932	0.135	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Caye Verte	Y	N	0 (2009-2018)	- 63.010938	18.087165	- 63.009705	18.091015	- 63.010692	18.089102	0.095	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Orientale	N	N	0 - 1 (2009-2018)	- 63.024014	18.095773	- 63.012685	18.081900	- 63.021186	18.088747	2.060	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Happy Baie	N	N	0 (2009-2018)	- 63.074298	18.099267	- 63.071802	18.100028	- 63.072603	18.099426	0.270	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie de Grand Case	N	N	0 (2009-2018)	- 63.066325	18.099848	- 63.052887	18.110439	- 63.058326	18.100908	1.960	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Sandyground	N	N	0 (2009-2018)	- 63.108227	18.061168	- 63.100659	18.059602	- 63.145900	18.059705	0.950	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Netlee	N	N	0 (2009-2018)	- 63.116531	18.067097	- 63.108227	18.061168	- 63.112200	18.062779	1.150	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Friar's Bay	N	N	0 (2009-2018)	- 63.075995	18.092990	- 63.074240	18.094515	- 63.074929	18.093738	0.255	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Galisbay	N	N	0 (2009-2018)	- 63.084166	18.072996	- 63.080845	18.078775	- 63.083425	18.073658	0.740	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Belle Creole	N	N	0 (2009-2018)	- 63.072364	18.072364	- 63.114248	18.072516	- 63.115144	18.073224	0.585	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Eretmochelys imbricata												

Baie aux Prunes	N	Y	8 (2009-2018)	-63.153061	18.062287	-63.147230	18.070683	-63.149161	18.066291	1.210	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Blanche	Y	Y	13 (2009-2018)	-62.988232	18.114496	-62.987781	18.118025	-62.987828	18.116461	0.400	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Longue	N	Y	8 (2009-2018)	-62.988232	18.114496	-63.139136	18.055593	-63.145183	18.059644	1.810	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Rouge	N	Y	2 (2009-2018)	-63.135328	18.071323	-63.120692	18.071692	-63.129901	18.068726	1.600+0,085+0.050	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Coralita	Y Waters N Private Beach	Y	3 (2009-2018)	-63.013745	18.060934	-63.012857	18.063400	-63.013770	18.062429	0.570	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Gallion	Y	Y	3 (2009-2018)	-63.016818	18.068207	-63.016308	18.078486	-63.020256	18.073060	1.610	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Grandes Cayes	Y	Y	4 (2009-2018)	-63.020083	18.112421	-63.018694	18.111041	-63.019543	18.111368	0.745	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Lagon	Y	Y	20 (2009-2018)	-62.986702	18.114450	-62.982826	18.115724	-62.985166	18.115532	0.395	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Petites Cayes	Y	Y	5 (2009-2018)	-63.032173	18.122530	-63.030494	18.122805	-63.031378	18.122471	0.195	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel western site	Y waters N beach	N	U	-63.017048	18.105535	-63.015539	18.105058	-63.016253	18.105640	0.265	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel northern site	Y waters N beach	N	U	-63.015604	18.107751	-63.013998	18.107378	-63.014855	18.107573	0.185	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel eastern site	Y waters N beach	N	U	-63.014349	18.104920	-63.013859	18.105598	-63.014231	18.105298	0.125	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Anse Marcel	Y Waters N	N	U	-63.042450	18.114003	-63.038734	18.115444	-63.040150	18.114149	0.430	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34

	Private Beach											
Bell Beach disappearance of the Sand bank	N	N	U	- 63.046712	18.116255	- 63.045554	18.115893	- 63.046124	18.115932	0.135	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Caye Verte	Y	N	U	- 63.010938	18.087165	- 63.009705	18.091015	- 63.010692	18.089102	0.095	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Orientale	N	N	U	- 63.024014	18.095773	- 63.012685	18.081900	- 63.021186	18.088747	2.060	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Happy Baie	N	N	U	- 63.074298	18.099267	- 63.071802	18.100028	- 63.072603	18.099426	0.270	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie de Grand Case	N	N	U	- 63.066325	18.099848	- 63.052887	18.110439	- 63.058326	18.100908	1.960	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Sandyground	N	N	U	- 63.108227	18.061168	- 63.100659	18.059602	- 63.145900	18.059705	0.950	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Netlee	N	N	U	- 63.116531	18.067097	- 63.108227	18.061168	- 63.112200	18.062779	1.150	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Friar's Bay	N	N	U	- 63.075995	18.092990	- 63.074240	18.094515	- 63.074929	18.093738	0.255	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Galisbay	N	N	U	- 63.084166	18.072996	- 63.080845	18.078775	- 63.083425	18.073658	0.740	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Belle Creole	N	N	U	- 63.072364	18.072364	- 63.114248	18.072516	- 63.115144	18.073224	0.585	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Chelonia mydas				Long	Lat	Long	Lat	Long	Lat			
Baie aux Prunes	N	Y	23 (2009-2018)	- 63.153061	18.062287	- 63.147230	18.070683	- 63.149161	18.066291	1.210	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Blanche	Y	Y	5 (2009-2018)	- 62.988232	18.114496	- 62.987781	18.118025	- 62.987828	18.116461	0.400	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Longue	N	Y	78 (2009-2018)	- 62.988232	18.114496	- 63.139136	18.055593	- 63.145183	18.059644	1.810	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Rouge	N	Y	4 (2009-2018)	- 63.135328	18.071323	- 63.120692	18.071692	- 63.129901	18.068726	1.600+0,085+0.050	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Coralita	Y Waters N	Y	1 (2009-2018)	- 63.013745	18.060934	- 63.012857	18.063400	- 63.013770	18.062429	0.570	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34

	Private Beach											
Gallion	Y	Y	1 (2009-2018)	- 63.016818	18.068207	- 63.016308	18.078486	- 63.020256	18.073060	1.610	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Grandes Cayes	Y	Y	1 (2009-2018)	- 63.020083	18.112421	- 63.018694	18.111041	- 63.019543	18.111368	0.745	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Lagon	Y	Y	7 (2009-2018)	- 62.986702	18.114450	- 62.982826	18.115724	- 62.985166	18.115532	0.395	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Petites Cayes	Y	Y	1 (2009-2018)	- 63.032173	18.122530	- 63.030494	18.122805	- 63.031378	18.122471	0.195	100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel western site	Y waters N beach	N	U	- 63.017048	18.105535	- 63.015539	18.105058	- 63.016253	18.105640	0.265	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel northern site	Y waters N beach	N	U	- 63.015604	18.107751	- 63.013998	18.107378	- 63.014855	18.107573	0.185	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Pinel eastern site	Y waters N beach	N	U	- 63.014349	18.104920	- 63.013859	18.105598	- 63.014231	18.105298	0.125	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Anse Marcel	Y Waters N Private Beach	N	U	- 63.042450	18.114003	- 63.038734	18.115444	- 63.040150	18.114149	0.430	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Bell Beach disappearance of the Sand bank	N	N	U	- 63.046712	18.116255	- 63.045554	18.115893	- 63.046124	18.115932	0.135	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Caye Verte	Y	N	U	- 63.010938	18.087165	- 63.009705	18.091015	- 63.010692	18.089102	0.095	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Orientale	N	N	U	- 63.024014	18.095773	- 63.012685	18.081900	- 63.021186	18.088747	2.060	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Happy Baie	N	N	U	- 63.074298	18.099267	- 63.071802	18.100028	- 63.072603	18.099426	0.270	0-100	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34

Baie de Grand Case	N	N	U	-63.066325	18.099848	-63.052887	18.110439	-63.058326	18.100908	1.960	25-50	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Sandyground	N	N	U	-63.108227	18.061168	-63.100659	18.059602	-63.145900	18.059705	0.950	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Baie Netlee	N	N	U	-63.116531	18.067097	-63.108227	18.061168	-63.112200	18.062779	1.150	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Friar's Bay	N	N	U	-63.075995	18.092990	-63.074240	18.094515	-63.074929	18.093738	0.255	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Galisbay	N	N	U	-63.084166	18.072996	-63.080845	18.078775	-63.083425	18.073658	0.740	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34
Belle Creole	N	N	U	-63.072364	18.072364	-63.114248	18.072516	-63.115144	18.073224	0.585	0-25	1;2;3;4;5;6;7;8;9;10;14; 15; 17;25;33;34

Table 3. International conventions protecting sea turtles and signed by France applying on Saint Martin FWI.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	Y (France, European Union)	Y	Y	all	CITES or Washington Convention 1972 governs the international trade in threatened and endangered species, which are listed in three appendices to the Convention. The Convention requires parties to prohibit trade in listed species except in accordance with the provisions of the Convention.	All species of Sea Turtles are listed in CITES Appendix I. Appendix I includes endangered species for which trade in specimens must be strictly regulated; primary purpose of commercial trade of those species is prohibited.
CMS	Y (France, European Union)	Y	Y	all. Reservation concerning Chelonia mydas since 07.01.1990 applicable on France and its oversea Departments and Territories	The Bonn Convention 1979, or the Convention on the Conservation of Migratory Species of Wild Animals, seeks to conserve terrestrial, aquatic, and avian migratory species throughout their range.	All species of Sea Turtles are on Appendix I of the CMS.Parties that are a Range State to a migratory species listed in Appendix I shall endeavour to strictly protect them by: prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them. Cheloniidae C.spp and Dermochelyidae D.spp are also listed on Appendix II of the CMS. They are therefore protected by its provisions.
CBD	Y (France, European Union)	Y	Y	all	The Convention on Biological Diversity 1992 provides for the conservation and sustainable use of biological diversity, including with regard to access and sharing of the benefits arising out of the use of genetic resources.	CBD applies to the sustainable Management of St Martin's natural ressources including Sea Turtles. Scientific Studies on Sea Turtles planning on the use of their genetic ressources therefore require the declaration to the French Ministry of Environment.

CAR-SPAW	Y (France, European Union)	Y	Y	all	The Protocol of the Carthagena Convention 1990 for Specially Protected Areas and Wildlife in the Caribbean Region calls upon its signatories to identify and protect threatened and endangered species of fauna and flora through national law, including the taking, possession, and killing of these species. In addition, parties are to adopt cooperative measures to protect species listed on one of three Annexes to the Protocol, which contain threatened or endangered plant species (Annex I); threatened or endangered animal species (Annex II); and animal and plant species that are not threatened or endangered but which require special measures to ensure their protection (Annex III). A variety of species, including mangroves and seagrass, are listed in Annex III.	St Martin Natural Reserve and St Martin Lagoon Ponds (ST Martin, France) are a SPAW listed site. (The AGOA Sanctuary - Marine Mammals sanctuary - includes St Martin and is also a SPAW listed site). All Sea Turtles Species present in the Lesser Antilles are listed on Annex II of the CAR SPAW Protocol (Last Revision 2016). Total protection and recovery to the species of Sea Turtles listed in Annex II are ensured by prohibiting the taking, possession or killing, the incidental taking, possession or killing or commercial trade of Sea Turtles, their eggs, parts or products; and prohibiting of the disturbance of Sea Turtles, particularly during periods of breeding, incubation, estivation or migration, as well as other periods of biological stress.
Bern Convention	Y (France, European Union)	Y	Y	all. Reservation concerning the Appendix II "Strictly protected species" and concerning Chelonia mydas	The Bern Convention 1979 is a European Treaty aiming at ensuring conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species specified in appendices.	All species of Sea Turtles are listes in Appendix II of the Bern Convention. Chapter II provides for the protection of the habitat of Wild Fauna and Flora especially the species listed in Appendix I and II. Chapter III provides for the protection of Species. Chapter III Article 6 calls for State Parties to take the appropriate administrative and legislative measures to provide complete protection to all Species of Sea Turtles and ensure the prohibition of capture keeping and killing, damage of breeding and resting sites, disturbance, possession of eggs, internal trade of animals alive or dead. Chapter IV pertaining to migratory species, specifically provides for cooperation between Parties.

UNCLOS	Y (France, European Union)	Y	Y	all	The Law of the Sea Convention 1982 defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural ressources. The Convention defines different areas from the baseline : internal waters, territorial waters, archipelagic waters, the contiguous zone, the exclusive economic zone, the continental shelf and the Area.	The convention provides the legal framework for marine and maritime activities, establishes obligations for safeguarding the marine environment and provides freedom of scientific research on the high seas, respecting the Common Heritage of Mankind Principle. The First intergovernmental conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction has been convened pursuant to General Assembly resolution 72/249. The conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, in particular, together and as a whole, marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity-building and the transfer of marine technology are provided for in the ABNJ Treaty President's Aid to Negotiations UNGA A/Conf.232/2019/1 that has been prepared following the First Session of the Conference in September 2018 in NYC USA.
RAMSAR Convention	Y (France)	Y	Y	all	The Ramsar Convention 1971 provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Saint Martin's Marine Protected Area is a RAMSAR site, a wetland of international importance, since 2012, which enforces the protection of Saint Martin's Sea Turtles and their habitat and foraging grounds.

Table 4. Projects and databases on sea turtles in Saint Martin FWI.

#	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact	Other Contacts
T4.1	Suivi Scientifique des pontes des Tortues de Mer a Saint Martin FWI/Sea Turte Nesting Season Monitoring at Saint Martin FWI	Sea Turtles ; Females ; Nesting ; Nest ; Monitoring ; Volunteers; Saint Martin FWI	2009	ongoing	Reserve Naturelle de Saint Martin FWI	Non Governmental Agency	Y	https://reservenaturelle-saint-martin.com	N	Julien Chalifour science@rnsm.org	Claire Saladin clairesaladin@hotmail.com
T 4.2	Widecast Atlas of Sea Turtles Nesting Beaches	Sea Turtles ; Nesting beach ; Atlas : Wider Caribbean; WIdecast	2016	2020	Widecast	International NGO	Y	https://www.widecast.org/Resources/Docs/Atlas/19_Eckert_and_Eckert_(2019)_Atlas_of_Caribbean_Sea_Turtle_Nesting.pdf ; http://seamap.env.duke.edu/widecast/	N	Claire Saladin clairesaladin@hotmail.com	Julien Chalifour science@rnsm.org
T 4.3	IUCN SSC MTSG regional report	Sea Turtles; Saint Martin FWI; IUCN	2019;2021	ongoing	IUCN SSC MTSG	IGO	Y	https://www.iucn-mtsg.org/regional-reports	N	Claire Saladin clairesaladin@hotmail.com	

T 4.4	SWOT	sea turtles; Caribbean; nesting beaches; telemetry	2019	2020	Oceanic Society, IUCN SSC MTSG, Duke University et al.	NGO IGO University	Y	Y See references	N	Claire Saladin clairesala din@hot mail.com	Julien Chalifour science@rnsm.or g
T 4.5	Suivi des herbiers et récifs coralliens a Saint Martin FWI / Seagrasses and Coral Reefs monitoring at Saint Martin FWI	coral reefs ; coral reefs monitoring ; seagrasses; invasive seagrasses; ecology; sea turtles'foraging grounds; Sea Turtle; Saint Martin FWI ; Caribbean	2007	ongoing	Reserve Naturelle de Saint Martin	National NGO	Y	Y See references	n/a	Julien Chalifour science@ rnsm.org	Nicolas Maslach nicolas.maslach@ rnsm.org
T 4.6	CITES	sea turtles ; trade ; illegal trade ; caribbean ; poaching	1978	ongoing	Direction de l'environnement, de l'aménagement et du logement de la Guadeloupe DEAL Guadeloupe	Governemntal Agency	Y	Y	n/r	pb.rn.deal - guadelou pe@ developp ement- durable.g ouv.fr	n/r
T4.7	Marine debris impacts mitigation	Marine Mammals; marine life; Sea Turtles; marine debris ; regional pollution ; transatlantic pollution; St Martin FWI; ALDFG; ghost	2020	ongoing	Ministere de la Transition Ecologique et Solidaire MTES / Megaptera NGO	Government/NG O	Y	n/a	Y	Michel Vely	megapteraone@h otmail.com

		nets; entanglement									

#	Database available	Name of Database	Names of sites included (matching Table B, if appropriate)	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR?	PIT tagging	Remote tracking	
T4.1	N	n/r	Cf Table 2	2009	ongoing	n/r	n/r	Green turtles Sasha FWI 7793 and FWI 5101 and Joe FWI 7791 and FWI 7774	n/a	N	Sasha and Joe 2 immature Green Turtles satellite tracked from Tintamarre in 2015 and transmitted for 157 and 307 days respectively. http://www.seaturtle.org/tracking/?project_id=942	14;15;
T 4.2	Y See the Widecast Atlas (2019)	n/r	See the Widecast Atlas (2019)	Sea turtles' data included from 2009	Sea turtle's data included until 2017	n/r	n/r	n/r	n/r	n/r	n/r	17;15
T 4.3	Y See IUCN SSC MTSG St Martin FWI report	n/r	See IUCN SSC MTSG St Martin FWI report	2019	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	14;on
T 4.4	N	n/r	See SWOT report XV	2019	2019	n/r	n/r	Y	n/a	N	Y	15;17;

T 4.5	N	n/r	Pinel (MPA), Caye Verte (MPA), Baie du Galion (MPA), Chicot (MPA), Fish Point (outside of the MPA), Basse Espagnole (MPA), Rocher Creole (MPA), Rocher Pelican (MPA) twice a year, + Baie Blanche Tintamarre, Anse Marcel, Wilderness, Baie de Cul de Sac	2007	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	14;19;
T 4.6	N	n/r	n/r	1978	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	12

T4.7	N	n/r	all sites reported	2020	ongoing	n/r	n/r	n/r	n/r	n/r	n/r	n/a

Table Supplementary 2. *Thalassia testudinum* rhizomes content in metallic trace element (Mn, Fe, Zn, Pb, Cd, Cr, Cu, Ni et Hg) (µg.g-1) (average ± standard deviation). Samples were taken at 3 stations of Saint Martin FWI in 2018. ND Non Detectable as concentrations are inferior to the detection threshold (< 0,01 µg.g-1). Stations are listed following the increased gradient of anthropogenic pressures.144

Station	Mn	Fe	Zn	Pb	Cd	Cr	Cu	Ni	Hg
	0,92 ± 0,37	90,04 ± 68,55	5,86 ± 2,34	0,06 ± 0,03	0,01 ± 0,00	0,35 ± 0,22	1,40 ± 0,56	0,42 ± 0,22	ND (< 0,01 µg.g-1)
	2,78 ± 0,83	207,74 ± 41,53	16,07 ± 3,22	0,27 ± 0,11	0,05 ± 0,02	0,49 ± 0,20	2,41 ± 0,73	0,64 ± 0,36	ND (< 0,01 µg.g-1)
	19,91 ± 12,64	930,45 ± 1653,99	17,09 ± 8,15	0,08 ± 0,07	0,06 ± 0,02	0,26 ± 0,13	4,00 ± 1,52	1,36 ± 0,90	ND (< 0,01 µg.g-1)

[144] See Chart 21 page 124 of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.

Table Supplementary 3. *Thalassia testudinum* leaves content in trace metallic element (Cr, Cd, Ni, Cu, Hg) (µg.g-1) at 3 stations of St Martin FWI in 2017 / 2018 (average ± standard deviation). Stations are indexed following the increased gradient of anthropogenic pressures. ND: Non Detectable, concentrations were inferior to the detection threshold (< 0,01 µg.g-1).[145]

Station	Cr	Cd	Ni	Cu	Hg
	0,35 ±0,30 / 0,46 ±0,40	0,03 ±0,01 / 0,10 ±0,04	3,14 ±1,01 / 5,57 ±1,48	0,44 ±0,12 / 0,96 ±0,24	ND
	0,37 ±0,21 / 0,24 ±0,03	0,04 ±0,01 / 0,08 ±0,01	2,99 ± 0,22 / 3,77 ± 0,89	0,83 ±0,10 / 1,30 ±0,16	ND
	0,40 ±0,18 / 0,38 ±0,15	0,09 ±0,03 / 0,11 ±0,01	3,97 ± 0,65 / 4,03 ± 0,46	0,95 ±0,31 / 1,16 ±0,45	ND

Table Supplementary 4. Values of stable isotope δ15N (‰) and nutriments N and P (%) in *Thalassia testudinum* rhizomes of 3 stations on Saint Martin (average ± standard deviation). Stations are listed by the gradient of anthropogenic pressures.[146]

Station	$\delta^{15}N$	N	P
Tintamarre	1,47 ± 1,15	0,64 ± 0,22	0,11 ± 0,09
Rocher Creole	0,35 ± 0,81	0,48 ± 0,11	0,11 ± 0,05
Galion	3,29 ± 2,16	1,19 ± 0,35	0,23 ± 0,17

[145]See Chart 23 page 126 of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.
[146]See Chart 20 page 123 of of Kerninon F. (2020) Développement d'outils méthodologiques pour le suivi et l'évaluation de l'état de santé des herbiers d'outre-mer français et de leur environnement, dans un contexte de perturbations multiples, 422 pages. Reference 37 of this report.

Figure 1. Map of Saint Martin FWI marine turtles nesting beaches, coral reefs and seagrass meadows monitoring stations. (source map Google Earth)

Suriname

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Suriname.

Topic	*C. mydas*	Ref #	*D. coriacea*	Ref #
Occurrence				
Nesting sites	Y	1	Y	1,8,16
Oceanic foraging areas	N		N	
Neritic foraging areas	N		N	
Key biological data				
Nests/yr: recent average (range of years)	13260 (2015-2020)	16, T4.1 and T4.2	733 (2015-2020)	16, T4.1 and T4.2
Nests/yr: recent order of magnitude	n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	2	1	2	1
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	are major		are major	
Nests/yr at "major" sites: recent average (range of years)	13324 (2015-2020)	16, T4.1 and T4.2	733 (2015-2020)	8, 10, 12, 16, T4.1 and T4.2
Nests/yr at "minor" sites: recent average (range of years)	n/r		n/r	
Total length of nesting sites (km)	12.65	16, T4.1 and T4.2	12.65	16, T4.1 and T4.2

Nesting females / yr	12744 (2018)	16, T4.1 and T4.2	719 (2018)	8, 10, 12, 16, T4.1 and T4.2
Nests / female season (N)	12744 (2018)	16, T4.1 and T4.2	719 (2018)	8, 10, 12, 16, T4.1 and T4.2
Female remigration interval (yrs) (N)	U		2	2,7
Sex ratio: Hatchlings (F / Tot) (N)	U		U	
Sex ratio: Immatures (F / Tot) (N)	U		U	
Sex ratio: Adults (F / Tot) (N)	U		U	
Min adult size, CCL or SCL (cm)	U		CCL 134.5 (2003)	7, 3, 5
Age at maturity (yrs)	U		U	
Clutch size (n eggs) (N)	101.5 (2019)	18,6	81.15 (2019)	18,7,6
Emergence success (hatchlings/egg) (N)	90.54% (2016)	11,6	59.29% (2016)	11,7,6
Nesting success (Nests/ Tot emergence tracks) (N)	U		12 (N=42) (2004)	2
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2001-2020)	6, 16	Decreasing (2001-2020)	1,8,10,16
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/r		n/r	
Oldest documented abundance: nests/yr (range of years)	4418 (1995)	13	90 - 1625 (1967-1975)	4,13
Published studies				
Growth rates	N		N	
Genetics	N		N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	N		Y	7

Survival rates	N		N	
Population dynamics	N		Y	2
Foraging ecology	N		N	
Capture-Mark-Recapture	Y	21	Y	7
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y	17, 19, 20	Y	9, 17, 19,20
Bycatch: presence of industrial fisheries?	N		Y (PLL) (OTH: fish trawls)	9
Bycatch: quantified?	Y	17, 19, 20	Y	17, 19, 20
Intentional killing of turtles	U		Y	3
Take. Illegal take of turtles	N		N	
Take. Permitted/legal take of turtles	N		N	
Take. Illegal take of eggs	Y	16	Y	16
Take. Permitted/legal take of eggs	N		N	
Coastal Development. Nesting habitat degradation	Y (sandmining)	15,22	Y (sandmining)	15,22
Coastal Development. Photopollution	U		U	
Coastal Development. Boat strikes	U		U	
Egg predation	Y	11,16	Y	11,16
Pollution (debris, chemical)	U		U	
Pathogens	U		U	
Climate change	U		U	
Foraging habitat degradation	U		U	

Other (erosion)	Y	15, 22	Y	15,22
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	Y (1967 - 2020)	6,16,4,13, 14	Y (1967 - 2020)	1,2,3,4,5,6,7,8,10, 16, 14
Number of index nesting sites	N		N	
Monitoring at foraging sites (period: range of years)	n/r		n/r	
Conservation				
Protection under national law	Y	1,16	Y	1,16
Number of protected nesting sites (habitat preservation) (% nests)	2 (100%)	1,8,10, 16	2 (100%)	1,8,10, 16
Number of Marine Areas with mitigation of threats	n/a		n/a	
N of long-term conservation projects (period: range of years)	1	6,16,14	1	1,2,3,5,6,7,8,10, 16,14
In-situ nest protection (eg cages)	N		N	
Hatcheries	Y	6	Y	6
Head-starting	N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	Y (BT)	17, 19, 20,9	Y (BT)	17, 19, 20,9
By-catch: onboard best practices	N		N	
By-catch: spatio-temporal closures/reduction	Y (No fishing zone during nesting season)	17, 19, 20,9	Y (No fishing zone during nesting season)	17, 19, 20,9
Other	N		N	

Table 2. Sea turtle nesting beaches in Suriname.

Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CM-NW IND				Long	Lat	Long	Lat					
Beach Galibi	N	11705 (2015 - 2019)	NA	-54.00697388	5.794165	-54.034	5.837101	11	U	16: NCD report 2017	2	B
Beach Braamspunt	N	3540 (2015- 2020)	NA	-55.15778672	5.960302	-55.1	5.983901	15	U	16: NCD report 2017	2	B
DC-NWA												
Beach Galibi	N	90 (2015-2020)	NA	-54.00697388	5.794165	-54.034	5.837101	11.409	U	16: NCD report 2017	2	B
Beach Matapica-Braamspunt	N	656 (2015 - 2020)	NA	-55.15778672	5.960302	-55.1	5.983901	15	U	16: NCD report 2017	2	B

Table 3. International conventions protecting sea turtles and signed by Suriname.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	Y	Y	Y	CM, DC	appendix 1; included on the national game calender with a entire closed season	Y

Table 4. Projects and databases on sea turtles in Suriname.

#	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public / Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)	Databas e available	Nam e of Data base
T4.1	Coast of Suriname (Galibi and Braamspunt)	Marine Turle Consevation Program	nesting data, poched nest	2012	2020	Nature Conservation Division	private	STIDUNAL	2012- 2020	WWF-Guianas	Claudine Sakimin: claudinesakimin@ yahoo.com		No	NA
T4.2	Coast of Suriname (Galibi and Matapica)	Marine Turle Consevation Program	nesting data, poched nest	2001	2012	STINASU	private	Nature Conservation Division	2001 - 2012	WWF-Guianas	Kenneth Cyrus: kdcyrus1956@yahoo.com	Claudine Sakimin: claudinesaki min@yahoo .com	No	NA

French Atlantic and Channel coasts

DELL'AMICO, Florence

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Table 1. Biological and conservation information about sea turtle Regional Management Units in French Atlantic and Channel coasts.

RMU	**DC-NW IND**	**Ref #**
Occurrence		
Nesting sites	N	
Pelagic foraging grounds	Y Both	1 to 52
Benthic foraging grounds	N	
Key biological data		
Nests/yr: recent average (range of years)	n/a	
Nests/yr: recent order of magnitude	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a	
Total length of nesting sites (km)	n/a	
Nesting females / yr	n/a	
Nests / female season	n/a	
Female remigration interval (yrs)	n/a	
Sex ratio: hatchlings (F / Tot)	n/a	
Sex ratio: juveniles (F / Tot)	n/a	
Sex ratio: Adults (F / Tot)	Y	1 to 46
Min adult size, CCL or SCL (cm)	Y	1 to 46
Age at maturity (yrs)	n/a	
Clutch size (n eggs)	n/a	
Emergence success (hatchlings/egg)	n/a	

Nesting success (Nests/ Tot emergence tracks)	n/a	
Trends		
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a	1 to 46, 51 to 52
Oldest documented abundance: nests/yr (range of years)	n/a	
Published studies		
Growth rates	N	
Genetics	Y	50
Stocks defined by genetic markers	Y	50
Remote tracking (satellite or other)	N	
Survival rates	N	
Population dynamics	N	
Foraging ecology (diet or isotopes)	Y	1, 2, 16, 26, 27, 38, 41, 47 to 49, 51, 52
Capture-Mark-Recapture	N	
Threats		
Bycatch: small scale / artisanal	Y	49
Bycatch: industrial	Y	49
Bycatch: quantified?	Y	49
Intentional killing or exploitation of turtles	N	
Egg poaching	N	
Egg predation	N	
Photopollution	N	
Boat strikes	Y	
Nesting habitat degradation	N	
Foraging habitat degradation	Y	23, 26, 47, 48, 49, 51
Other	N	
Long-term projects		
Monitoring at nesting sites	N	
Number of index nesting sites	N	
Monitoring at foraging sites	Y	
Conservation		
Protection under national law	Y	

Number of protected nesting sites (habitat preservation)	N	
Number of Marine Areas with mitigation of threats	n/a	
Long-term conservation projects (number)	>1 (1988-ongoing)	1 to 46
In-situ nest protection (eg cages)	N	
Hatcheries	N	
Head-starting	N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N	
By-catch: onboard best practices	ongoing	
By-catch: spatio-temporal closures/reduction	N	
Other	N	

Table 2. Sea turtle nesting beaches in French Atlantic and Channel coasts.

Non occurring.

Table 3. International conventions protecting sea turtles and signed by French Atlantic and Channel coasts.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).
CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce

						bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch).*
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973).	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
The Convention for the protection of the marine environment of the North-East Atlantic (the OSPAR Convention) (1992).	Y	y	y	Dc, Cc	To protect and conserve marine ecosystems and biological diversity of the North-East Atlantic.	These two species are considered threatened and/or declining wherever the species is present in OSPAR regions (Dc : every OSPAR Regions, Cc : OSPAR Regions IV and V)
Marine Strategy Framework Directive (2008).	Y	Y	Y	Dc, Cc	This Directive leds European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	These two species of marine turtles are considered as an indicator for MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 4. Projects and databases on sea turtles in French Atlantic and Channel coasts.

RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration	Reports / Information material	Current Sponsors	Primary Contact (name and Email)
Atlantic Northwest	France	French Atlantic and Channel coasts and its EEZ and marine subregions according to MSFD: Channel – North Sea, Celtic Seas and Bay of Biscay.	Strandings, accidental bycatch and sea sightings database	Database, sea turtles, strandings, sea sightings, accidental bycatch	1988	ongoing	Aquarium La Rochelle / CESTM	Private	French Environmental Ministry, MNHN and French Biodiversity Agency		Aquarium La Rochelle and French Biodiversity Agency	Florence DELL'AMICO, tortues@aquarium-larochelle.com
Atlantic Northwest	France	Atlantic Northeast	Sea turtle conservation program	Satellite tracking, *Caretta caretta*, *Chelonia mydas*, *Lepidochelys kempii*	2008	ongoing	Aquarium La Rochelle / CESTM	Private			Aquarium la Rochelle. In 2009 with French Biodiversity Agency. Since 2009, with National Centre for	Florence DELL'AMICO, tortues@aquarium-larochelle.com

											Space Studies	
Atlantic Northwest	France	French metropolitan waters	OBSMER	At sea observer	2003	ongoing	DPMA	Public	IFREMER, CNPMEM		DPMA and European Union	DPMA
Atlantic Northwest	France	French metropolitan waters	Suivi Aérien de la Mégafaune Marine (SAMM)	Aerial survey, marine megafauna	2011	winter 2011 - summer 2012 ; 2019 - 2021	Observatoire Pelagis (La Rochelle Université-CNRS)	Public	APECS, Eco Océan Institut, LPO, LPO Haute-Normandie		MEDDE, AAMP, La Rochelle Université, EDF Nouvelles Energies	Observatoire Pelagis (La Rochelle Université – CNRS)

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Turks and Caicos Islands

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1.1. Distribution, abundance, trends.

Please see Table 1.

1.2. Other biological data

Please see Table 1.

Table 1. Biological and conservation information about sea turtle Regional Management Units in the Turks and Caicos Islands.

Topic	*C. caretta*	Ref #	*C. mydas*	Ref #	*E. imbricata*	Ref #
Occurrence						
Nesting sites	N	5,8, 10	Y	5,8,10	Y	5,8,10
Oceanic foraging areas	U		U		U	
Neritic foraging areas	A	5,9	Y	5,9	Y	5,9
Key biological data						
Nests/yr: recent average (range of years)	n/r		48 (2009-2010)	5	125 (2009-2010)	5
Nests/yr: recent order of magnitude	n/r		n/r		n/r	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/r		0		0	5,9
Number of "minor" sites (>20 nests/yr OR >10 nests/km yr)	n/r		0		2	5,9
Nests/yr at "major" sites: recent average (range of years)	n/r		n/r		U	
Nests/yr at "minor" sites: recent average (range of years)	n/r		n/r		U	
Total length of nesting sites (km)	n/r		15	5	40	5
Nesting females / yr	n/r		8	5	21	5
Nests / female season (N)	n/r		U		U	
Female remigration interval (yrs) (N)	n/r		U		U	

Sex ratio: Hatchlings (F / Tot) (N)	n/r		U		U	
Sex ratio: Immatures (F / Tot) (N)	n/r		U		U	
Sex ratio: Adults (F / Tot) (N)	n/r		U		U	
Min adult size, CCL or SCL (cm)	n/r		U		U	
Age at maturity (yrs)	n/r		U		U	
Clutch size (n eggs) (N)	n/r		U		U	
Emergence success (hatchlings/egg) (N)	n/r		U		U	
Nesting success (Nests/ Tot emergence tracks) (N)	n/r		U		U	
	n/r					
Trends	n/r					
Recent trends (last 20 yrs) at nesting sites (range of years)	n/r		U		U	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/r		U		U	
Oldest documented abundance: nests/yr (range of years)	n/r		48 (2009-2010)	5	125 (2009-2010)	5
Published studies						
Growth rates	N		Y	2	Y	3
Genetics	N		Y	5,9	Y	5,9
Stocks defined by genetic markers	N		Y	5,9	Y	5,9
Remote tracking (satellite or other)	N		Y	1,5	Y	5
Survival rates	N		N		N	
Population dynamics	N		N		N	
Foraging ecology	N		Y	4	Y	4
Capture-Mark-Recapture	Y		Y	1, 5,9	Y	5,9
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (FP, OTH)	7,9	Y (FP, OTH)	7,9	Y (FP, OTH)	7,9
Bycatch: presence of industrial fisheries?	N		N		N	
Bycatch: quantified?	N		N		N	
Intentional killing of turtles	N		Y	5,7,9	Y	5,7,9
Take. Illegal take of turtles	N		Y	5,7,9	Y	5,7,9
Take. Permitted/legal take of turtles	N		N	5,7,9	Y	5,7,9
Take. Illegal take of eggs	n/r		Y	5,7,9	Y	5,7,9
Take. Permitted/legal take of eggs	N		N	5,7,9	N	5,7,9

Coastal Development. Nesting habitat degradation	Y		Y		Y	
Coastal Development. Photopollution	Y		Y		Y	
Coastal Development. Boat strikes	U		Y		Y	
Egg predation	n/r		N		N	
Pollution (debris, chemical)	Y		Y		Y	
Pathogens	U		Y		Y	
Climate change	Y		Y		U	
Foraging habitat degradation	Y		Y		Y	
Other	N		N		N	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	n/r		y (2008-2021)	Table 4	y (2008-2021)	Table 4
Number of index nesting sites	n/r		1	Table 2	3	Table 2
Monitoring at foraging sites (period: range of years)	y (2008-2018)	Table 4	y (2008-2021)	Table 4	y (2008-2021)	Table 4
Conservation						
Protection under national law	Y	5	Y	5	Y	5
Number of protected nesting sites (habitat preservation) (% nests)	n/r		7	unpublished	7	unpublished
Number of Marine Areas with mitigation of threats	0		0		0	
N of long-term conservation projects (period: range of years)	1 (2008-present)	Table 4	1 (2008-2021)	Table 4	1 (2008-2021)	Table 4
In-situ nest protection (eg cages)	n/r		N		N	
Hatcheries	n/r		N		N	
Head-starting	n/r		N		N	
By-catch: fishing gear modifications (eg, TED, circle hooks)	U		N		N	
By-catch: onboard best practices	U		N		N	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other	N		N		N	

1.3. Threats

1.3.1. Nesting sites (Table 2)

Table 2. Sea turtle nesting beaches in the Turks and Caicos Islands.

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Central point		% Monitored	Reference #
EI ATL WC/USA				Long	Lat		
Bambarra Beach	N	U	U	-71.730589	21.828352	opportunistic	10
North Beach—East Caicos	N	U	U	-71.533549	21.724802	opportunistic	10
Long Bay – East Caicos	Y	U	U	-71.464626	21.681532	opportunistic	10
McCartney Key	N	U	U	-71.49229	21.59592	opportunistic	10
Long Beach, South Caicos	N	U	U	-71.495918	21.531201	opportunistic	10
Shark Bay, South Caicos	N	U	U	-71.502351	21.490963	opportunistic	10
East Bay, South Caicos	N	U	U	-71.51866	21.491442	opportunistic	10
Fish Cay	N	U	U	-71.616336	21.367739	opportunistic	10
Big Ambergris Cay	N	U	U	-71.627709	21.30631	opportunistic	10
White Cay	N	U	U	-71.706228	21.179299	opportunistic	10
Bush Cay	N	U	U	-71.631857	21.199776	opportunistic	10
Big Sand Cay	Y	U	U	-71.248658	21.19463	opportunistic	10
Cotton Cay	N	U	U	-71.152705	21.361813	opportunistic	10
Grand Turk (W)	N	U	U	-71.149912	21.494339	opportunistic	10
Grand Turk (E)	N	U	U	-71.130293	21.4911	opportunistic	10
Gibbs Cay	Y	U	U	-71.111939	21.442486	opportunistic	10
Eastern Cay	N	U	U	-71.086761	21.356935	opportunistic	10
CM-NW ATL							
Grace Bay Beach	N	U	U	-72.210939	21.783422	opportunistic	10
Long Bay - Providenciales	N	U	U	-72.157416	21.78009	opportunistic	10

Highas Cay—North Caicos	N	U	U	-71.846614	21.869113	opportunistic	10
Long Bay – East Caicos	N	U	U	-71.464626	21.681532	opportunistic	10
McCartney Key	N	U	U	-71.49229	21.59592	opportunistic	10
Long Beach, South Caicos	N	U	U	-71.495918	21.531201	opportunistic	10
Shark Bay, South Caicos	N	U	U	-71.502351	21.490963	opportunistic	10
East Bay, South Caicos	N	U	U	-71.51866	21.491442	opportunistic	10
Fish Cay	N	U	U	-71.616336	21.367739	opportunistic	10
Big Ambergris Cay	N	U	U	-71.627709	21.30631	opportunistic	10
White Cay	N	U	U	-71.706228	21.179299	opportunistic	10
Bush Cay	N	U	U	-71.631857	21.199776	opportunistic	10
Big Sand Cay	N	U	U	-71.248658	21.19463	opportunistic	10
Cotton Cay	N	U	U	-71.152705	21.361813	opportunistic	10
Grand Turk (E)	N	U	U	-71.130293	21.4911	opportunistic	10
Gibbs Cay	Y	U	U	-71.111939	21.442486	opportunistic	10
Eastern Cay	N	U	U	-71.086761	21.356935	opportunistic	10

1.4. Conservation

See Table 3.

Table 3. International conventions protecting sea turtles and signed by the Turks and Caicos Islands.

International Conventions	**Signed**	**Binding**	**Compliance measured and reported**	**Species**	**Conservation actions**	**Relevance to sea turtles**
Convention on Migratory Species (CMS or Bonn Convention)	Y	Y	Y	ALL	Revised fishery legislation - 2014	Y
Convention on International Trade of Endangered Species of Fauna and Flora (CITES)	N	N	N	ALL	n/r	Y

Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	N	N	N	ALL	n/r	Y
Protocol Concerning Specially Protected Areas and Wildlife (SPAW) to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention)	N	N	N	ALL	n/r	Y

1.5. Research

See Table 4.

Table 4. Projects and databases on sea turtles in the Turks and Caicos Islands.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	CM+CM+EI NW ATL	Turks and Caicos Islands	Turks and Caicos Islands, Caribbean	Turks and Caicos Islands Turtle Project	Flipper tagging; satellite tracking; nesting monitoring	11.2008	Present	www.mcsuk.org	Public	Department of Environment and Coastal Resources, Governtment of TCI; University of Exeter	Published peer-reviewed literature	People's Trust for Endangered Species	Dr Peter Richardson, peter.richardson@mcsuk.org	Katharine Hart, KatharineAHart@gmail.com

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United Kingdom and Ireland

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Table 1. Biological and conservation information about sea turtle Regional Management Units in UK and Ireland.

	Caretta caretta Northwest Atlantic		*Lepidochelys kempii* Northwest Atlantic		*Dermochelys coriacea* Northwest Atlantic	
RMU	**CC**	**Ref #**	**LK**	**Ref #**	**DC**	**Ref #**
Occurrence						
Nesting sites	N		N		N	
Pelagic foraging grounds	N		N		Y	1,2,3,
Benthic foraging grounds	N		N		N	
Key biological data						
Nests/yr: recent average (range of years)	n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a	
Nests / female season	n/a		n/a		n/a	
Female remigration interval (yrs)	n/a		n/a		n/a	
Sex ratio: hatchlings (F / Tot)	n/a		n/a		n/a	
Sex ratio: juveniles (F / Tot)	n/a		n/a		n/a	
Sex ratio: Adults (F / Tot)	n/a		n/a		n/a	
Min adult size, CCL or SCL (cm)	60 SCL	1	60 SCL	1	102 SCL	1
Age at maturity (yrs)	n/a		n/a		n/a	

Clutch size (n eggs)	n/a		n/a		n/a	
Emergence success (hatchlings/egg)	n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks)	n/a		n/a		n/a	
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		decrease in reported sightings and strandings	1
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		n/a	
Published studies						
Growth rates	N		N		N	
Genetics	N		N		N	
Stocks defined by genetic markers	N		N		N	
Remote tracking (satellite or other)	N		N		N	
Survival rates	N		N		N	
Population dynamics	Y	1	Y	1	Y	1,2,3
Foraging ecology (diet or isotopes)	N		N		N	
Capture-Mark-Recapture	N		N		N	
Threats						
Bycatch: small scale / artisanal	Y (SN)	1	Y (SN)	1	Y (PLL, SN, OTH)	1

Bycatch: industrial	N		N		Y (PLL, SN, BT, OTH)	1
Bycatch: quantified?	Y	1	Y	1	Y	1
Intentional killing or exploitation of turtles	N		N		N	
Egg poaching	N		N		N	
Egg predation	N		N		N	
Photopollution	N		N		N	
Boat strikes	N		N		Y	1
Nesting habitat degradation	N		N		N	
Foraging habitat degradation	N		N		N	
Other	N		N		N	
Long-term projects						
Monitoring at nesting sites	n/a		n/a		n/a	
Number of index nesting sites	n/a		n/a		n/a	
Monitoring at foraging sites	N		N		N	
Conservation						
Protection under national law	Y		Y		Y	
Number of protected nesting sites (habitat preservation)	n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	0		0		0	
Long-term conservation projects (number)	N		N		N	
In-situ nest protection (eg cages)	n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a	
Head-starting	n/a		n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N	
By-catch: onboard best practices	Y		Y		Y	
By-catch: spatio-temporal closures/reduction	N		N		N	
Other	N		N		N	

Table 2. Sea turtle nesting beaches around the UK and Ireland.

None occurring.

Table 3. International conventions protecting sea turtles and signed for the UK and Ireland.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.	Marine turtle conservation is relevant to the agreement given the species' importance to overall biological diversity. For example, text in Article 8 states that each contracting party shall: "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings" (CBD, 1992).

CMS: Convention on the Conservation of Migratory Species of Wild Animals (1979). Also known as the Bonn Convention. CMS instruments can be both binding and non-binding.	Y	Y	Y	ALL	To conserve migratory species and take action to this end, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.	All seven species of marine turtles are listed within the convention text (CMS, 2014). A specific agreement has been developed for marine turtles under CMS. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), for example, to which the UK and France are individual EU country signatories. CMS has a specific resolution on bycatch detailing various actions needed to reduce bycatch of migratory species that will include marine turtles (*UNEP/CMS/Resolution 9.18 on Bycatch)*.
Convention on the Conservation of European Wildlife and Natural Habitats (1979). Also known as the Bern Convention and is binding.	Y	Y	Y	ALL	To conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation.	Conserving European natural heritage is a key element of this convention (CoE, 2014) and this will include marine turtle populations in the Mediterranean, for example. The EU aims to fulfil its obligations under the Bern Convention through its Habitats Directive (a directive designed to ensure the conservation of rare, threatened, or endemic animal and plant species) .

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973).	Y	Y	Y	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	All seven species listed in Appendix I of CITES.
UNFSA: United Nations Fish Stock Agreement. Known formally as the Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.	Y	Y	Y	ALL	A legal regime for the long-term conservation and sustainable use of straddling and highly migratory fish stocks (i.e. addressing problems related to the management of high seas fish stocks).	Ratified by 81 states and the European Union. Mentions a range of problems, including those related to unselective fishing gear. Elaborates on the fundamental principle that countries should, inter alia, cooperate to ensure conservation. Most shrimp are trawled within EEZs, though in those instances where tropical shrimp may be caught outside of EEZs, or where there are straddling stocks (i.e. stocks that migrate through, or occur in, more than one EEZ), UNFSA will have a bearing on the EU's involvement in such cases.
Regional Fisheries Management Organisations (RFMOs) and	Y	Y	Y	ALL	The EU is party to numerous RFMOs and RFBs that although not classed as global agreements are considered as binding multilateral agreements.	The main relevance has to do with the EU's Common Fisheries Policy (CFP) - the framework that establishes the rules that govern how the shared fish stocks within European

Regional Fisheries Bodies (RFBs).						Union waters are managed. The CFP now includes an external dimension establishing the standards by which EU vessels should adhere to when fishing outside of EU waters. The relevance of the CFP to this is detailed in section 6.1.
The Convention for the protection of the marine environment of the North-East Atlantic (the OSPAR Convention) (1992).	Y	Y	Y	Dc, Cc	To protect and conserve marine ecosystems and biological diversity of the North-East Atlantic.	These two species are considered threatened and/or declining wherever the species is present in OSPAR regions (Dc : every OSPAR Regions, Cc : OSPAR Regions IV and V)
Marine Strategy Framework Directive (2008).	Y	Y	Y	Dc, Cc	This Directive leads European member states to take the necessary measures to reduce the impact of activity in this environment in order to achieve or maintain a good environmental status by 2020.	These two species of marine turtles are considered as an indicator for MSFD descriptors: 1"Biological diversity", 8"Contaminants", and 10"Marine debris".

Table 4. Sea turtle conservation projects in UK and Ireland.

RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Collaboration	Primary Contact (name and Email)
Atlantic Northwest	UK and Ireland	UK and Ireland	TURTLE project database Strandings, accidental bycatch and sea sightings database	Database, sea turtles, strandings, sea sightings, accidental bycatch	2001	ongoing	Marine Environmental Monitoring	Private	Natural England, National Parks & Wildlife Service, Scottish Natural Heritage, Welsh Government, UK Cetacean Strandings Investigation Programme (CSIP) and Scottish Marine Animal Stranding Scheme (SMASS)	Rod Penrose rodpenrose@strandings.com

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United States

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1 RMU: Loggerhead turtle (*Caretta caretta)* - Northwest Atlantic

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

A total of 314 nesting sites are used by the Northwest Atlantic (NW ATL) subpopulation (Figure 1), with 78 of these being index nesting sites (see Supplemental table of the IUCN NW ATL Loggerhead regional management unit (RMU) Red List Assessment [Ref# 699]) where the recent average number of nests/year is reported for the 2009–2013 period. Information on total beach length (km), % beach monitored, beach monitoring level and protocol are available only for 30 of the Florida index sites (Ref# 27) and not available for any of the other nesting sites. Nesting habitat is mostly continuous in the continental U.S.; thus, nesting sites were defined arbitrarily based on geopolitical boundaries (e.g., municipalities, state parks, national wildlife refuges, military land).

1.1.2 Marine areas

Oceanic and neritic foraging grounds for juvenile and adult loggerhead turtles from the NW ATL subpopulation are widely distributed across the Gulf of Mexico and the eastern coast of the U.S. (Table 1; Figure 2). For this assessment, neritic foraging grounds were defined by all studies that explicitly mentioned this type of foraging habitat and studies in which turtles occurred in coastal habitats. As for the oceanic category, we included studies that explicitly mentioned this type of foraging habitat in coastal/offshore waters and juvenile turtles that occurred in offshore waters (i.e., *Sargassum* habitats).

1.2 Other biological data

1.2.1 Nests/year: recent average

We provide two values in Table 1. The first value reported (97,447 nests) represents the 5-year average number of loggerhead nests in Florida during the 2014 to 2018 time period (Ref# 27). Florida accounts for ~90% of the loggerhead nest numbers in the NW ATL RMU (Ref# 699) and this estimate reflects the most up-to-date number of nests recorded (2014–2018). However, it does not include the portion of the NW ATL loggerhead RMU that nests in the U.S. outside of Florida (i.e., Georgia through Virginia and Alabama through Texas; Figure 1). Based on Ceriani and Meylan (2017, Ref# 699), these areas account for ~7% of the NW ATL loggerhead RMU nesting activity and nesting occurs almost entirely in three states (Georgia, South Carolina, and North Carolina).

To be more comprehensive, we provide a second value (87,837 nests) that was calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287) by summing the annual number of loggerhead nests documented in the Northern Recovery Unit (NRU; North Carolina, South Carolina and Georgia) and the annual number of nests documented on all the beaches in Peninsular Florida during the 2010–2014 period and then averaging over the 5-year period. We chose not to include the Northern Gulf of Mexico (northwest Florida through Texas) and the Dry Tortugas (Florida) because these areas have a minimum number of nests (<1,000 nests/year combined) and the time series available ended in 2007 and 2004, respectively (see Valdivia et al. (2019), Ref# 287, supplemental data for raw numbers).

1.2.2 Number of "major" and "minor" nesting sites

Nesting sites could not be easily classified in "major" (>20 nests/year AND > 10 nests/km year) and "minor" (<20 nests/year OR <10 nests/km year) categories due to the paucity of data published in peer-reviewed journals and books (see *Disclaimer*). However, Fuentes et al. (2016, Ref# 6) provided sufficient information to estimate a range in the number of "major" and "minor" nesting sites for loggerheads. Table 1 in Fuentes et al. (2016, Ref# 6) set nest density ranges to categorize each loggerhead recovery unit into "very high", "high", "medium", and "low" density categories and the Supplemental dataset in Fuentes et al. (2016, Ref# 6) designated each nesting site as one of these four nest density categories.

We defined nesting sites as either "major" or "minor" based only on the "10 nests/km/yr" criterion. If the maximum value of a nest density range in Table 1 of Fuentes et al. (2016, Ref# 6) was less than 10 nests/km/yr, then all nesting sites with those nest density designations in the Supplemental dataset of Fuentes et al. (2016, Ref# 6) were considered "minor" sites. If the minimum value of a nest density range in Table 1 was greater than 10 nests/km/yr, then all nesting sites with those nest density designations in the Supplemental dataset were considered "major" sites. However, if a nest density range in Table 1 overlapped with 10 nests/km/yr, then nesting sites with those designations could not be classified with certainty as either "major" or "minor" nesting sites. This was the case for 133 out of 314 nesting sites. Because of this limitation, we provide a minimum number of "major" (and "minor") nesting sites and a maximum number of "major" (and "minor") nesting sites and present the data as $a < x \leq b$ where "a" is the minimum number of nesting sites that are considered "major" (or "minor") and "b" is the sum of "a" plus the number of nesting sites that are in the density category that overlap 10 nests/km/yr. As a result, a minimum of 77 (and a maximum of 210) nesting sites are classified as "major" sites and a minimum of 104 (and a maximum of 237) nesting sites are classified as "minor" nesting sites (Table 1).

1.2.3 Total length of nesting sites

The precise total length of nesting sites in the U.S. is not published but it is greater than 2,585 km. This number was obtained by summing the length of nesting sites in the

NRU (Georgia through Virginia: 1,235 km; Ref# 52 supplement) and in Florida (1,350 km; Ref# 27). The length of nesting sites west of Florida is not published.

1.2.4 Nesting females/year

We provide two values in Table 1. The most recent (2014–2018) annual average estimate of female abundance is 51,319 (CI95%: 16,639-99,739) and is based only on Florida data (Ref# 27). The most recent annual median estimate of female abundance for the entire U.S. is 35,603 (Ref# 289) and was calculated for the 2001–2010 period.

1.2.5 Nests/female/season (clutch frequency)

For both observed clutch frequency (OCF) and estimated clutch frequency (ECF), we provide a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of females; Table 1). Because sample sizes based on the number of nests are not provided for all individual estimates, we expressed the cumulative sample size for loggerhead turtles as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number.

1.2.6 Female remigration interval

Female remigration interval was calculated and presented as per clutch frequency section (Section 1.2.5; Table 1).

1.2.7 Sex ratios (hatchlings, immatures, and adults)

Sex ratio estimations are provided for each life stage and for different locations for each species found in the U.S. (Table 5). As sex ratios vary spatially and temporally, they are presented for different locations rather than summed and averaged across life stages per species.

1.2.8 Minimum adult size and age at sexual maturity

Minimum adult size data are summarized with a mean value, while keeping straight carapace length (SCL) and curved carapace length (CCL) measurements separated (Table 1). Age at sexual maturity data are summarized with a mean and range of reported values (Table 1).

1.2.9 Clutch size and emergence success

We provide an overall mean value, a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of nests) for the NW ATL loggerhead turtle RMU nesting in the continental U.S. (Table 1). Since sample sizes were not provided for all estimates, we could not weigh the overall mean value by sample size. Therefore, we simply averaged all mean values regardless of sample size to provide an overall mean estimate. Moreover, we expressed the cumulative sample size as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number.

1.2.10 Nesting success

See explanation for clutch size and emergence success (Section 1.2.9). However, the sample sizes for nesting success values represent the number of crawls, not the number of nests. We used "n/a" to indicate when there were insufficient data to generate a certain summary statistic.

1.2.11 Recent trends at nesting sites

An overall nesting trend analysis for the NW ATL loggerhead turtle in the U.S. has not been conducted. The recent overall loggerhead nesting trends (1983-2019) for the Northern Recovery Unit (the second largest nesting assemblage of loggerheads in the U.S.) is increasing by 1.3% annually (Ref# 789). However, the recent overall loggerhead nesting trend (1989–2018) for Florida is stable (Ref# 27). However, it should be emphasized that nest counts followed a general non-monotonic trend with wide fluctuations that corresponded to decreasing and increasing trends during short intervals. Florida accounts for ~90% of the entire NW ATL RMU (Ref# 699); thus, the Florida trend is representative of the entire RMU. A nesting site level trend analysis can be found in Mazaris et al. (2017, Ref# 368) supplemental data but it includes all nesting sites and not just index sites. Index sites are not identified by Mazaris et al. (2017, Ref# 368). Moreover, the nesting site level trend analysis conducted by Mazaris et al. (2017, Ref # 368) is largely based on data gathered from grey literature and online sources that were not necessarily verified for accuracy.

1.2.12 Recent trends at foraging sites

Trends in foraging sites are presented using the best available data, which suggested an upward trend since 1982 (Table 1). However, we suggest using caution when interpreting these trends because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability (e.g., estimates based on catch per unit effort [CPUE] and aerial/sighting; Ref# 174 and 194, respectively).

1.2.13 Oldest documented abundance (nests/year)

We provide two values for the oldest documented nest abundance: 60,768 nests (only Florida) and 65,632 (Florida-Georgia-South Carolina and North Carolina combined) for consistency with the approach we used for the recent average of nest numbers (Section 1.2.4). Both values were calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287) by summing the annual number of loggerhead nests documented in the NRU (North Carolina, South Carolina and Georgia) and the annual number of nests documented on all the nesting sites in Peninsular Florida during the 1989–1993 period and then averaging over the 5-year period. Also, in this case we chose not to include the Northern Gulf of Mexico (northwest Florida through Texas) and the Dry Tortugas (Florida) because these areas have a minimum number of nests (<1,000 nests/year combined) and the time series available started in 2002 and 1995, respectively. See Valdivia et al. (2019, Ref# 287) supplemental data for raw numbers.

1.2.14 Published studies

See Table 1. Please note that this Report includes only information published in peer-reviewed journals and books from research conducted in the continental United States and surrounding waters delimited by the Exclusive Economic Zone (EEZ). However, some references related to genetic studies that were conducted in the Caribbean were included in the list because the source of those turtles was the U.S. in one way or another.

1.3 Threats

Multiple threats were identified to impact loggerhead turtles in the U.S. on nesting beaches and in the marine environment (Table 1). Terrestrial threats include coastal development and associated hazards including photopollution and nesting habitat degradation. In the marine environment, threats include bycatch in industrial fisheries, vessel strikes, foraging habitat degradation, and HABs. Climate change is identified as a threat both on the nesting beach and in the marine environment. Additional valuable and up-to-date information on bycatch in industrial fisheries are available in various government publications, which will be included in the second iteration of this Report. Only information published in peer-reviewed journals and books were included in the first iteration of this Report (see *Disclaimer*).

1.4 Conservation

Loggerhead turtles and their habitats are protected in the U.S. (Table 3).

1.5 Research

There is a wealth of studies that has been conducted on loggerhead turtles in the U.S. (Table 1). However, many basic data (e.g., list of geographic coordinates of nesting sites, list of index nesting sites, annual nest and crawl counts, length of suitable nesting habitat) have not been published in peer-reviewed journals or books. Likewise, a wealth of important data has been gathered on other parameters (e.g., demographic and biological parameters obtained from nesting and in-water long-term studies) but not published.

We strongly encourage the publication of these existing and unpublished data in peer-reviewed journals as they are necessary to inform management and conservation actions. Considering the global importance of the loggerhead population nesting in the U.S., a better understanding of population trends (breeding and non-breeding abundance) and threats (including climate change and the impact of cumulative threats) remain a research priority. The interpretation of trends at foraging sites remains difficult because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability. As outlined by several authors and publications, there is a need to develop in-water index programs and focus on integrating demography and abundance trends.

Existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, and may be linked to environmental or individual-level variability and may vary with population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. Furthermore, precise estimates of survival rates of younger age classes (e.g., hatchling, and pelagic juvenile) are essential to accurately estimate population size and trend.

The following topic-specific knowledge gaps have been identified.

Pollution - Knowledge gaps related to chemical pollution (e.g., persistent synthetic organic compounds, heavy metals, polycyclic aromatic hydrocarbons) and sea turtles are similar to other regions of the world and for reptiles in general. Much of the available information reports exposure based on opportunistic sampling with little understanding of actual effects on sea turtles due to many challenges inherent to this research. Studies of pollutant effects have mostly relied on statistical comparisons between measured compound concentrations (resulting from field exposure) with various parameters of interest, especially hematological and blood chemistry values, immune function assays, and reproductive indices. Some *in vitro* studies also have been performed. Challenges associated with comparisons of studies are not unique to sea turtles and include methodological differences, inconsistencies in reported correlations or effects, and lack of specificity of many studied parameters leading to considerable uncertainty regarding cause and effect. While insight can be gained from these studies, translation to biological effect, much less population effect, for the purposes of threat assessment and actionable conservation management remains very difficult.

The issue of marine debris in this region would benefit from a thoughtful broad-scale synthesis of existing data with careful examination of debris types, source, and effects on turtles to the degree possible. Lumping all discarded anthropogenic materials under the umbrella of "marine debris" is problematic because materials, particularly those associated with fisheries, may have specific feasible mitigation opportunities as compared to the more diffuse and pervasive debris types, such as mixed-source plastics. The physical effects of marine debris entanglement and ingestion are relatively apparent; however, as with other chemical contaminants, notable knowledge gaps exist related to the effects of compounds that may be absorbed from plastics and other forms of marine debris.

Harmful Algal Blooms (HABs) - Effects of brevetoxins produced by the red tide organism *Karenia brevis* on hard-shelled (Cheloniid) species have been relatively well studied in this region, although knowledge gaps persist related to the ecology of exposure, potential differences in effects or exposure among sea turtle species, and sublethal effects. In addition, as in other parts of the world, study of other biotoxins has been relatively limited. Very little is understood about exposure and effects of these toxins on sea turtles. Moreover, information on biotoxins and laboratory assays available for detection are largely for toxins relevant to human health and seafood safety. There is considerable potential for marine animal exposure to unrecognized biotoxins that may affect ecosystems and sea turtle health.

Pathogens - Various microorganisms and parasites of sea turtles have been described in this region in recent years demonstrating that the complement of pathogens (as well as potential emergent ones) has yet to be fully characterized. In addition, various disease states have been described that may have an infectious component to their cause but have not been conclusively linked to a specific pathogen. As in other reptiles, many pathogens described in sea turtles are opportunists that follow predisposing conditions that impair turtle host defenses, such as injuries, suboptimal environmental conditions, and poor nutritional state.

Spirorchiid trematodes (blood flukes) have been catalogued in multiple areas of the region and several have been shown to cause disease in some turtle hosts. The epidemiology of these parasites and the breadth of effects on sea turtle health are poorly understood. The lifecycles of most spirorchiids remain unknown. The potential for chronic, sublethal effects on sea turtle fitness is largely unstudied and may be a significant aspect of host-parasite interaction and any population-level effects.

Fibropapillomatosis (probable viral etiology) is known to occur in all sea turtle species. Although the disease is less frequent and is most often less severe in other species as compared to green turtles, its occurrence in all sea turtle species and potential links to environmental co-factors warrant general concern with regard to sea turtle health. Despite decades of study, the etiology of fibropapillomatosis and its possible co-factors remain to be fully elucidated. This shortfall arguably is the most significant knowledge gap related to a sea turtle pathogen, particularly for green turtles.

2 RMU: Green turtlew (*Chelonia mydas)* - Northwest Atlantic

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

In total, 164 nesting sites (see 1.1.1 for definition of nesting site) are used by the NW ATL green turtle RMU (Figure 1). Specific data associated with nesting sites, including geographic coordinates and nest densities, are not currently published in peer-reviewed scientific journals or books. Valuable and up-to-date information on nesting distribution and abundance are available in various government publications, which will be included in the second iteration of this Report (see *Disclaimer*).

2.1.2 Marine areas

Oceanic and neritic foraging grounds for juvenile and adult green turtles from the NW ATL RMU are widely distributed mostly in inshore and nearshore waters across the Gulf of Mexico and the eastern coast of the U.S., from Texas to Massachusetts (Table 1; Figure 2). For this assessment, neritic foraging grounds were defined by all studies that explicitly mentioned this type of foraging habitat and studies in which turtles occurred in coastal habitats. As for the oceanic category, we included studies that explicitly mentioned this type of foraging habitat in coastal/offshore waters and juvenile turtles that occurred in offshore waters (i.e., *Sargassum* habitats).

2.2 Other biological data

2.2.1 Nests/year: recent average

The 5-year annual average number of green turtle nests and the recent order of magnitude of nests/year were calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287) and are based on Florida index sites (number and name of index nesting sites is not provided). Most green turtles in the U.S. nest in Florida (Ref# 287) and, thus, nest counts in Florida were used to represent the U.S.

2.2.2 Recent order of magnitude

Nesting green turtles tend to follow a two-year reproductive cycle (Ref# 287) and, typically, there are wide year-to-year fluctuations in the number of nests recorded (Table 1).

2.2.3 Number of "major" and "minor" nesting sites

Nesting sites could not be easily classified in "major" (>20 nests/year AND > 10 nests/km year) and "minor" (<20 nests/year OR <10 nests/km year) due to the paucity of published data. However, Fuentes et al. (2016, Ref# 6) provided sufficient information to estimate a range in the number of "major" and "minor" nesting sites for green turtles. Table 1 in Fuentes et al. (2016, Ref# 6) set nest density ranges for "very high", "high", "medium", and "low" density, while the supplemental dataset in Fuentes et al. (2016, Ref# 6) designated each nesting site into one of these four nest density categories.

We defined nesting sites as either "major" or "minor" based only on the "10 nests/km/yr" criterion. If the maximum value of a nest density range in Table 1 of Fuentes et al (2016, Ref# 6) was less than 10 nests/km/yr, then all nesting sites with those nest density designations in the supplemental dataset of Fuentes et al. (2016, Ref# 6) were considered "minor" sites. If the minimum value of a nest density range in Table 1 was greater than 10 nests/km/yr, then all nesting sites with those nest density designations in the supplemental dataset were considered "major" sites. However, if a nest density range in Table 1 overlapped with 10 nests/km/yr, then nesting sites with those designations could not be classified with certainty as either "major" or "minor" nesting sites. This was the case for 38 out of 164 nesting sites. Because of this limitation, we provided a minimum number of "major" (and "minor") nesting sites and a maximum number of "major" (and "minor") nesting sites and present the data as $a < x \leq b$ where "a" is the minimum number of nesting sites that are "major" (or "minor") and "b" is the sum of "a" plus the number of nesting sites that are in the density category that overlap 10 nests/km/yr (Table 1). As a result, a minimum of 3 (and a maximum of 41) nesting sites are classified as "major" sites and a minimum of 123 (and a maximum of 161) nesting sites are classified as "minor" nesting sites (Table 1).

2.2.4 Total length of nesting sites

n/a

2.2.5 Nesting females/year

n/a

2.2.6 Nests/female/season (clutch frequency)

For both OCF and ECF, we provide a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of females). Because sample sizes are not provided for all estimates, we expressed the cumulative sample size for green turtles as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number.

2.2.7 Female remigration interval

Female remigration interval was calculated and presented as per clutch frequency section (Section 2.2.7; Table 1). We used "n/a" to indicate when there was insufficient data to generate specific information.

2.2.8 Sex ratios (hatchlings, immatures, and adults)

Sex ratio estimations are provided for each life stage and for different locations for each species found in the U.S. (Table 5). As sex ratios vary spatially and temporally, they are presented for different locations rather than summed and averaged across life stages per species.

2.2.9 Minimum adult size and age at sexual maturity

Minimum adult size data are summarized with a mean value, while keeping SCL and CCL measurements separated (Table 1). Age at sexual maturity data are summarized with a mean and range of reported values (Table 1).

2.2.10 Clutch size and emergence success

We provide an overall mean value, a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of nests). Because sample sizes are not provided for all estimates, we could not weigh the overall mean value by sample size. Therefore, we simply averaged all mean values regardless of sample size to provide an overall mean estimate. Moreover, we expressed the cumulative sample size as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number. We used "n/a" to indicate when there were insufficient data to generate a certain summary statistic.

2.2.11 Nesting success

See explanation for clutch size and emergence success (Section 2.2.10). However, the sample sizes for nesting success values represent the number of crawls, not the number of nests (Table 1).

2.2.12 Recent trends at nesting sites

An overall nesting trend analysis for green turtles in the U.S has not been previously conducted. However, green turtles nest almost exclusively in Florida (Ref# 287), and green turtle nesting trends on Florida index nesting sites has increased exponentially during the 1989–2017 period (Ref# 287). The number and list of Florida index nesting sites used in the trend analysis is not specified (Ref# 287). A nesting site level trend analysis can be found in Mazaris et al. (2017, Ref# 287) supplemental data, but it includes all nesting sites and not just index sites. Index beaches are not identified by Mazaris et al. (2017, Ref# 368). Moreover, the nesting site level trend analysis conducted by Mazaris et al. (2017., Ref # 368) is largely based on data gathered from grey literature and online sources that were not necessarily verified for accuracy.

2.2.13 Recent trends at foraging sites

Trends in foraging areas are presented using the best available data, which suggest an upward trend in green turtle numbers since 1982 (Table 1). However, we suggest using caution when interpreting these trends because published datasets are few, small in scale, often short term, and occasionally biased by the difficulty in accounting for detectability (e.g., estimates based on CPUE; Ref# 174 and 253).

2.2.14 Oldest documented abundance (nests/year)

The oldest documented nest abundance for green turtles in the U.S. was calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287) by averaging the annual number of green turtle nests documented statewide in Florida during the 1979–1983 period (Table 1).

2.2.15 Published studies

See Table 1. Please note that this Report includes only information published in peer-reviewed journals and books from research conducted in the continental United States and surrounding waters delimited by the Exclusive Economic Zone (EEZ). However, some references related to genetic studies that were conducted in the Caribbean were included in the list because the source of those turtles was the U.S. in one way or another.

2.3 Threats

Multiple threats were identified to impact green turtles in the U.S. on nesting beaches and in the marine environment (Table 1). Terrestrial threats include coastal development and associated hazards including photopollution and nesting habitat degradation. In the marine environment, threats include bycatch in commercial fisheries, vessel strikes, foraging habitat degradation, pathogens, and HABs. Climate change is identified as a threat both on the nesting beach and in the marine environment. Additional valuable and up-to-date information on bycatch in industrial fisheries are available in various government publications, which will be included in the second iteration of this Report. Only information published in peer-reviewed journals and books were included in the first iteration of this Report (see *Disclaimer*).

2.4 Conservation

Green turtles and their habitats are protected in the U.S. (Table 3).

2.5 Research

There is a wealth of studies that has been conducted on green turtles in the U.S. However, many basic data (e.g., list of geographic coordinates of nesting sites, list of index nesting sites, annual nest and crawl counts, length of suitable nesting habitat) have not been published in peer-reviewed journals. Likewise, a wealth of important data has been gathered on other parameters (e.g., demographic and biological parameters obtained from nesting and in-water long-term studies), but not published.

We strongly encourage the publication of these existing and unpublished data in peer-reviewed journals as they are necessary to inform management and conservation actions. A better understanding of population trends (breeding and non-breeding abundance) and threats (including climate change and the impact of cumulative threats) remain a research priority. The interpretation of trends at foraging sites remains difficult because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability. As outlined by several authors and publications, there is a need to develop in-water index programs and focus on integrating demography and abundance trends.

There is a paucity of studies, in particular mark-recapture studies, to estimate survival rate, age at maturity, remigration interval, and clutch frequency for green sea turtles in the NW ATL RMU. Furthermore, existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, and may be linked to environmental or individual-level variability and population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. In addition, special effort should be directed towards precise estimates of survival rates of younger age classes (e.g., hatchling, and pelagic juvenile) as these are essential to accurately estimate population size and trend.

The following topic-specific knowledge gaps have been identified.

<u>Pollution</u> - Knowledge gaps related to chemical pollution (e.g., persistent synthetic organic compounds, heavy metals, polycyclic aromatic hydrocarbons) and sea turtles

are similar to other regions of the world and for reptiles in general. Much of the available information reports exposure based on opportunistic sampling with little understanding of actual effects on sea turtles due to many challenges inherent to this research. Studies of pollutant effects have mostly relied on statistical comparisons between measured compound concentrations (resulting from field exposure) with various parameters of interest, especially hematological and blood chemistry values, immune function assays, and reproductive indices. Some *in vitro* studies also have been performed. Challenges associated with comparisons of studies are not unique to sea turtles and include methodological differences, inconsistencies in reported correlations or effects, and lack of specificity of many studied parameters leading to considerable uncertainty regarding cause and effect. While insight can be gained from these studies, translation to biological effect, much less population effect, for the purposes of threat assessment and actionable conservation management remains very difficult.

The issue of marine debris in this region would benefit from a thoughtful broad-scale synthesis of existing data with careful examination of debris types, source, and effects on turtles to the degree possible. Lumping all discarded anthropogenic materials under the umbrella of "marine debris" is problematic because materials, particularly those associated with fisheries, may have specific feasible mitigation opportunities as compared to the more diffuse and pervasive debris types, such as mixed-source plastics. The physical effects of marine debris entanglement and ingestion are relatively apparent; however, as with other chemical contaminants, notable knowledge gaps exist related to the effects of compounds that may be absorbed from plastics and other forms of marine debris.

<u>Harmful Algal Blooms (HABs)</u> - Effects of brevetoxins produced by the red tide organism *Karenia brevis* on hard-shelled (Cheloniid) species have been relatively well studied in this region, although knowledge gaps persist related to the ecology of exposure, potential differences in effects or exposure among sea turtle species, and sublethal effects. In addition, as in other parts of the world, study of other biotoxins has been relatively limited. Very little is understood about exposure and effects of these

toxins on sea turtles. Moreover, information on biotoxins and laboratory assays available for detection are largely for toxins relevant to human health and seafood safety. There is considerable potential for marine animal exposure to unrecognized biotoxins that may affect ecosystems and sea turtle health.

Pathogens - Various microorganisms and parasites of sea turtles have been described in this region in recent years demonstrating that the complement of pathogens (as well as potential emergent ones) has yet to be fully characterized. Those organisms that appear to have the greatest potential for effect on green turtles in this region based on currently available data are fibropapillomatosis (probable viral etiology), spirorchiid trematodes (blood flukes), and *Caryospora* or *Caryospora*-like species (protozoa). Despite decades of study, the etiology of fibropapillomatosis and its possible co-factors remain to be fully elucidated. This shortfall arguably is the most significant knowledge gap related to a sea turtle pathogen and sea turtle health, particularly for green turtles.

Spirorchiid trematodes have been catalogued in multiple areas of the region and several have been shown to cause disease in some turtle hosts. The epidemiology of these parasites and the breadth of effects on sea turtle health are poorly understood. The lifecycles of most spirorchiids remain unknown. The potential for chronic, sublethal effects on sea turtle fitness is largely unstudied and may be a significant aspect of host-parasite interaction and any population-level effects. Lastly, the protozoan parasites, *Caryospora*-like sp., are an example of another knowledge gap, one that is relevant to other pathogens as well, which is incomplete representation of data from other regions. These parasites appear to have circulated globally within modern times, potentially by anthropogenic means, and have caused mass mortality of wild and captive green turtles. The mechanism by which *Caryospora*-like sp. may have occurred and their global phylogeography require further study.

3 RMU: Leatherback turtle (*Dermochelys coriacea)* - Northwest Atlantic

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

In total there are 107 nesting sites (see 1.1.1 for definition of nesting site) used by the NW ATL leatherback RMU (Figure 1). Specific data associated with nesting sites, including geographic coordinates and nest densities, are not currently published in peer-reviewed scientific journals or books. Valuable and up-to-date information on nesting distribution and abundance are available in various government publications, which will be included in the second iteration of this Report (see *Disclaimer*).

3.1.2 Marine areas

Oceanic foraging grounds of juvenile and adult leatherback turtles from the NW ATL RMU are widely distributed across coastal and offshore waters of the Gulf of Mexico and the eastern coast of the U.S. (Table 1; Figure 2).

3.2 Other biological data

3.2.1 Nests/year: recent average

The 5-year annual average number of leatherback nests and the recent order of magnitude of nests/year were calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287) and are based on Florida index nesting sites. Most leatherback turtles in the continental U.S. nest in Florida (Ref# 67) and, thus, nest counts in Florida were used to represent the U.S.

3.2.2 Recent order of magnitude

Please see Table 1.

3.2.3 Number of "major" and "minor" nesting sites

Nesting sites could not be easily classified in "major" (>20 nests/year AND > 10 nests/km year) and "minor" (<20 nests/year OR <10 nests/km year) due to the paucity of published data. However, Fuentes et al. (2016, Ref# 6) provided sufficient information to estimate a range in the number of "major" and "minor" nesting sites for leatherbacks. Table 1 in Fuentes et al. (2016, Ref# 6) set nest density ranges for "very high", "high", "medium", and "low" density, while the Supplemental dataset in Fuentes et al. (2016, Ref# 6) designated each nesting site as one of these four nest density categories.

We defined nesting sites as either "major" or "minor" based only on the "10 nests/km/yr" criterion. If the maximum value of a nest density range in Table 1 of Fuentes et al. (2016, Ref# 6) was less than 10 nests/km/yr, then all nesting sites with those nest density designations in the Supplemental dataset of Fuentes et al. (2016, Ref# 6) were considered "minor" sites. If the minimum value of a nest density range in Table 1 was greater than 10 nests/km/yr, then all nesting sites with those nest density designations in the Supplemental dataset were considered "major" sites. However, if a nest density range in Table 1 overlapped with 10 nests/km/yr, then nesting sites with those designations could not be classified with certainty as either "major" or "minor" nesting sites. This was the case for 23 out of 107 nesting sites. Because of this limitation, we provide a minimum number of "major" (and "minor") nesting sites and a maximum number of "major" (and "minor") nesting sites and present the data as $a < x \leq b$ where "a" is the minimum number of nesting sites that are "major" (or "minor") and "b" is the sum of "a" plus the number of nesting sites that are in the density category that overlap 10 nests/km/yr. As a result, a minimum of 4 (and a maximum of 27) nesting sites are classified as "major" sites and a minimum of 80 (and a maximum of 103) nesting sites are classified as "minor" nesting sites (Table 1).

3.2.4 Total length of nesting sites

The exact total length of nesting sites in the continental U.S is not published but it is greater than 534 km. This number was obtained by summing the length of the 68 nesting sites in Florida where leatherbacks regularly nest and listed in Stewart et al. (2011, Ref# 67) (see Table 1 in Stewart et al. 2011). The recent Endangered Species Act status review (Ref# 790) considers the entire length of nesting beaches in Florida, South Carolina and North Carolina as nesting beach for the species (2,183km). Stewart et al. (2011, Ref# 67) provides a list of nesting site names, survey length and only one latitude coordinate per site and not the number of nests/years. Similarly, the number of index nesting sites and associated details are not available in peer-reviewed publications.

3.2.5 Nesting females/year

n/a

3.2.6 Nests/female/season (clutch frequency)

For both observed OCF and ECF, we provide a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of females). Because sample sizes are not provided for all estimates, we expressed the cumulative sample size for leatherback turtles as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number. We used "n/a" to indicate when there was insufficient data to generate a certain summary statistic.

3.2.7 Female remigration interval

Female remigration interval was calculated and presented as per clutch frequency section (Section 3.2.6; Table 1). We used "n/a" to indicate when there were insufficient data to generate specific information.

3.2.8 Sex ratios (hatchlings, immatures, and adults)

Sex ratio estimations are provided for each life stage and for different locations for each species found in the U.S. (Table 5). As sex ratios vary spatially and temporally, they are presented for different locations rather than summed and averaged across life stages per species.

3.2.9 Minimum adult size and age at sexual maturity

Please see Table 1.

3.2.10 Clutch size and emergence success

We provide an overall mean value, a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of nests; Table 1). Because sample sizes are not provided for all estimates, we could not weigh the overall mean value by sample size. Therefore, we simply averaged all mean values regardless of sample size to provide an overall mean estimate. Moreover, we expressed the cumulative sample size as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number.

3.2.11 Nesting success

A single estimate was only provided for one site (Table 1), so a range of values is not available.

3.2.12 Recent trends at nesting sites

An overall nesting trend for leatherbacks in the continental U.S. has not been conducted to date. Stewart et al. (2011, Ref# 67) examined 68 Florida sites where leatherbacks regularly nest and found a 10.2% increase in the number of nests per year during the 1979–2008 period. A more recent analysis conducted only on Florida index sites found an increase (+7.12%) on leatherback nesting trend during the 1989–2017 period (Ref# 369). However, the number and associated details of Florida index nesting sites used in the trend analysis is not specified (Ref# 369). The Northwest Atlantic Leatherback Group concluded that nesting trend increased during the 1990-2017 period but decreased (although not significantly) during the 2008-2017 period (Ref# 790). A nesting site level trend analysis can be found in Mazaris et al. (2017, Ref# 368) supplemental data, but it includes all nesting sites and not just index sites. Moreover, the nesting site level trend analysis conducted by Mazaris et al. (2017., Ref # 368) is largely based on data gathered from grey literature and online sources that were not necessarily verified for accuracy.

3.2.13 Recent trends at foraging sites

n/a

3.2.14 Oldest documented abundance (nests/year)

We provide two values for the oldest documented nest abundance of leatherback turtles in the U.S. One was calculated using the raw data found in the supplemental data of Valdivia et al. (2019, Ref# 287), with 31 nests, by averaging the annual number of leatherback nests documented statewide in Florida during the 1979–1983 period. The second value included both Florida and North Carolina but refers to a more recent period (1989–1993) and considered 51 nests (Ref# 369; Table 1).

3.2.15 Published studies

See Table 1. Please note that this Report includes only information published in peer-reviewed journals and books from research conducted in the continental United States and surrounding waters delimited by the Exclusive Economic Zone (EEZ). However, some references related to genetic studies that were conducted in the Caribbean were included in the list because the source of those turtles was the U.S. in one way or another.

3.3 Threats

Multiple threats were identified to impact leatherback turtles in the U.S. on nesting beaches and in the marine environment (Table 1). Terrestrial threats include coastal development and associated hazards including photopollution and nesting habitat degradation. In the marine environment, threats include bycatch in commercial fisheries, vessel strikes, foraging habitat degradation, and HABs. Climate change is identified as a threat both on the nesting beach and in the marine environment. Additional valuable and up-to-date information on bycatch in industrial fisheries are available in various government publications, which will be included in the second iteration of this Report. Only information published in peer-reviewed journals and books were included in the first iteration of this Report (see *Disclaimer*).

3.4 Conservation

Leatherback turtles and their habitats are protected in the U.S. (Table 3).

3.5 Research

Key questions remain about leatherbacks that are critical to understanding their population dynamics in the U.S. Survival of younger age classes, age to maturity, and location of juvenile foraging grounds would help identify where further protection or research is needed. The individual variation in reproductive periodicity is important to understand for explaining the various trends observed within the NW ATL RMU.

There is a wealth of studies that has been conducted on leatherback turtles in the U.S. However, many basic data (e.g., list of geographic coordinates of nesting sites, list of index nesting sites, annual nest and crawl counts, length of suitable nesting habitat) have not been published in peer-reviewed journals. Likewise, a wealth of important data has been gathered on other parameters (e.g., demographic and biological parameters obtained from nesting and in-water long-term studies) but not published.

We strongly encourage the publication in peer-reviewed journals of these existing and unpublished data as they are necessary to inform management and conservation actions. A better understanding of population trends (breeding and non-breeding abundance) and threats (including climate change and the impact of cumulative threats) remain a research priority. The interpretation of trends at foraging sites remains difficult because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability. As outlined by several authors and publications, there is a need to develop in-water index programs and focus on integrating demography and abundance trends.

There is a paucity of studies, in particular mark-recapture studies, to estimate survival rate, age at maturity, remigration interval, and clutch frequency. Furthermore, existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, and may be linked to environmental or individual-level variability, and population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. In addition, special effort should be directed towards precise estimates of survival rates of younger age classes (e.g., hatchling, and pelagic juvenile) as they are essential to accurately estimate population size and trend.

The following topic-specific knowledge gaps have been identified.

Pollution - Knowledge gaps related to chemical pollution (e.g., persistent synthetic organic compounds, heavy metals, polycyclic aromatic hydrocarbons) and sea turtles are similar to other regions of the world and for reptiles in general. Much of the available information reports exposure based on opportunistic sampling with little understanding of actual effects on sea turtles due to many challenges inherent to this research. Studies of pollutant effects have mostly relied on statistical comparisons between measured compound concentrations (resulting from field exposure) with various parameters of interest, especially hematological and blood chemistry values, immune function assays, and reproductive indices. Some *in vitro* studies also have been performed. Challenges associated with comparisons of studies are not unique to sea turtles and include methodological differences, inconsistencies in reported correlations or effects, and lack of specificity of many studied parameters leading to considerable uncertainty regarding cause and effect. While insight can be gained from these studies, translation to biological effect, much less population effect, for the purposes of threat assessment and actionable conservation management remains very difficult.

The issue of marine debris in this region would benefit from a thoughtful broad-scale synthesis of existing data with careful examination of debris types, source, and effects on turtles to the degree possible. Lumping all discarded anthropogenic materials under the umbrella of "marine debris" is problematic because materials, particularly those associated with fisheries, may have specific feasible mitigation opportunities as compared to the more diffuse and pervasive debris types, such as mixed-source plastics. The physical effects of marine debris entanglement and ingestion are relatively apparent; however, as with other chemical contaminants, notable knowledge gaps exist related to the effects of compounds that may be absorbed from plastics and other forms of marine debris.

Biotoxins - There is been limited study of biotoxins in Atlantic leatherbacks in general. Basic studies of exposure to biotoxins are needed, particularly for those produced by harmful algal blooms known to occur in deeper shelf and oceanic waters. Potential health effects of biotoxins on leatherbacks are similarly unknown.

Pathogens - There have been relatively few publications on pathogens of Atlantic leatherbacks. Two observations that have been documented in multiple Atlantic leatherbacks but that remain poorly understood are intestinal diverticulum formation (thinning and bulging of the bowel wall) and protozoal parasitism of the adrenal glands. Formation of solitary diverticula and associated inflammation at the junction of the small and large intestine have been documented in a number of leatherbacks in this region. The cause of this condition remains unknown, although bacterial infection is a contributory component. Whether the diverticula are caused by pathogens, such as localized bacterial infection or endoparasites, or are caused by injury from ingested foreign material or other conditions that affect gut motility is unknown. Parasitism of the adrenal glands by coccidia (protozoan parasites) is another frequent observation in Atlantic leatherbacks. The life cycle of these parasites and effects on adrenal function, if any, have yet to be determined.

4 RMU: Kemp's Ridley (*Lepidochelys kempii)* - Northwest Atlantic

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

In total there are nine nesting sites used by Kemp's ridley turtles in the NW ATL RMU, all located in Texas, hosting a small population (Table 1, Figure 1). Even though they are all classified as "minor" nesting sites, they are the only regular nesting sites in the U.S. A list of all the sites with their geographic coordinates and nest density is not available in peer-reviewed scientific journals or books. Valuable and up-to-date information on nesting distribution and abundance are available in various government publications, which will be included in the second iteration of this Report.

4.1.2 Marine areas

Oceanic and neritic foraging grounds for juvenile and adult Kemp's ridley turtles from the NW ATL RMU are widely distributed across the Gulf of Mexico and the eastern coast of the U.S. (Table 1; Figure 2). For this assessment, neritic foraging grounds were defined by all studies that explicitly mentioned this type of foraging habitat and studies in which turtles occurred in coastal habitats. As for the oceanic category, we included studies that explicitly mentioned this type of foraging habitat in coastal/offshore waters and juvenile turtles that occurred in offshore waters (i.e., *Sargassum* habitats).

4.2 Other biological data

4.2.1 Nests/year: recent average

We calculated the recent (2009–2014) average annual nests number for Kemp's ridley turtles in the U.S. using the raw data found in Shaver et al. (2016, Ref# 288).

4.2.2 Recent order of magnitude

Please see Table 1.

4.2.3 Number of "major" and "minor" nesting sites

Please see Table 1.

4.2.4 Total length of nesting sites

Please see Table 1.

4.2.5 Nesting females/year

The number of nesting females/year for Kemp's ridley nesting in the U.S. was calculated using the raw data found in Table 4 of Frey et al. (2014, Ref# 70) by averaging the annual number of Kemp's ridley females documented for the 2003–2006 period (Table 1).

4.2.6 Nests/female/season (clutch frequency)

For OCF, we provide a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of females). Because sample sizes are not provided for all estimates, we expressed the cumulative sample size for those species as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number. No values for ECF are available for Kemp's ridley turtles.

4.2.7 Female remigration interval

Female remigration interval was calculated and presented as per clutch frequency section (Section 4.2.6; Table 1). We used "n/a" to indicate when there were insufficient data to generate specific information.

4.2.8 Sex ratios (hatchlings, immatures, and adults)

Sex ratio estimations are provided for each life stage and for different locations for each species found in the U.S. (Table 5). As sex ratios vary spatially and temporally, they are presented for different locations rather than summed and averaged across life stages per species.

4.2.9 Minimum adult size and age at sexual maturity

Please see Table 1.

4.2.10 Clutch size and emergence success

We provide an overall mean value, a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of nests). Because sample sizes are not provided for all estimates, we could not weigh the overall mean value by sample size. Therefore, we simply averaged all mean values regardless of sample size to provide an overall mean estimate. Moreover, we expressed the cumulative sample size as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number. We used "n/a" to indicate when there were insufficient data to generate a certain summary statistic. It should be noted that the emergence success reported represents the emergence success for protected nests as nearly all nests for Kemp's ridley turtles in the U.S. are moved to a hatchery and protected.

4.2.11 Nesting success

n/a

4.2.12 Recent trends at nesting sites

Between 1978 and 2014, the annual number of nests of Kemp's ridley turtles in the U.S. has increased (Table 1, Ref# 288). However, since 2010, nesting trends have leveled, remaining well below predicted levels at all locations throughout their range, including the U.S. (Ref# 75, 288, 478, and 479).

4.2.13 Recent trends at foraging sites

Trends in foraging areas are presented using the best available data, which suggest an upward trend since 1991. However, we suggest using caution when interpreting these trends because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability (e.g., estimates based on CPUE; Ref# 174 and 371).

4.2.14 Oldest documented abundance (nests/year)

Please see Table 1.

4.2.15 Published studies

See Table 1. Please note that this Report includes only information published in peer-reviewed journals and books from research conducted in the continental United States and surrounding waters delimited by the Exclusive Economic Zone (EEZ). However, some references related to genetic studies that were conducted in the Caribbean were included in the list because the source of those turtles was the U.S. in one way or another.

4.3 Threats

Multiple threats were identified to impact Kemp's ridley in the U.S. on nesting beaches and in the marine environment (Table 1). In the marine environment, threats include bycatch in commercial fisheries, vessel strikes, foraging habitat degradation, and HABs. Climate change is identified as a threat both on the nesting beach and in the marine environment. Additional valuable and up-to-date information on bycatch in industrial fisheries are available in various government publications, which will be included in the second iteration of this Report. Only information published in peer-reviewed journals and books were included in the first iteration of this Report (see *Disclaimer*).

4.4 Conservation

Kemp's ridley turtles and their habitats are protected in the U.S. Please see Table 3.

4.5 Research

There is a wealth of studies that has been conducted on Kemp's ridley turtles in the U.S. However, many basic data (e.g., list of geographic coordinates of nesting sites, list of index nesting sites, annual nest and crawl counts, length of suitable nesting habitat) have not been published in peer-reviewed journals. Likewise, a wealth of important data has been gathered on other parameters (e.g. demographic and biological parameters obtained from nesting and in-water long-term studies) but not published.

We strongly encourage the publication in peer-reviewed journals of these existing and unpublished data as they are necessary to inform management and conservation actions. As Kemp's ridley is the most critically endangered sea turtle species globally, a better understanding of population trends (breeding and non-breeding abundance) and threats (including climate change and the impact of cumulative threats) remain a research priority. Determining the decline in predicted nesting trends since 2010 is of critical importance. The interpretation of trends at foraging sites remains difficult because published datasets are few, small in scale, often short term, and occasionally biased by difficulty in accounting for detectability. As outlined by several authors and publications, there is a need to develop in-water index programs and focus on integrating demography and abundance trends.

There is a paucity of studies, in particular mark-recapture studies, to estimate survival rate, age at maturity, remigration interval, and clutch frequency. Furthermore, existing research suggests that key vital rates (i.e. remigration interval, clutch frequency, etc.) are highly variable, and may be linked to environmental or individual-level variability, and population density. Long-term mark-recapture studies are necessary to evaluate potential drivers that may influence this variability and to calculate more accurate and precise estimates of these vital rates. In addition, special effort should be directed towards precise estimates of survival rates of younger age classes (e.g., hatchling, and pelagic juvenile) as they are essential to accurately estimate population size and trend.

The following topic-specific knowledge gaps have been identified.

<u>Pollution</u> - Knowledge gaps related to chemical pollution (e.g., persistent synthetic organic compounds, heavy metals, polycyclic aromatic hydrocarbons) and sea turtles are similar to other regions of the world and for reptiles in general. Much of the available information reports exposure based on opportunistic sampling with little understanding of actual effects on sea turtles due to many challenges inherent to this research. Studies of pollutant effects have mostly relied on statistical comparisons between measured compound concentrations (resulting from field exposure) with various parameters of interest, especially hematological and blood chemistry values, immune function assays, and reproductive indices. Some *in vitro* studies also have been performed. Challenges associated with comparisons of studies are not unique to sea turtles and include methodological differences, inconsistencies in reported correlations or effects, and lack of specificity of many studied parameters leading to considerable uncertainty regarding

cause and effect. While insight can be gained from these studies, translation to biological effect, much less population effect, for the purposes of threat assessment and actionable conservation management remains very difficult.

The issue of marine debris in this region would benefit from a thoughtful broad-scale synthesis of existing data with careful examination of debris types, source, and effects on turtles to the degree possible. Lumping all discarded anthropogenic materials under the umbrella of "marine debris" is problematic because materials, particularly those associated with fisheries, may have specific feasible mitigation opportunities as compared to the more diffuse and pervasive debris types, such as mixed-source plastics. The physical effects of marine debris entanglement and ingestion are relatively apparent; however, as with other chemical contaminants, notable knowledge gaps exist related to the effects of compounds that may be absorbed from plastics and other forms of marine debris.

Harmful Algal Blooms (HABs) - Effects of brevetoxins produced by the red tide organism *Karenia brevis* on hard-shelled (Cheloniid) species have been relatively well studied in this region, although knowledge gaps persist related to the ecology of exposure, potential differences in effects or exposure among sea turtle species, and sublethal effects. In addition, as in other parts of the world, study of other biotoxins has been relatively limited. Very little is understood about exposure and effects of these toxins on sea turtles. Moreover, information on biotoxins and laboratory assays available for detection are largely for toxins relevant to human health and seafood safety. There is considerable potential for marine animal exposure to unrecognized biotoxins that may affect ecosystems and sea turtle health.

Pathogens - Various microorganisms and parasites of sea turtles have been described in this region in recent years demonstrating that the complement of pathogens (as well as potential emergent ones) has yet to be fully characterized. In addition, various disease states have been described that may have an infectious component to their cause but have not been conclusively linked to a specific pathogen. As in other reptiles, many pathogens described in sea turtles are opportunists that follow predisposing conditions that impair turtle host defenses, such as injuries, suboptimal environmental conditions, and poor nutritional state.

Spirorchiid trematodes (blood flukes) have been catalogued in multiple areas of the region and several have been shown to cause disease in some turtle hosts. The epidemiology of these parasites and the breadth of effects on sea turtle health are poorly understood. The lifecycles of most spirorchiids remain unknown. The potential for chronic, sublethal effects on sea turtle fitness is largely unstudied and may be a significant aspect of host-parasite interaction and any population-level effects.

Fibropapillomatosis (probable viral etiology) is known to occur in all sea turtle species. Although the disease is less frequent and is most often less severe in other species as compared to green turtles, its occurrence in all sea turtle species and potential links to environmental co-factors warrant general concern with regard to sea turtle health. Despite decades of study, the etiology of fibropapillomatosis and its possible co-factors remain to be fully elucidated. This shortfall arguably is the most significant knowledge gap related to a sea turtle pathogen, particularly for green turtles.

5 RMU: Hawksbill turtle (*Eretmochelys imbricata)* – Atlantic, Western Caribbean/USA

5.1 Distribution, abundance, trends

5.1.1 Nesting sites

Hawksbill turtles rarely nest in the U.S. with one to two nests documented each year. Nests have been documented across 13 different sites from 1979 to 2003 (Ref# 80). For this reason, there are no abundance indexes for this species in the U.S. Please see Table 1 for the information available for this RMU in the U.S.

5.1.2 Marine areas

Oceanic and neritic foraging grounds for juvenile and benthic foraging grounds for adult hawksbill turtles from the Atlantic-Western Caribbean/USA RMU are mostly located in nearshore waters of southern Florida and near jetties in Texas, but have also been recorded occasionally in North Carolina, and as far north as Massachusetts (Table 1; Figure 2). For this assessment, neritic foraging grounds were defined by all studies that explicitly mentioned this type of foraging habitat and studies in which turtles occurred in coastal habitats. As for the oceanic category, we included studies that explicitly mentioned this type of foraging habitat and juvenile turtles in offshore waters (i.e., *Sargassum* habitats).

5.2 Other biological data

5.2.1 Nests/year: recent average

n/a

5.2.2 Recent order of magnitude

Please see Table 1.

5.2.3 Number of “major” and “minor” nesting sites

Please see Table 1.

5.2.4 Total length of nesting sites

n/a

5.2.5 Nesting females/year

n/a

5.2.6 Nests/female/season (clutch frequency)

Insufficient nesting activity in the U.S. by hawksbill turtles made it impossible to estimate clutch frequency for this species.

5.2.7 Female remigration interval

Remigration interval is estimated from one individual (Table 1).

5.2.8 Sex ratios (hatchlings, immatures, and adults)

Sex ratio estimations are provided for each life stage and for different locations for each species found in the U.S. (Table 5). As sex ratios vary spatially and temporally, they are presented for different locations rather than summed and averaged across life stages per species.

5.2.9 Minimum adult size and age at sexual maturity

Please see Table 1.

5.2.10 Clutch size and emergence success

We provide an overall mean value, a range of mean values, an overall range of values, and the sample size used to generate the summary statistics (i.e., number of nests). Because sample sizes are not provided for all estimates, we could not weigh the overall mean value by sample size. Therefore, we simply averaged all mean values regardless of sample size to provide an overall mean estimate. Moreover, we expressed the cumulative sample size as the sum of all sample sizes that were provided and included a greater than symbol to indicate that the cumulative sample size is a minimum number. We used "n/a" to indicate when there were insufficient data to generate a certain summary statistic.

5.2.11 Nesting success

n/a

5.2.12 Recent trends at nesting sites

n/a

5.2.13 Recent trends at foraging sites

n/a

5.2.14 Oldest documented abundance (nests/year)

n/a

5.2.15 Published studies

See Table 1. Please note that this Report includes only information published in peer-reviewed journals and books from research conducted in the continental United States and surrounding waters delimited by the Exclusive Economic Zone (EEZ). However, some references related to genetic studies that were conducted in the Caribbean were included in the list because the source of those turtles was the U.S. in one way or another.

5.3 Threats

Multiple threats were identified to impact hawksbill turtles in the U.S. on nesting beaches and in the marine environment (Table 1). Terrestrial threats include coastal development and associated hazards including photopollution and nesting habitat degradation. In the marine environment, threats include bycatch in commercial fisheries, vessel strikes, foraging habitat degradation, and HABs. Climate change is identified as a threat both on the nesting beach and in the marine environment. Additional valuable and up-to-date information on bycatch in industrial fisheries are available in various government publications, which will be included in the second iteration of this Report. Only information published in peer-reviewed journals and books were included in the first iteration of this Report (see *Disclaimer*).

5.4 Conservation

Hawksbill turtles and their habitats are protected in the U.S. (Table 3).

5.5 Research

A better understanding of population trends (mostly non-breeding abundance) and threats (including climate change and the impact of cumulative threats) remain a research priority.

The following topic-specific knowledge gaps have been identified.

Pollution - Knowledge gaps related to chemical pollution (e.g., persistent synthetic organic compounds, heavy metals, polycyclic aromatic hydrocarbons) and sea turtles are similar to other regions of the world and for reptiles in general. Much of the available information reports exposure based on opportunistic sampling with little understanding of actual effects on sea turtles due to many challenges inherent to this research. Studies of pollutant effects have mostly relied on statistical comparisons between measured compound concentrations (resulting from field exposure) with various parameters of interest, especially hematological and blood chemistry values, immune function assays, and reproductive indices. Some *in vitro* studies also have been performed. Challenges associated with comparisons of studies are not unique to sea turtles and include methodological differences, inconsistencies in reported correlations or effects, and lack of specificity of many studied parameters leading to considerable uncertainty regarding cause and effect. While insight can be gained from these studies, translation to biological effect, much less population effect, for the purposes of threat assessment and actionable conservation management remains very difficult.

The issue of marine debris in this region would benefit from a thoughtful broad-scale synthesis of existing data with careful examination of debris types, source, and effects on turtles to the degree possible. Lumping all discarded anthropogenic materials under the umbrella of "marine debris" is problematic because materials, particularly those associated with fisheries, may have specific feasible mitigation opportunities as compared to the more diffuse and pervasive debris types, such as mixed-source plastics. The physical effects of marine debris entanglement and ingestion are relatively apparent; however, as with other chemical contaminants, notable knowledge gaps exist related to the effects of compounds that may be absorbed from plastics and other forms of marine debris.

Harmful Algal Blooms (HABs) - Effects of brevetoxins produced by the red tide organism *Karenia brevis* on hard-shelled (Cheloniid) species have been relatively well studied in this region, although knowledge gaps persist related to the ecology of exposure, potential differences in effects or exposure among sea turtle species, and sublethal effects. In addition, as in other parts of the world, study of other biotoxins has been relatively limited. Very little is understood about exposure and effects of these toxins on sea turtles. Moreover, information on biotoxins and laboratory assays available for detection are largely for toxins relevant to human health and seafood safety. There is considerable potential for marine animal exposure to unrecognized biotoxins that may affect ecosystems and sea turtle health.

Pathogens - Various microorganisms and parasites of sea turtles have been described in this region in recent years demonstrating that the complement of pathogens (as well as potential emergent ones) has yet to be fully characterized. In addition, various disease states have been described that may have an infectious component to their cause but have not been conclusively linked to a specific pathogen. As in other reptiles, many pathogens described in sea turtles are opportunists that follow predisposing conditions that impair turtle host defenses, such as injuries, suboptimal environmental conditions, and poor nutritional state.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in the U. S.

Table 1. Key biological information for sea turtles in the United States. (n/a = Not applicable or available; CC = *Caretta caretta*, CM = *Chelonia mydas*, DC = *Dermochelys coriacea,* EI = *Eretmochelys imbricata*, LK = *Lepidochelys kempii*, FL = Florida, NC = North Carolina). When more than one estimate/value is provided * and ** refer to the specific reference associated with each value provided.

RMU	**CC-NW ATL**	**Ref#**	**CM-NW ATL**	**Ref#**	**DC-NW ATL**	**Ref#**	**LK-NW ATL**	**Ref#**	**EI-ATL W. CAR**	**Ref#**
Occurrence										
Nesting sites (Number of sites)	Yes (314)	1-57, 731-739	Yes (164)	1-24, 59-61, 731-732, 740-742	Yes (107)	1-14, 62-67, 731, 733	Yes (9)	1-6, 68-76, 732, 743	Yes	1-4, 77-80
Oceanic foraging grounds	Juvenile, Adult	58, 81-121, 744-747	Juvenile, Adult	61, 81-87, 122-125, 744	Adult	63, 66, 81-83, 88-95, 127-166, 744, 748-749	Juvenile, Adult	73, 81-86, 88, 122, 744	Juvenile, Adult	80-81, 84-86, 744
Neritic foraging grounds	Juvenile, Adult	16, 29, 37, 40, 54, 58, 81, 83, 98, 101, 103-107, 111, 113-116, 118-119, 167-198, 200-240, 746, 750-756	Juvenile, Adult	16, 61, 81, 83, 123, 125, 167-182, 241-259, 750-752, 757	Adult	748-749	Juvenile, Adult	73, 81, 83, 167-180, 183, 185-190, 241, 260-279, 750-753, 758-759	Juvenile	80-81, 167-169, 172-173, 191, 280-286, 750

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Key biological data										
Nests/yr: recent average [range of years]	*97,447 [2014-2018]; **87,837 [2010-2014]	*27, **287	18,883 [2012-2016]	287	1,352 [2012-2016]	287	170 [2009-2014]	288	n/a	
Nests/yr: recent order of magnitude [range of years]	100,000 [2010-2018]	27, 287	10,000 [2012-2016]	287	1,000 [2012-2016]	287	100 [2000-2014]	288	1	80
Number of "major" sites (>10 nests/km/yr)	77<x≤210	6	3<x≤41	6	4<x≤27	6	0	288	0	80
Number of "minor" sites (<10 nests/km/yr)	104<x≤237	6	123<x≤161	6	80<x≤103	6	9	288	13	80
Nests/yr at "major" sites: recent average [range of years]	n/a		n/a		n/a		n/a		n/a	
Nests/yr at "minor" sites: recent average [range of years]	n/a		n/a		n/a		48 [1978-2014]	288	n/a	
Total length of nesting sites (km)	>2,585	27, 52	n/a		*>534; **2183	*67, **760	590	70, 288	n/a	
Nesting females/yr: mean (95% confidence interval) [range of years]	*51,319 (16,639-99,739) [2014-2018); **35,603 [2001-2010]	*27, **289	n/a		n/a		29	70	n/a	
Nests/female/season (clutch frequency): mean or range of means, range (number of females)	OCF: 1.35-4.5, 1-8 (>9,300); ECF: 2.44-5.4, 1-8 (>9,300)	33, 38, 52, 119, 290-305, 736, 761-762	OCF: 2.4-3.6, 1-10 (>150); ECF: 3.0, 1-10 (145)	290, 306-307, 763-764	OCF: 1.8-5.0, 1-8 (>850); ECF: 4.2-4.4, 2-7 (>500)	62, 65, 765	OCF: 1.3-1.45, 1-3 (735)	288, 308	n/a	

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Female remigration interval (yrs): mean or range of means, range (number of females)	2.54-3.69, 1-16 (>2,300)	15, 38, 119, 201, 290, 293, 297, 300, 302, 305, 736, 761-763, 958	2, n/a (n/a)	15, 290, 763	2.2-2.7, 1-6 (>200)	62, 65, 765	2.7, 1-8 (236)	288	2-3 (1)	79
Sex ratio: Hatchlings	Table 5	309-313, 766	n/a		n/a		n/a		n/a	
Sex ratio: Immatures	Table 5	233, 314-317	Table 5	318-320	n/a		Table 5	279, 321-322	Table 5	281, 283
Sex ratio: Adults	Table 5	323-324	Table 5	325	n/a		n/a		n/a	
Minimum adult size (cm): minimum observed value (see text of acronyms)	SCL: 68.1	15, 235, 293, 300, 326-333, 767-770	SCL: 81.4	15, 740, 742, 763, 767, 771-773	CCL: 118.9	334-335	SCL: 55.7; CCL: 58.5	336-337	SCL: 80.0	79
Age at maturity (yrs): mean, range of values	33.6, 12-50.8	326, 328, 330, 338, 774-777	27.5, 15-44.5	330, 339-343	19, 13-28	334	14.1, 9.7-22.8	336-337, 778	15-25	779
Clutch size (number of eggs/nest): overall mean, range of means, range (number of nests)	113.7, 71-149, 6-198 (>119,000)	7-8, 30, 33-34, 42, 47, 105, 119, 201, 290, 293, 295, 297, 300, 344-356, 756, 761, 780-784, 959	124.7, 113-135, 58-199 (>2,500)	7-8, 290, 344, 740, 742, 763-764, 780-781	77.3, 72-83.4, 34-103 (>660)	7-8, 66, 344, 357-358, 780-781	96.9, 96.7-97.1, 2-142 (2,202)	288, 344, 785	135, n/a, 96-206 (6)	77-79
Emergence success (hatchlings/egg): overall mean, range of means, range (number of nests)	0.64, 0.10-0.95, 0.0-1.0 (>38,000)	8, 19, 30, 38, 42, 46-47, 105, 201, 290, 296-	0.64, 0.47-0.93, 0.0-0.93 (>5,600)	8, 19, 290, 307, 344, 359-360, 740, 742, 763, 781	0.50, 0.37-0.72, 0.0-0.93 (881)	8, 344, 357-358, 781	0.83, 0.63-0.98, 0.0-1.0 (4,816)	75, 288, 344, 785, 787	0.58, n/a, 0.29-0.71 (4)	77-79

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
		297, 344-345, 350, 354-355, 359-365, 781, 783, 786, 959								
Nesting success (nest/crawl): overall mean, range of means, range (number of events)	0.53, 0.20-0.90, n/a (>16,000)	7, 12, 20, 38, 41-42, 293, 303, 346, 351, 359-361, 366-367, 739, 783, 788	0.48, 0.42-0.53, 0.29-0.64 (>1,700)	7, 12, 20, 359-360, 742, 788	0.67 (111)	7, 788	n/a		n/a	
Trends										
Recent trends (last 20 yrs) at nesting sites [range of years]	*Stable [1989-2018], ** Up [1983-2019], +1.3%/yr	*27 (Florida only), 368 (Florida only), **789 (Northern Recovery Unit only)	*Up [1989-2017], +75.71%/yr	*287, 368	*Up [1979-2008], +10.2%/yr; **Up [1989-2017], 7.12%; ***Up [1990-2017], Down (n.s.) [2008-2017]	*67, **369, ***790	Up [1978-2014]	288	n/a	
Recent trends (last 20 yrs) at foraging grounds [ranges of years]	Up [1995-2009; 2000-2011; 2011-2012; 1982-2006]	96, 174, 194, 370	Up [1995-2009; 1982-2006; 1991-2010]	174, 253, 370	n/a		Up [1995-2009; 1991-2013]	174, 371	n/a	

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Oldest documented abundance (nests/yr): mean [range of years]	*60,768 [1989-1993]; **65,632 [1989-1993]	*287 (FL); **287 (NC-FL)	201 [1979-1983]	287	*31 [1979-1983]; **51 [1989-1993]	*287, **369	4 [1995]	70	n/a	
Published studies										
Growth rates	Yes	15, 177, 196-197, 237, 326, 328, 330, 338, 342, 372-378, 791	Yes	248, 251, 318, 330, 342-343, 379-381, 792	Yes	334, 382, 759, 778, 793	Yes	177, 336, 383-386, 779	Yes	280, 283, 286
Genetics	Yes	52, 195, 387-400, 502, 736, 845, 960-962	Yes	59-60, 124, 387-388, 401-405, 741, 750, 960, 963-964	Yes	160, 164, 387-388, 406-407	Yes	70, 387-388, 965-966	Yes	387-388, 852
Stocks defined by genetic markers	Yes	408-413	Yes	243, 408, 414, 967	Yes	408, 415	Yes	408, 416	Yes	408, 852
Remote tracking (satellite or other)	Yes	37, 54, 98, 103-107, 109-113, 115, 117, 120, 180, 192-193, 201, 204-206, 209, 211-213, 223-224, 226-227, 230-231,	Yes	122, 180, 252, 306, 417, 432-437, 735, 757, 794-801, 828-830	Yes	128, 131, 133-134, 136, 139-140, 149-151, 155, 162, 438-446, 749, 802-806, 831	Yes	122, 180, 260, 262-263, 265-267, 271-272, 274, 276-277, 308, 417, 432-433, 447-453, 735, 753, 758, 794-799, 807-	Yes	283-285, 794-795

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
		234-235, 305, 331, 417-431, 734-735, 745-746, 753-756, 794-827						813, 828, 832-835		
Survival rates	Yes	32, 117, 198, 229-230, 297, 300, 454-462	No	n/a	Yes	65	Yes	178, 463-465	No	n/a
Population dynamics	Yes	30, 38, 42, 289, 299, 368, 370, 457, 460, 466-474, 731, 734-735, 737, 739, 752-756, 780, 799, 836, 838-845, 864	Yes	253, 256, 368, 370, 466-468, 475, 731, 735, 750, 752, 757, 780, 794, 799, 836, 838-843, 846, 864	Yes	65, 67, 368, 731, 748, 780, 836, 838, 847-849, 864	Yes	70, 288, 368, 371, 381, 464-467, 476-482, 735, 750, 752-753, 759, 778, 799, 834, 836, 839-842, 850-851, 864	Yes	750, 794, 836, 838-839, 852, 864
Foraging ecology (diet or isotopes)	Yes	50, 86, 103-105, 112-116, 118-119, 121, 201, 203, 208, 222, 237, 431, 483-491, 853-854	Yes	86, 173, 247, 249-250, 252, 492-494, 855-861	Yes	135, 143, 146, 165-166, 495-497	Yes	86, 266, 270, 273, 275, 483-485, 498-500, 759	Yes	191, 285

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Capture-Mark-Recapture	Yes	32, 38, 52, 174, 178, 193, 196-198, 229-230, 297, 299-300, 328, 338, 370, 378, 458-459, 461, 466, 501-502, 736, 750-751, 839	Yes	174, 178, 248, 251, 256, 341, 370, 379, 459, 466, 503, 741, 750-751, 839	Yes	65, 164	Yes	68, 174, 178, 261, 272, 288, 370-371, 466, 750, 793, 839	Yes	283, 286, 370, 750, 839, 863
Threats										
Bycatch: presence of small scale / artisanal fisheries?	No	n/a	No	n/a	No	n/a	No	n/a	No	n/a
Bycatch: presence of industrial fisheries? (PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multispecific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net; OTH: Other, *see text*)	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 90, 93-94, 102, 174, 183, 219-220, 466, 504-508, 864-871	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 174, 466, 504-508, 864-866	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 90, 93-94, 144, 504-507, 864-868	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 174, 220, 466, 504-508, 864-867	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 504-505, 864-865

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Bycatch: quantified? (codes as above)	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 90, 93-94, 102, 174, 183, 219-220, 466, 504-508, 872	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 174, 466, 504-508, 872	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 90, 93-94, 144, 504-507	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 174, 220, 466, 504-508, 872	Yes (PLL, DLL, SN, DN, ST, MT, FP, PN, OTH)	81, 504-505
Intentional killing or exploitation of turtles	No	n/a	No	n/a	No	n/a	No	n/a	No	n/a
Take. Illegal take of turtles	No	n/a	No	n/a	No	n/a	No	n/a	No	n/a
Take. Permitted/legal take of turtles	No	n/a	No	n/a	No	n/a	No	n/a	No	n/a
Take. Egg poaching	No	n/a	No	n/a	No	n/a	No	n/a	No	n/a
Take. Permitted/legal take of eggs	Yes	52, 736	No	n/a	No	n/a	No	n/a	No	n/a
Coastal Development. Nesting habitat degradation	Yes	6, 11-12, 359, 367, 509-512, 731-732	Yes	6, 11-12, 359, 509-510, 731-732	Yes	6, 11-12, 509, 731-732	Yes	6, 72, 732	No	n/a
Coastal Development. Photopollution	Yes	6, 9, 13, 366, 511-519, 873	Yes	6, 9, 13, 513-514, 873	Yes	6, 9, 13, 873	Yes	6	No	n/a
Coastal Development. Boat strikes	Yes	520-522, 874-877	Yes	520, 874-875	Yes	520, 874	Yes	520, 874	Yes	520, 874
Egg predation	Yes	7-8, 19, 31, 293, 303, 344, 355, 364, 523-553, 761, 784, 786, 843, 878, 959	Yes	7-8, 19, 344, 523-537, 742	Yes	7, 344, 523-529	Yes	75, 787	Yes	523

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Pollution (debris, chemical)	Yes	43, 54, 85, 121, 188, 202, 226, 374, 486, 554-588, 747, 879-893	Yes	85, 319, 554-562, 589-595, 879-885	Yes	358, 554-556, 596-599, 894	Yes	85, 188, 266, 275, 480, 554-560, 563-564, 589-590, 600-601, 785, 879-887, 895	Yes	85, 554-559, 879-882, 885
Pathogens	Yes	245, 553, 575, 602-631, 896-901	Yes	245, 602-617, 632-665, 896-912	Yes	602-604, 666-668, 896	Yes	602-608, 618-619, 632, 669-673, 896-898, 913	Yes	602-605, 896-897
Climate change	Yes	21, 46, 49, 309, 315, 674-685, 731-732, 914-918	Yes	21, 674-676, 686-687, 731-732, 764, 914	Yes	674-678, 688-698, 731-732, 760	Yes	72, 674-675, 677, 690, 732, 919-920	Yes	674-675, 686, 732
Foraging habitat degradation	Yes	54, 186, 560, 921-925	Yes	560, 691, 921-924, 926	Yes	921-924	Yes	186, 266, 560, 692, 758, 921-926	Yes	921-925
Other (HAB - harmful algal blooms)	Yes	575, 693-697, 927-928	Yes	632, 693-694, 698, 927-928	No	n/a	Yes	632, 693-694, 698, 927-928	Yes	693, 927
Long-term projects (>5yrs)										
Monitoring at nesting sites [range of years]	Yes [1979-present]	27, 699	Yes [1979-present]	287	Yes [1979-present]	67, 287	Yes [1986-present]	288	Yes [1979-present]	80
Number of index nesting sites	78	699	n/a		n/a		n/a		n/a	

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Monitoring at foraging sites [ranges of years]	Yes [1995-2009; 2000-2011; 2011-2012; 1982-2006; 2003-2012]	96, 173-174, 194, 370	Yes [1995-2009; 1982-2006; 1991-2010; 2003-2012]	173-174, 253, 370	n/a		Yes [1995-2009; 1991-2013]	174, 371	Yes [2003-2012]	173
Conservation										
Protection under national law	Yes	Table 3	Yes	Table 3	Yes	Table 3	Yes	Table 3	Yes	Table 3
Number of protected nesting sites (habitat preservation) (% nests)	not published	n/a	not published	n/a	not published	n/a	not published	n/a	not published	n/a
Number of Marine Areas with mitigation of threats	not published	n/a	not published	n/a	not published	n/a	not published	n/a	not published	n/a
Number of long-term conservation projects [range of years]	not published	n/a	not published	n/a	not published	n/a	not published	n/a	not published	n/a
In-situ nest protection (e.g., cages)	Yes	7, 31, 55, 344-345, 355, 364, 526, 529, 533, 535-536, 538, 545, 548-549, 553, 700-708, 739, 775, 782, 784, 786, 929-940, 959	Yes	344, 536, 933-934, 943	Yes	344, 933-934, 946	Yes	787, 947	Yes	948
Hatcheries	Yes	709, 775	Yes	943	No	n/a	Yes	75, 288, 947	Yes	948

RMU	CC-NW ATL	Ref#	CM-NW ATL	Ref#	DC-NW ATL	Ref#	LK-NW ATL	Ref#	EI-ATL W. CAR	Ref#
Head-starting	No	n/a	Yes	341, 710	No	n/a	Yes	68-69, 74-76, 464, 481, 711-728, 947	No	n/a
By-catch: fishing gear modifications (e.g., TED, circle hooks)	Yes	93, 172, 729, 949-955	Yes	93, 949-953	Yes	93, 949-950, 954-955	Yes	93, 949-955	Yes	93
By-catch: onboard best practices	Yes	730, 956	Yes	730, 956	Yes	730, 956	Yes	730, 956	Yes	730, 956
By-catch: spatio-temporal closures/reduction	Yes	957	No	n/a	No	n/a	No	n/a	No	n/a

Table 2. Sea turtle nesting beaches in the U. S. (blank)

Table 2. Nesting sites. Left blank; only peer reviewed publications and books were included in the 2020 Report.

Table 3. International conventions protecting sea turtles and signed by the U. S.

Table 3. Conventions. International conventions protecting sea turtles in the United States. (CC = *Caretta caretta*, CM = *Chelonia mydas*, DC = *Dermochelys coriacea*, EI = *Eretmochelys imbricata*, LK = *Lepidochelys kempii*, LO = *Lepidochelys olivacea,* ND = *Natator depressus*).

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES)	Y	Y	Y	CC, CM, EI, LK, DC, LO	Ensures that the international trade in wild animal and plant specimens does not threaten their survival.	All species are listed in Appendix 1.
Convention on Wetlands of International Importance (Ramsar)	Y	N	N	CC, CM, EI, LK, DC, LO	Halt the worldwide loss of wetlands and ensure their proper, sustainable use and management,	Sea turtles not specifically covered by Ramsar, but as existing and potential Ramsar sites are used by sea turtles for nesting and foraging, Ramsar and the IAC entered into a MOU to collaborate and designate Ramsar sites with an eye towards conservation of all sea turtle species.
Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA Marine Turtles; under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals)	Y	N	Y	CC, CM, EI, LK, DC, LO, ND	IOSEA Marine Turtles puts in place a framework through which States, territories, inter- and non-governmental stakeholders of the Indian Ocean and South-East Asian region, as well as other concerned States, can work together to conserve marine turtle populations and their habitats for which they share responsibility. This objective can be achieved most effectively through the collective implementation of the IOSEA Conservation and Management Plan (CMP).	All species are foci of management plan.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	Y	Y	Y	CC, CM, EI, LK, DC, LO	Members must: prohibit deliberate "take" of sea turtles or their eggs (e.g., intentional capture, retention or killing of, and domestic trade in, sea turtles, their eggs, parts or products); comply with the Convention on International Trade in Endangered Species; implement appropriate fishing practices and gear technology to reduce bycatch and entanglement of turtles in all relevant fisheries; use turtle excluder devices on shrimp trawl vessels; designate protected areas for critical turtle habitat; restrict human activities that could harm turtles; promote of sea turtle research and education.	Six species are protected under the IAC.
Endangered Species Act (ESA)	Y	Y	Y	CC, CM, EI, LK, DC, LO	The purpose of the ESA is to protect and recover imperiled species and the habitats upon which they depend. The law provides for listing species as endangered or threatened and designating critical habitat, developing and implementing recovery plans for listed species, developing and implementing regulations to protect listed species, developing cooperative agreements with and providing grants to states for species conservation, consulting on any federal actions that may affect a listed species to minimize	Six species are listed under the ESA.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
					the effects of the action, partnering with other nations to ensure that international trade does not threaten species, investigating violations of the ESA, cooperating with non-federal partners to develop conservation plans for the long-term conservation of the species.	

Table 4. Projects and databases on sea turtles in the U. S. (blank)

Table 4. Projects and databases. Left blank; only peer-reviewed journal publications and books were included in the 2020 Report.

Table 5. Sex ratios

Table 5. Sex ratios. Published estimates for sex ratios for each species of sea turtle in the U.S. and relevant life stage (hatchling, immature, adult). Each entry represents a different location.

Life stage	**Species**	**Sex Ratio: Females / Total (nests)**	**Sex Ratio: Females / Total (individuals)**	**Ref#**
Hatchling	Loggerhead turtles	0.58 (24)		309
Hatchling	Loggerhead turtles	0.67 ± 0.40 (212)	0.67 ± 0.40 (669)	310
Hatchling	Loggerhead turtles	0.99 (46)	0.95–0.99 (458)	311
Hatchling	Loggerhead turtles	0.72 (30)	0.87–0.89 (298)	311
Hatchling	Loggerhead turtles	0.56 (38)		312
Hatchling	Loggerhead turtles	0.91–0.95 (20)	0.91–0.95 (204)	313
Hatchling	Loggerhead turtles	0.65–1.00 (82)	0.65–1.00 (708)	313
Hatchling	Loggerhead turtles	0.00-1.00 (39)	0.00–1.00 (351)	766
Immature	Loggerhead turtles		0.75 (946)	315
Immature	Loggerhead turtles		0.74 (270)	316
Immature	Loggerhead turtles		0.68 (89)	316
Immature	Loggerhead turtles		0.71 (170)	233
Immature	Loggerhead turtles		0.68 (218)	317
Immature	Loggerhead turtles		0.68 (1349)	314
Adult	Loggerhead turtles	0.37 (72)	0.37 (1282)	323
Adult	Loggerhead turtles	0.40 (51)	0.40 (989)	324
Immature	Green turtles		0.71 (434)	318
Immature	Green turtles		0.77 (51)	319
Immature	Green turtles		0.61 (44)	320
Adult	Green turtles		0.66 (15)	325
Immature	Kemp's ridley turtles		0.79 (42)	321

Immature	Kemp's ridley turtles		0.59 (39)	322
Immature	Kemp's ridley turtles		0.66 (87)	279
Immature	Hawksbill turtles		0.70 (64)	281
Immature	Hawksbill turtles		0.77 (30)	283

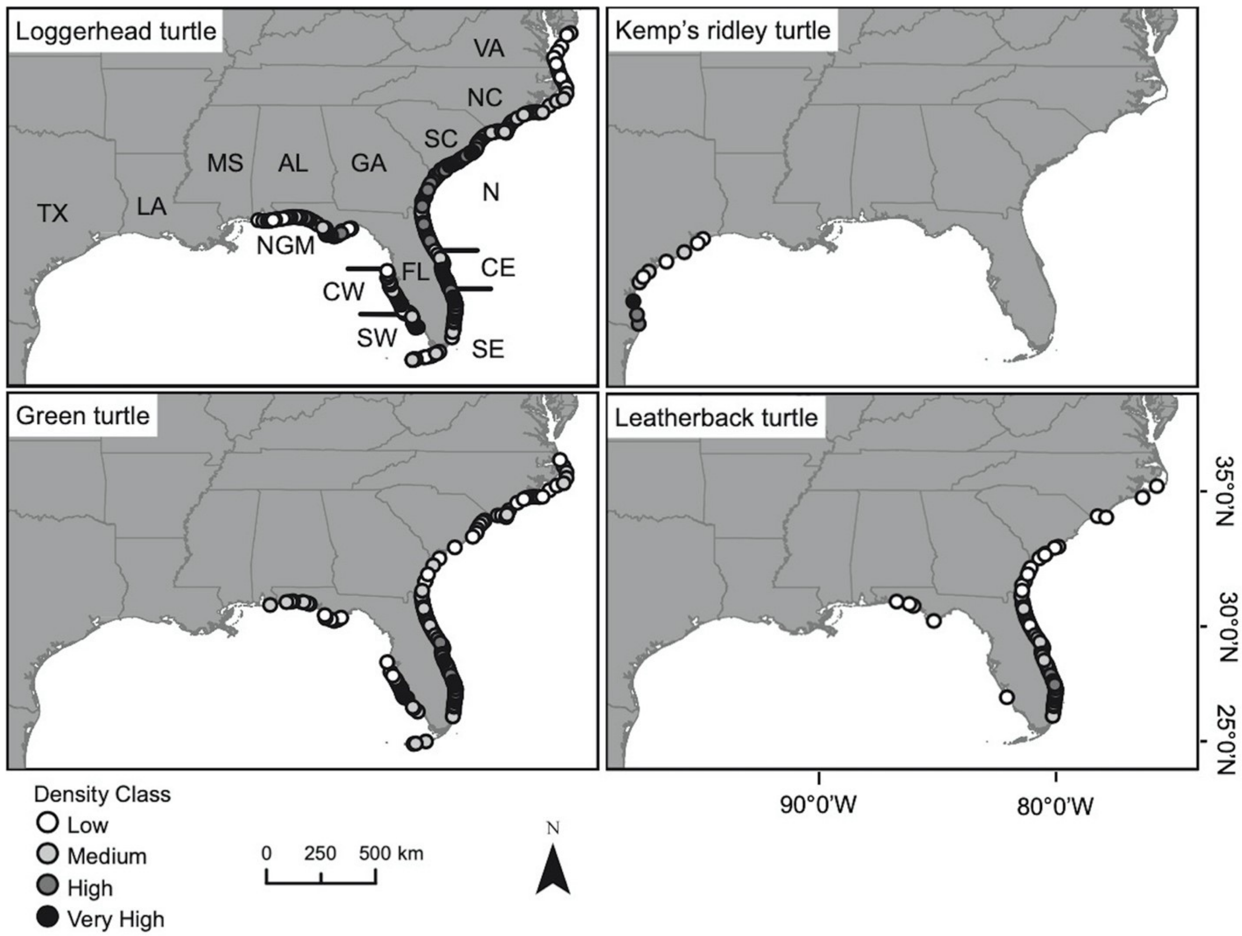

Figure 1. Nesting sites. Nesting sites for sea turtles in the United States modified from Fuentes et al. (2016; Ref# 6). Hawksbill turtles are not represented as their nesting is rare, sporadic, and almost exclusively in southeast Florida.

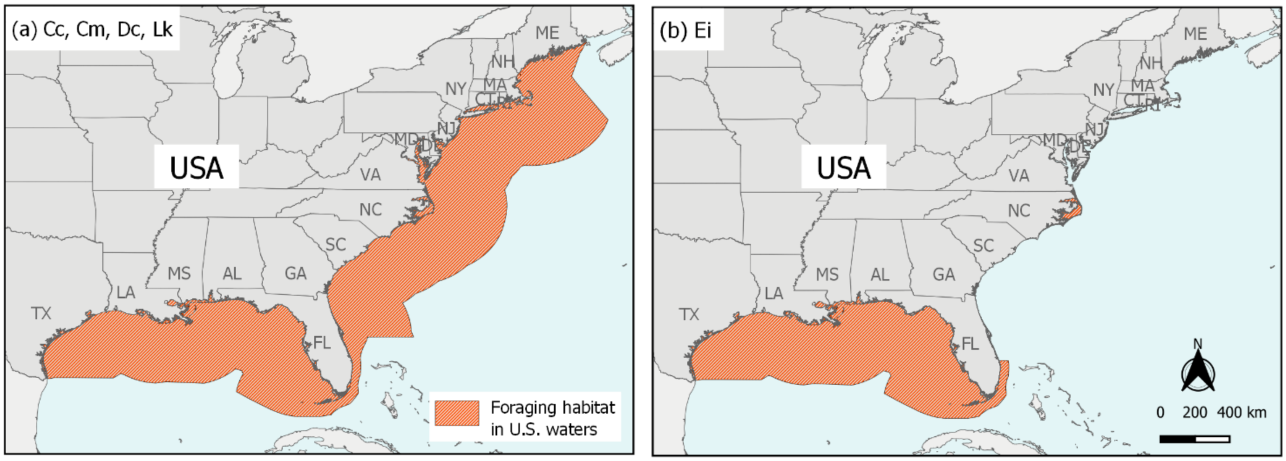

Figure 2. Foraging habitat. Potential foraging habitat (neritic and/or oceanic) for sea turtles in the continental United States delimited by EEZ boundaries. Cc = *Caretta caretta*, Cm = *Chelonia mydas*, Dc = *Dermochelys coriacea*, Lk = *Lepidochelys kempii,* Ei = *Eretmochelys imbricata*.

Venezuela

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There are five species of sea turtles in Venezuela, grouped into six different Regional Management Units (RMUs) following the definition by Wallace et al. 2010. Two RMUs for green turtle (*Chelonia mydas*, rmu47: Southern Caribbean; and rmu50 North-western Atlantic), and one RMU for each of the remaining species: hawksbill turtle (*Eretmochelys imbricata*, rmu10: Western Atlantic); loggerhead turtle (*Caretta caretta*, rmu25: North Atlantic); leatherback turtle (*Dermochelys coriacea*, rmu51: North Atlantic) and olive ridley turtle (*Lepidochelys olivacea*, rmu02: Western Atlantic). Regular nesting events are registered for the four first species, only Olive ridley turtles have not been verified to nest along the Venezuelan coast (4,10) (Figure 20.1). The technical information contained in this report has been analysed by species according to the widely distribution area of each RMUs.

1 Distribution, abundance, trends.

1.1.1. Nesting sites

Nesting values reported in this section should be considered with caution, given that reporting periods for each project might differ and thus might not be comparable at a regional scale (i.e. if values reported from one project cover the period 2000-2010, and another one 2015-2020).

1.1.1.a North Western Atlantic (Cm-RMU 50)

Nesting activity of green turtles has only been recorded in one beach, Aves Island, which is considered an Index Nesting Beach (INB) for the Caribbean Sea with up to 3000 nest each year (1,2,3,4,17). The nesting population at Aves island has increased during the past 30 years from approx. 500 to >1000 nesting females in 2009 (1,2,4). (Table 1). However, due to its low survival rate (0.79, 95% CI=0.73-0.84) these recovery numbers need to be considered with caution (1,2).

1.1.1.b Southern Caribbean (Cm-RMU 47)

Green turtle nesting beaches are widely distributed along continental Venezuela as well as the insular complex, from Peninsula of Paraguaná (western coast) to Peninsula of Paria (eastern coast) (12, 20, 25, 28, 35,43,44, 45, 51). There is a total of 08 beaches that have been and/or are currently being monitored, but there are additional nesting beaches that have not been systematically recorded in the literature and thus are not included in this report. The largest number of nests in this RMU was reported for the period 2001-2006 for Archipiélago Los Roques National Park, with an average of 72.7 nest/year (51); there are no recent nest counts for this area. Up to 2019, the remaining of the beaches along the country received a very low number of nests with a range of 0.5 –6.2 nest/year (25,27,26,34,46,48,43,44,45,54) (Table 20.1). To date, there are no estimates of population trends in the number of annual females.

1.1.1.c Western Atlantic (Ei-RMU 10)

Hawksbill turtle nesting beaches are widely distributed along continental Venezuela as well as the insular complex, from the Gulf of Venezuela (western coast) to Peninsula of Paria (eastern coast) (21,25,27,26,30,34,35,41,46,48,50,51,55,56, 57).There is a total of 16 beaches that have been and/or are currently being monitored, but there are additional nesting beaches that have not been systematically recorded in the literature and thus are not included in this report. The number of nests is very variable along the coast with an average of 27.6 nest/year (range 5-167.7). Between 2001-2006 Los Roques National Park recorded the highest number of nests per year for the species (N = 167.7 nest/year; relative density =3.8 nest/km). The highest densities of nests in the country were reported for the Gulf of Paria during the period 2009-2017 in Silvano (25.4 nests/years; relative density = 254 nests/km), Los Garzos (N = 60.4 nests/years; relative density = 201 nests/km) and Macurito (N = 29.8 nests/years; relative density = 149 nests/km) beaches (Table 20.1). Despite holding the highest relative nest densities in the country, the nesting population at Gulf of Paria showed a decreasing trend from 2009 to 2017 (21).

1.1.1.d North Atlantic (Cc-RMU 25)

Loggerhead turtle nesting beaches are widely distributed along continental Venezuela as well as the insular complex including Ensenada de Malimansipa (Gulf of Venezuela), Peninsula of Paraguaná, central coast of Venezuela, Archipiélago Los Roques National Park, Peninsula of Paria and Margarita Island, (25,27,28,29,30,31,33,34,35,41,43,44,45,46,48,51). There is a total of 12 beaches that have been and/or are currently being monitored, but there are additional nesting beaches that have not been systematically recorded in the literature and thus are not included in this report. The number of nests is variable among nesting beaches with an average of 8.6 nest/year (ranging between2 - 12.67).Between 2001-2006, Archipiélago Los Roques National Park held the largest number of nests in this RMU (51,52,53,54) per year. Other locations reporting more than 10 nests per year include Querepare and Cipara beaches in Gulf of Paria, Cuyagua beach in Aragua state (14nests/year) and El Codo-La Bocaina in Península of Paraguaná (11 nests/year in 2010) (43,44,45) (Table 20.1).

1.1.1.d North Atlantic (Dc-RMU 51)

Leatherback turtle nesting beaches are widely distributed along continental Venezuela as well as the insular complex, including the Ensenada de Malimansipa (Gulf of Venezuela), Peninsula of Paraguaná, central coast of Venezuela, Archipiélago Los Roques, Complejo Insular La Tortuga, Margarita Island, Peninsula de Paria and Gulf of Paria (21,30,31,32,33,34,40,41,46,48,50,51,55,56,57). There is a total of 20 beaches that have been and/or are currently being monitored, but there are additional nesting beaches that have not been systematically recorded in the literature and thus are not included in this report. The number of nests is very variable among nesting beaches with an average of 22.4 nest/year (range 1-234.8). Between 1999-2014, Margarita Island recorded an average of 234.8 nests/year. Nesting populations from two of the main nesting beaches northern Peninsula of Paria appear to have slightly increased during the first years of the project (41), but when the nest data are analyzed in the period 1990-2017 (Cipara Beach) and the period 2008-2017 (Querepare Beach) (38,39) the trend is negative, as well as it is for the main part of the Wider Caribbean region (40,41) and these beaches are having less than 100 nests/year since 2017. In the beaches of Sotillo and Puy Puy in Peninsula of Paria the population has decreased by 40% (information published in this report). Likewise, in the Gulf of Paria the population has decreased from 2009 to 2017 (21).

1.1.2. Marine areas

Venezuela is located in the southern region of the Caribbean Sea and the continental shelf provides foraging habitat, mating areas, and migratory corridors for all five species of sea turtles that occur in the country(2,4, 6,8,11,12,13,14,15,18,25,27,28,31,46,47,48,54,65)(Figure 20.1). The shallow bathymetry in the Gulf of Venezuela (western coast of continental Venezuela) offers resources to support foraging marine turtle populations all year-round in the area (11,1,9,65), and there is genetic evidence that it provides habitat for multiple RMUs of green turtles (rmu47: Southern Caribbean; and rmu50 North-western Atlantic) (9,65). In addition, the Gulf of Venezuela is likely to support regionally valuable habitats for the other species of marine turtles from the Caribbean and Atlantic Ocean RMUs (6,8,11,13,65), including hawksbill turtles (rmu10: Western Atlantic); loggerhead turtles (rmu25: North Atlantic); leatherback turtles (rmu51: North Atlantic), olive ridley turtle (rmu02: Western Atlantic).Aves Island Wildlife Refuge is also one of the few areas in the world where male green turtles can be found in large courtship and mating aggregations in shallow and clear waters (2)(Figure 20.2).

1.2 Other biological data

Emergence success has been recorded in Venezuela for loggerhead, hawksbill and leatherback turtles (Table 2a), but not for other species.

1.3 Threats.

1.3.1 Nesting sites.

See Table 3a.

1.3.2 Marine areas.

Marine turtles in Venezuela face many threats within marine habitats (1,2,3,4,5,6,12,14,16,18,19,20,21,22,23,24,25,26,27,28,29, 30,31,37,39,41,43,44,45,47,48,52,55,58,60,62,63). (6) identified and summarised human-induced threats to foraging sea turtles in the Gulf of Venezuela in four categories: (a) commercial marine traffic; (b) potential expansion of gas and oil extraction activities; (c) illegal trade of marine turtle products and sub-products (7,8); (d) unregulated use of marine turtle for traditional purposes (6, 9, 66). Although (6) focused in the Gulf of Venezuela region, due to the similarities in general terms among the feeding grounds in the country, it is likely that similar pressures also occur in other foraging areas (See details in 6). Venezuela's oil production activities may have an impact in the feeding grounds as consequence of the high shipping intensity, with some of the busiest commercial maritime transport routes in the

Southern Caribbean. Although oil and gas activities have decreased steeply in the country over the last decade, projected oil and gas extraction zones in critical feeding habitats of all the marine turtle species registered in the country may have an impact in the future (6). Extensive use by local community members is likely to represent the biggest impact to their development in waters of the Gulf of Venezuela (6,7,8,9,20,66). Commercial and unregulated artisanal fisheries based on the use of marine turtles in the Western of the country (for both cultural and subsistence purposes) may act as a 'sink' for marine turtle populations from multiple areas in the Caribbean and the Atlantic (6,11,12,20, 65,66, 67). The take of marine turtles in the Gulf of Venezuela has been quantified at 3,649 ± 434 green turtles per year in the Upper Guajira region (9, 11), plus 359.04 turtles per year in the Kazuzain artisanal port (Middle Guajira region) (12) (Table 20.3a, 20.3b, 20.3c, 20.3d, 20.3e). Incidental catch in the artisanal fisheries must be assessed throughout the country; for instance, in the Peninsula of Paria incidental catch was estimated at over 1500 turtles/year(mainly the green turtle) (41),and these numbers must be updated.

1.4 Conservation

Management of the human and environmental pressures that affect sea turtles and their habitats in the country is hampered by a general lack of knowledge concerning marine turtle population biology and their in-water habitat preferences (4, 64). As of June 2020, there are 5 ongoing conservation projects (Table 4).

In particular in the Gulf of Venezuela, although the Wayuú people's use of turtles would be classed as illegal under wildlife protection legislation, Venezuela also has national legislation aimed at protecting the rights of Indigenous peoples and their tribal communities. This legislation states that the Venezuelan Indigenous people have rights to use the regions natural resources, especially resources occurring within the ancestral territories (Venezuela, 2005). In addition, there is an International treaty signed and ratified by the Venezuela Government to protect the traditional use of natural resources within Venezuela: Indigenous and Tribal Peoples Convention) (ILO, 1989) and the Inter-American Convention for the Protection and

Conservation of Sea Turtles (IAC 1996[147]) (Table 5). Thus, it could be perceived that there is a conflict of legislation and/or policy (9,68), and progressing conservation initiatives for marine turtles in Venezuela and the southern Caribbean requires alignment of conservation and traditional goals of the indigenous people and the local Government (64,68).

The following is a list of some of the most pressing conservation strategies in the country, as identified by the authors of this report from the current available literature and previous conservation initiatives implemented in the country:

Follow up previous cross-sectional studies where community-based conservation were implemented (e.g. Venezuelan portion of the Guajira Peninsula).

Update and assess sea turtle conservation success indicators which are available for multiple projects, to understand the current situation in the conservation of marine turtles in Venezuela.

Environmental education at all levels: formal education institutions, informal talks with local fishers, social media awareness, among other stakeholders.

Continue efforts on formal training in basic marine turtle biology and identification including students, local community members, general public, environmental practitioners, researchers, managers, law enforcement authorities, and other personnel based on marine protected areas, traffic routes, and marine and artisanal ports.

Empowering local communities who have participated in the past in marine turtle conservation activities. Increasing their capacity, training, leadership, and key-roles in conservation.

Increase and improve surveillance and enforcement capacity at nesting beaches and foraging areas.

Following the IAC guidelines, enforce the institutional relationships between the governmental institutions responsible by environmental and fisheries issues, as well as between them and the academic institutions and NGOs making sea turtle research and conservations, in order to mitigate the issues related with the bycatch in the different fisheries in the country.

Continue efforts on formal training for treatments stranded, injured or sick animals (Fibropapillomatosis and others)

1.5 Research

Most efforts in the country have focused on monitoring and conservation of sea turtles, and limited published studies on research topics exist to date and have focused mainly on green turtles (see Table 5a, 5b for details). The following is a list of some of the most pressing research gaps in the country, as identified by the authors of this report from the gaps in current available literature:

Genetic characterization of nesting population and foraging stocks of all species (excepting green turtles in Aves Island and Gulf of Venezuela)

In-water distribution and habitat use of all species, including establish indicators for climate change impacts in these areas.

Quantifying the impact of shipping, anchoring, destruction of benthic habitats and discharge of waste (associated with the oil and gas exploitation) on the populations of marine turtles.

Evaluating the rate of sea turtle bycatch in artisanal fisheries in nesting and feeding areas.

Evaluate the intentional catch of sea turtles in other key feeding areas, such as the Peninsula of Paraguaná, Morrocoy and Archipelago Los Roques National Parks.

The degree of connectivity among nesting sites within the country and with other Caribbean subpopulations.

Stable isotopes analysis to construct animal diets, elucidate trophic level and body condition, and to determinate feeding habits.

Characterizing male migration patterns, operational sex ratios and estimating effective population size of breeding populations.

Exploring the pre- and post-reproductive tracking of breeding turtles using satellite tracking.

Prevalence of fibropapillomatosis in the green turtle population of the Gulf of Venezuela (Zulia and Falcon States).

Evaluate the presence of microplastics in several index beaches and feeding areas in Venezuela.

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Table 1. Biological and conservation information about sea turtle Regional Management Units in Venezuela.

Nesting activity (nest/year) off our sea turtles species *C. mydas* (Cm), *E. imbricata* (Ei), *C. caretta* (Cc) and *D. coriacea* (Dc) along the coast of Venezuela (continental and insular complex) in the Caribbean Sea. We also include the length of the beaches, the coordinates and the monitoring level and protocol implemented based on Data Standards for Nesting Beach Monitoring by SWOT).

RMU / Nesting beach name	**Index site**	**Nests/yr: recent average (range of years)**	**Central**	**Point**	**Length (km)**	**% Monitored**	**Reference #**	**Monitoring Level (1-2)**	**Monitoring Protocol (A-F)**
CM-RMU 50			Long	Lat					
Isla de Aves	Y	up to 3000	-63.61	15.67	0.53	100	1,2	1	B
CM-RMU 47									
Aragua State	N	1.5(2010-2012)	-67.55	10.52	6.00	75	25,27,28,35	2	A
Playa Querepare	Y	<25 (2002-2020)	-62.88	10.70	>1.8	100	40, 41	1	B
Playa Cipara	Y	<25 (1999-2020)	-62.88	10.70	>2.06	100	40,41	1	B
Carabobo State	N	0.50 (2008-2014)	-67.55	10.52	9.95	100%	46,47,48		
El Codo-La Bocaina Península of Paraguaná	N	6 (2010)	-69.81	11.86			43,44,45		

Archipiélago de Los Roques National Park	N	72.67 (2001-2006)	-66.7	11.82	25	100%	51,53,54		
EI-RMU 10									
Ensenada de Malimansipa (Gulf of Venezuela)	N	up to 10	-71.34	11.82	2.09	100	10	2	A
Playa Macurito	Y	29.8 (2009-2017)	-61.92	10.66	0.2	100	21		B
Playa Los Garzos	Y	60.4 (2009-2017)	-61.88	10.69	0.3	100	21		B
Playa Silvano	Y	25.4 (2009-2017)	-61.88	10.71	0.1	100	21		B
Aragua State	N	2.5(2010-2012)	-67.55	10.52	6	75%	25,27,28,35	1	A
Playa Grande	Y	0.5(2014)	-67.60	10.51	0.704	100%	30,35	1	B
Playa Cuyagua	Y	0.5(2013-2014)	-67.69	10.50	1.376	100%	30,34,35	1	B
Playa Querepare	Y	<25 (2002-2020)	-62.88	10.70	>1.8	100%	40,41	1	B
Playa Cipara	Y	<25 (1999-2020)	-62.70	10.70	>2.06	100	40,41	1	B
Carabobo State	N	19.33 (2008-2014)	-67.55	10.52	14.74	100%	46,47,48		
Complejo Insular La Tortuga	N	64.5 (2008-2009)	-65.3	10.93	24.4	100%	50		
Archipiélago de Los Roques National Park	N	167.67 (2001-2006)	-66.7	11.82	43.75	100%	51,53,54		
Isla Margarita	N	15.50 (1999-2014)	-64.05	10.96	n/a	50%	1,2,3		
El Codo-La Bocaina Peninsula of Paraguaná	N	40 (2010)	-69.81	11.86			43,44,45		

Cc RMU 25									
Ensenada de Malimansipa (Gulf of Venezuela)	N	up to 10	-71.34	11.82	2.09	100	10	2	A
Playa Puy puy	Y	Up to 5 (2015-ongoing)	-62.97	10.70	1	100%		1	B
Playa Chaguarama de Sotillo	Y	Up to 15 (2017-ongoing)	-62.99	10.71				2	B
Aragua State	N	4(2010-2012)	-67.55	10.52	6	75%	25,27,28,29,30,31,33,34,35,69	2	n/a
Playa Grande	Y	3 (2014)	-67.60	10.51	0.704	100%	30,34	1	B
Playa Cuyagua	Y	14(2013-214)	-67.69	10.50	1.376	100%	30,34	1	B
Playa Querepare	Y	100-500 (2002-2016) 25-100 (2002-2020)	-62.88	10.70	>1.8	100%	40,41	1	B
Playa Cipara	Y	100-500 (2002-2016) 25-100 (2002-2020)	-62.70	10.70	>2.06	100	40,41	1	B
Carabobo State	N	2.50 (2008-2014)	-67.55	10.52	12.69	100%	46,47,48		
El Codo-La Bocaina Península of Paraguaná	N	11 (2010)	-69.81	11.86			43,44,45		

Archipiélago de Los Roques National Park	N	12.67 (2001-2006)	-66.7	11.82	18.75	100%	51,53,54		
Dc RMU 51									
Ensenada de Malimansipa (Gulf of Venezuela)	N	up to 10	-71.34	11.82	2.09	100	10	2	A
Playa Los Garzos	Y	18.4 (2009-2017)	-61.88	10.69	0.3	100	21		B
Playa Puy Puy	Y	Up to 35 (2015-ongoing)	-62.97	10.7	1.0	100%		1	B
Playa Chaguarama de Sotillo	Y	Up to 5 (2017-ongoing)	-62.99	10.71	1.0	100%		2	B
Playa Grande	Y	2(2014)	-67.60	10.51	0.7	100%	30,32,33,34	1	B
Playa Cuyagua	Y	1 (2013-2014)	-67.69	10.50	1.3	100%	30,32,33,34	1	B
Playa Querepare	Y	100-500 (2002-2020)	-62.88	10.70	>1.8	100%	40,41	1	B
Playa Cipara	Y	100-500 (1999-2020)	-62.70	10.70	>2.06	100	40,41	1	B
Carabobo State	N	20 (2008-2014)	-67.55	10.52	14.8	100%	46,48		
Complejo Insular La Tortuga	N	87 (2008-2009)	-65.3	10.93	23,6	100%	50		
Playa del Este, Complejo Insular La Tortuga	N	30.67 (2007-2009)	-65.22	10.94	5.9	100%	50		
Archipiélago Los Roques National Park	N	11 (2001-2006)	-66.7	11.82	12.5	100%	51,53,54		

Isla Margarita	N	234.83 (1999-2014)	-64.05	10.96	n/a	90%	55,56,57		
Playa Parguito	N	58.28 (1001-2014)	-63.85	11.13	1.7	100%	55,56,57		
Playa el Agua	N	68.71 (1001-2014)	-63.87	11.15	2.9	100%	55,56,57		
Playa el Humo	N	61.33 (1001-2014)	-63.88	11.17	1.0	100%	55,56,57		
El Codo-La Bocaina Península of Paraguaná	N	13 (2010)	-69.81	11.86			43,44,45		
La Encrucijada, Medanos de Coro National Park, Península of Paraguaná	N	11 nests/yr (2007-2011)	-71.34	11.82	20.0	100	43,44		

Table 2a. Some biological data of sea turtle nesting activity for four species of sea turtles *C. mydas* (Cm), *E. imbricata* (Ei), *C. caretta* (Cc), and *D. coriacea* (Dc)along the coast of Venezuela (continental and insular complex) in the Caribbean Sea. Continue table 2b.

Biological data	**Cm-RMU 50**		**Cm-RMU47**		**Ei-RMU10**					
	Aves Island	Ref #	**Archipiélago Los Roques**	Ref #	**Gulf of Paria**	Ref #	**Archipiélago Los Roques**	Ref #	**Margarita Island**	Ref #
Clutch size (n eggs) (N)	122.9 (range 93-178)(445)	1,2	112 (13)	51	158.8	23	136.37 (35)	51	148.33 (121-166)(72)	56,57,58,59
Emergence success (hatchlings/egg) (N)	n/a		n/a		0.34	23	n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a				n/a		n/a	

Table 2b. Some biological data for the compiled sea turtle nesting beaches for four species *C. mydas* (Cm), *E. imbricata* (Ei), *C. caretta* (Cc) and *D. coriacea* in the coast of Venezuela (littoral and insular complex) in the Caribbean Sea.

Biological data	**Cc-RMU25**								**Dc-RMU51**							
	NW Sucre State	Ref #	**NW Sucre State**	Ref #	**NE Sucre State**	Ref #	**Archipiélago Los Roques**	Ref #	**NW Sucre State**	Ref #	**NW Sucre State**	Ref #	**NE Sucre State**	Ref #	**Margarita Island**	Ref #

Clutch size (n eggs) (N)	(range 70-150)		(range 80-150)		122	31	129.87 (4)	51	(range 60-110)		(range 60-110)		60-120	36	114 (1-185)(563)	56,57,58,59
Emergence success (hatchlings/egg) (N)	70%		70%		not available		n/a		60%		70%		73.3% (40.4)	36	n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		not available		n/a		n/a		n/a		79.8±1% (N ± StDev)	38	n/a	

Table 3a. Reported threats for Cm-RMU50 and Cm-RMU47 in the Venezuelan territory. Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multi-specific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net.

	Cm-RMU 50		**Cm-RMU47**											
	Aves Island	Ref #	**Gulf of Venezuela**	Ref #	**NE Sucre State**	Ref #	**Aragua State**	Ref #	**Península Paraguaná**	Ref #	**Carabobo**	Ref #	**Archipiélago Los Roques**	Ref #
Threats														
Bycatch: presence of small scale / artisanal fisheries?	N	1,2	Y (DLL; SN; DN; Turtle Nets)	11, 12, 14, 66, 67	Y (SN; DN)	40	Y(SN)	26	Y	43, 45	Y	47, 48	Y	52
Bycatch: presence of industrial fisheries?	Y	1,2, 3	?		N		n/a	n/a	N		N		N	
Bycatch: quantified?	N		154 (SN;DN)	12, 20	N		n/a	n/a	N		N		N	
Take. Intentional killing or exploitation of turtles	**Y**		Y	66	Y	40	n/a	n/a	Y	31, 43, 45,	Y	47, 48	Y	51, 52
Take. Egg poaching	N		N		Y	40	Y	25,27, 28	Y	31, 43, 45,	Y	47, 48	Y	51

Coastal Development. Nesting habitat degradation	N		N		Y	40	Y	27,28, 29	Y	31, 43, 45,	Y	47, 48	N	
Coastal Development. Photopollution	N		N		Y	40, 41	Y	27,28, 29	Y	31, 43, 45,	Y	47, 48	Y	
Coastal Development. Boat strikes	N		Y		Y	40	n/a	n/a	N		Y	47, 48	Y	
Egg predation	N		?		N		Y	27	?		Y	47, 48	N	
Pollution (debris, chemical)	N		Y		Y		n/a	n/a	Y	31, 43, 45,	Y	47, 48	N	
Pathogens	**Y**	5, 16	Y	5, 16	N		n/a	n/a			n/a		N	
Climate change	Y	2	?		Y		n/a	n/a			y	48	y	
Foraging habitat degradation	Y		Y	6	N		n/a	n/a			Y	47, 48	Y	
Other	N				N		n/a	n/a			n/a		n/a	

Table 3b. Reported threats for Ei-RMU10 in n the Venezuelan territory. Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multi-specific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net.

	Ei-RMU10

	Gulf of Venezuela	Ref #	**Gulf of Paria**	Ref #	**NE Sucre State**	Ref #	**Aragua State**	Ref #	**Peninsula Paraguana**	Ref #	**Carabobo**	Ref #	**Complejo La Tortuga**	Ref #	**Archipielago Los Roques**	Ref #	**Margarita Island**	Ref #
Threats																		
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL; SN; DN; Turtle Nets)	11, 12, 14	Y	23	Y (SN; DN)	40	Y	27	Y	43,45	Y	47,48	Y	50	Y	52	Y	55,58,60
Bycatch: presence of industrial fisheries?	?		N	23	N		n/a	n/a	N		N		N		N		n/a	
Bycatch: quantified?	3 (SN;DN)	12, 20	Y	23	N		n/a	n/a	N		N		n/a		N		n/a	
Take. Intentional killing or exploitation of turtles	Y		Y	23	Y	40	n/a	n/a	Y	31,43,45	Y	47,48	Y	50	Y	51,52	Y	55,58,60
Take. Egg poaching	?		Y	22	Y	40	Y	25,27,28	Y	31,43,45	Y	47,48	Y	50	Y	51	Y	55,58

																		,60
Coastal Development. Nesting habitat degradation	N		Y	21	Y	40	Y	27,28,29	Y	31,43,45	Y	47,48	Y	50	N		Y	55,58,60
Coastal Development. Photopollution	N		N		Y	40	Y	27,28,29	Y	31,43,45	Y	47,48	N		Y		Y	59
Coastal Development. Boat strikes	?		Y	24	Y	40	n/a	n/a	N		N		Y	50	Y		Y	55,58,60
Egg predation	?		Y	22	N		Y	27	?		Y	47,48	N		N		N	
Pollution (debris, chemical)	Y		Y	21	Y		n/a	n/a	Y	31,43,45	Y	47,48	Y	50	N		Y	
Pathogens	Y	5	Y	5	N		n/a	n/a			n/a		n/a		N		Y	70
Climate change	?		n/a		N		n/a	n/a			y	48	n/a		y		n/a	63

Foraging habitat degradation	Y	6	n/a		N		n/a	n/a			Y	47,48	Y	50	Y		Y	6 3
Other			n/a		N		n/a	n/a			n/a		N		n/a		N	

Table 3c. Reported threats for Cc-RMU25 in the Venezuelan territory. Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multi-specific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net.

	CC-RMU25											
	Gulf of Venezuela	Ref #	**NE Sucre State**	Ref #	**Gulf of Paria**	Ref #	**Península Paraguana**	Ref #	**Carabobo**	Ref #	**Archipiélago de Los Roques**	Ref #
Threats												
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL; SN; DN; Turtle Nets)	11, 12, 14,66, 67	Y (SN)	41	n/a	n/a	Y	43,45	Y	47,48	Y	52
Bycatch: presence of industrial fisheries?	?		N		n/a	n/a	N		N		N	
Bycatch: quantified?	10 (SN;DN)	12, 20	N		n/a	n/a	N		N		N	

Take. Intentional killing or exploitation of turtles	Y	66, 67	Y	37	n/a	n/a	Y	31,43,45	Y	47,48	Y	51,52
Take. Egg poaching	?		Y	37	Y	2527,28	Y	31,43,45	Y	47,48	Y	51
Coastal Development. Nesting habitat degradation	N		Y	41	Y	27,28,29	Y	31,43,45	Y	47,48	N	
Coastal Development. Photopollution	N		Y	37	Y	27,28,29	Y	31,43,45	Y	47,48	Y	
Coastal Development. Boat strikes	Y		Y	37	n/a	n/a	N		N	47,48	Y	
Egg predation	?		N		Y	27	?		Y	47,48	N	
Pollution (debris, chemical)	Y		Y		n/a	n/a	Y	31,43,45	Y	47,48	N	
Pathogens	?		N		n/a	n/a			n/a		N	
Climate change	?		Y		n/a	n/a			y	48	y	
Foraging habitat degradation	Y	6	N		n/a	n/a			n/a		Y	
Other			N		n/a	n/a			n/a		n/a	

Table 3d. Reported threats for Dc-RMU51 in the Venezuelan territory. Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multi-specific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net.

	DC-RMU51															
	Gulf of Venezuela	Ref #	**Gulf of Paria**	Ref #	**NE Sucre State**	Ref #	**Aragua State**	Ref #	**Peninsula Paraguana**	Ref #	**Carabobo**	Ref #	**Complejo La Tortuga**	Ref #	**Margarita Island**	Ref #
Threats																
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL; SN; DN; Turtle Nets)	8, 11, 12, 14	n/a		Y (PLL, SN, FP)	46	Y(SN)	27	Y	43,45	Y	47,48	Y	52	Y	55,58,60
Bycatch: presence of industrial fisheries?	?		n/a		N		n/a	n/a	N		N		N		N	
Bycatch: quantified?			n/a		N		n/a	n/a	N		N		N		N	
Take. Intentional killing or exploitation of turtles	Y		n/a		Y	40	n/a	n/a	Y	43,45	Y	47,48	Y	51,52	Y	55,58,60
Take. Egg poaching	?		n/a		Y	40	Y	25,27,28	Y	43,45	Y	47,48	Y	51	Y	55,58,60

Coastal Development. Nesting habitat degradation	N		n/a		Y	40	Y	27,28,29	Y	43,45	Y	47,48	N		Y	55,58,60
Coastal Development. Photopollution	N		n/a		Y	42	Y	27,28,29	Y	43,45	Y	47,48	Y		Y	59
Coastal Development. Boat strikes	Y		n/a		Y	37	n/a	n/a	N		N		N		N	55,58,60
Egg predation	?		n/a		Y	39,41	Y	27	Y	44	Y	47,48	N		N	
Pollution (debris, chemical)	Y		n/a		Y	39	n/a	n/a	Y	43,45	Y	47,48	N		Y	55,58,59,6
Pathogens	?		n/a		Y	37	n/a	n/a			n/a		N		Y	61
Climate change	?		n/a		Y	37	n/a	n/a			Y	48	y		Y	63
Foraging habitat degradation	Y	6	n/a		N		n/a	n/a			n/a		Y		Y	63
Other			N		N		n/a	n/a			n/a		n/a		N	

Table 3e. Reported threats for Lo-RMU02 in the Venezuelan territory. Codes for fishing gears: PLL: Pelagic Longlines; DLL: demersal longlines; SN: Set Nets; DN: Drift Nets; ST: Shrimp Trawls; MT: Multi-specific bottom Trawls; PT: Pelagic Trawls; FP: Fish/Crustacean Pots/Traps; PN: Pound net.

	LO-RMU02			
	Gulf of Venezuela	Ref #	**Península Paraguana**	Ref #
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL; SN; DN; Turtle Nets)	11, 12, 13, 14, 66, 67	Y	
Bycatch: presence of industrial fisheries?	?		N	
Bycatch: quantified?			N	
Take. Intentional killing or exploitation of turtles	Y	66, 67	N/A	
Take. Egg poaching	N		N/A	
Coastal Development. Nesting habitat degradation	N		N/A	
Coastal Development. Photopollution	N		N/A	
Coastal Development. Boat strikes	?		N/A	
Egg predation	?		N/A	
Pollution (debris, chemical)	Y		N/A	
Pathogens	?		N/A	
Climate change	?		N/A	
Foraging habitat degradation	Y	6	N/A	

Other			N/A	

Table 4. Sea turtle conservation projects in Venezuela. Region/Location abbreviations: NWA – Northwest Atlantic, SC – Southern Caribbean, WA – Western Atlantic, NA – North Atlantic

RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public /Private	Collaboration with	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
Cm-RMU50	VEN	NWA	Monitoring and Conservation on Chelonia mydas Project	Tracking; Fastloc GPS tag; Nesting female; western	1979	Ongoing	Ministerio del Poder Popular para el Ecosocialismo	Public	Venezuelan Institute for Scientific Research, Direccion de Hidrografia y Navegacion	Ministerio del Poder Popular para el Ecosocialismo, Venezuelan Institute for Scientific Research, Direccion de Hidrografia y Navegacion	Alfredo.arteaga@gmail.com	marcogarciacruz@gmail.com /marcogarcia@ufl.edu
Dc-RMU51	VEN	NA	Programa de Conservación de Tortugas Marinas del Estado Nueva Esparta	Nesting females, Monitoring	2009	Ongoing	Ministerio del Poder Popular para el Ecosocialismo			Ministerio del Poder Popular para el Ecosocialismo	Biól. Mar. Graciela Hernández	gracielabelenh@gmail.com

Dc-RMU5 1	VEN	SC	Conservacion de tortugas marinas en el Golfo de Paria	Nesting, Gulf of Paria, Poaching control	2003		Env. Ministry, UCV	Public/ Private	SEE Turtle, Provita NGO	SEE Turtle	cballadares86 @gmail.com	Luis Cova (ljcova@hotmail .com)
Cm-RMU4 7	VEN	SC	Proyecto Shawa	Tagging, rescue, rehabilitation, release.	1997	Ongoing	GTTM-GV	Private	University of Zulia	N/A	Hector Barrios-Garrido; hbarriosg@fec.luz.edu.ve; hbarriosg@gmail.com	
EiRMU 10	VEN	WA	Proyecto Shawa	Tagging, rescue, rehabilitation, release.	1997	Ongoing	GTTM-GV	Private	University of Zulia	N/A	Hector Barrios-Garrido; hbarriosg@fec.luz.edu.ve; hbarriosg@gmail.com	
Cc-RMU2 5	VEN	NA	Proyecto Shawa	Tagging, rescue, rehabilitation, release.	1997	Ongoing	GTTM-GV	Private	University of Zulia	N/A	Hector Barrios-Garrido; hbarriosg@fec.luz.edu.ve; hbarriosg@gmail.com	
Dc-RMU5 1	VEN	NA	Proyecto Shawa	Tagging, rescue, rehabilitation, release.	1997	Ongoing	GTTM-GV	Private	University of Zulia	N/A	Hector Barrios-Garrido; hbarriosg@fec.luz.edu.ve;	

											hbarriosg@gmail.com	
Lo-RMU02	VEN	WA	Proyecto Shawa	Tagging, rescue, rehabilitation, release.	1997	Ongoing	GTTM-GV	Private	University of Zulia	N/A	Hector Barrios-Garrido; hbarriosg@fec.luz.edu.ve; hbarriosg@gmail.com	
Cc-RMU25	VEN	SC	Conservacion de tortugas marinas en el Golfo de Paria	Nesting, Gulf of Paria, Poaching control	2003		Ministerio del Poder Popular para el Ecosocialismo, UCV	Public/ Private	SEE Turtle, Provita NGO	SEE Turtle	cballadares86@gmail.com	Luis Cova (ljcova@hotmail.com)
Cc-RMU25	VEN	NA	Proyecto Akupara	environmental education, Nesting female.	2015	Ongoing	Ecoposadas del mar	Private	N/A	URCOSA, CORPOMEDINA, Ecoposadas y Spa Sietemares	Eneida Fajardo; eneida.fajardo@gmail.com	
DC-RMU51	VEN	NA	Proyecto Akupara	environmental education, Nesting female.	2015	Ongoing	Ecoposadas del mar	Private	N/A	URCOSA, CORPOMEDINA, Ecoposadas y Spa Sietemares	Eneida Fajardo; eneida.fajardo@gmail.com	

Cc-RMU25	VEN	NA	Survey and Conservation of the Sea Turtles in the Aragua State	nesting, Aragua, training, conservation, sea turtles	2010	2012	Instituto Nacional de Parques (INPARQUES)	Public	CICTMAR; Centro Integral de Submarinismo, Puerto Escondido Dive Center	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Dc-RMU51	VEN	NA	Survey and Conservation of the Sea Turtles in the Aragua State	nesting, Aragua, training, conservation, sea turtles	2010	2012	Instituto Nacional de Parques (INPARQUES)	Public	CICTMAR; Centro Integral de Submarinismo, Puerto Escondido Dive Center	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Ei-RMU10	VEN	WA	Survey and Conservation of the Sea Turtles in the Aragua State	nesting, Aragua, training, conservation, sea turtles	2010	2012	Instituto Nacional de Parques (INPARQUES)	Public	CICTMAR; Centro Integral de Submarinismo, Puerto Escondido Dive Center	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Cm-RMU47	VEN	SC	Survey and Conservation of the Sea Turtles in the Aragua State	nesting, Aragua, training, conservation, sea turtles	2010	2012	Instituto Nacional de Parques (INPARQUES)	Public	CICTMAR; Centro Integral de Submarinismo, Puerto Escondido Dive Center	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com

Cc-RMU25	VEN	NA	Project Monitoring and Conservation of Sea Turtles in the Aragua State	nest protection, Aragua, training, conservation, sea turtles	2013	2014	Ecodiversa Fundation	Private	Instituto Nacional de Parques (INPARQUES). CICTMAR.	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Dc-RMU51	VEN	NA	Project Monitoring and Conservation of Sea Turtles in the Aragua State	nest protection, Aragua, training, conservation, sea turtles	2013	2014	Ecodiversa Fundation	Private	Instituto Nacional de Parques (INPARQUES). CICTMAR.	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Ei-RMU10	VEN	WA	Project Monitoring and Conservation of Sea Turtles in the Aragua State	nest protection, Aragua, training, conservation, sea turtles	2013	2014	Ecodiversa Fundation	Private	Instituto Nacional de Parques (INPARQUES). CICTMAR.	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com
Cm-RMU47	VEN	SC	Project Monitoring and Conservation of Sea Turtles in the Aragua State	nest protection, Aragua, training, conservation, sea turtles	2013	2014	Ecodiversa Fundation	Private	Instituto Nacional de Parques (INPARQUES). CICTMAR.	n/a	Ernesto Pulgar Hahn ernestopulgar@gmail.com	Hedelvy Guada; hedelvy.guada@gmail.com

Cc-RMU25	VEN	NA	Sea turtle research and conservation of the Paria Peninsula, Sucre State, Venezuela	Tagging, nest protection, environmental education, community participation	1999	Ongoing	CICTMAR (NGO)	Private /Public	WIDECAST, Universidad Central de Venezuela	Global Conservation Connections, Cleveland Metroparks Zoo, Buttonwood Park Zoo	Hedelvy J. Guada, hedelvy.guada@gmail.com	
Cm-RMU47	VEN	SC	Sea turtle research and conservation of the Paria Peninsula, Sucre State, Venezuela		1999	Ongoing	CICTMAR (NGO)	Private /Public	WIDECAST, Universidad Central de Venezuela	Global Conservation Connections, Cleveland Metroparks Zoo, Buttonwood Park Zoo	Hedelvy J. Guada, hedelvy.guada@gmail.com	
Ei-RMU10	VEN	WA	Sea turtle research and conservation of the Paria Peninsula, Sucre State, Venezuela		1999	Ongoing	CICTMAR (NGO)	Private /Public	WIDECAST, Universidad Central de Venezuela	Global Conservation Connections, Cleveland Metroparks Zoo, Buttonwood Park Zoo	Hedelvy J. Guada, hedelvy.guada@gmail.com	

Dc-RMU51	VEN	NA	Sea turtle research and conservation of the Paria Peninsula, Sucre State, Venezuela		1999	Ongoing	CICTMAR (NGO)	Private /Public	WIDECAST, Universidad Central de Venezuela	Global Conservation Connections, Cleveland Metroparks Zoo, Buttonwood Park Zoo	Hedelvy J. Guada, hedelvy.guada@gmail.com	
Dc-RMU51	VEN	NA	Manejo, Conservación y Seguimiento de las Poblaciones de Tortugas Marinas en las Costas del Estado Carabobo.	Playas de anidación, Áreas de desarrollo, protección de nidadas, mitigación de impactos, Basura, Pasivos Ambientales, liberación de tortuguillos, uso del hábitat.	2008	2014	Palmichal S.C.	Publica	GTTM-NE, Pequiven C.A.	N/A	Pedro D. Vernet P. pedrovernet@gmail.com	

Dc-RMU 51	VEN	NA	Proyecto integrado de Conservación de Tortugas Marinas en Isla La Tortuga	Playas de anidación, Áreas de desarrollo, seguimiento de nidadas, identificación de impactos, liberación de tortuguillos, uso del hábitat.	2007	2009	Fundación la tortuga	Privada	GTTM-NE.	N/A	Pedro D. Vernet P. pedrovernet@gmail.com	
Dc-RMU51	VEN	NA	Proyecto integrado de Conservación y Desarrollo de Tortugas Marinas del Archipiélago los Roques	Playas de anidación, Áreas de desarrollo, protección de nidadas, mitigación de impactos, liberación de tortuguillos, Head starting, uso del hábitat.	1999	2006	Fundación Científica Los Roques	Privada	GTTM-NE, Fundación Museo Marino de Margarita.	N/A	Pedro D. Vernet P. pedrovernet@gmail.com	

Dc-RMU 51	VEN	NA	Proyecto integrado de Conservación y Desarrollo de Tortugas Marinas del Estado Nueva Esparta	Playas de anidación, Marcaje y recaptura, protección de nidadas, mitigación de impactos, liberación de tortuguillos, Rescate, Rehabilitación, liberación, uso del hábitat	1999	2014	GTTM-NE	Privada	Provita, Fundación Museo Marino de Margarita.	N/A	Pedro D. Vernet P. pedrovernet@gmail.com	

Table 5. International conventions protecting sea turtles and signed in Venezuela.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions
CBD: Convention on Biological Diversity (1992).	Y	Y	Y	ALL	To conserve the biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, taking into account all rights over those resources and to technologies, and by appropriate funding.
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.	Y	Y	?	ALL	An international agreement between governments, the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Cartagena Convention (1983)	Y	Y	?	ALL	The aim is that the countries of the Greater Caribbean region strike a balance between development and protection of the marine environment.
Washington Convention (1940)	Y	Y		ALL	Protect all species and genera of the flora and fauna of America from extinction and preserve areas of extraordinary beauty, with an emphasis on geological formations or with aesthetic, historical or scientific value
Ramsar Convention	Y	Y	?	ALL	It is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)	Y	Y	?	ALL	The Convention promotes the protection, conservation and recovery of the populations of sea turtles and those habitats on which they depend, on the basis of the best available data and taking into consideration the environmental, socioeconomic and cultural characteristics of the Parties (Article II, Text of the Convention). These actions should cover both nesting beaches and the Parties' territorial waters.

[1] Venezuela R d. Convención Interamericana para la Protección y Conservación de las Tortugas Marinas. Venezuela: Caracas; 1996a. Retrieved from http://www.iacseaturtle.org/docs/Texto-CIT-ESP.pdf.

Table 5a. Published studies on research topics for RMUs.

	Cm-RMU 50		**Cm-RMU47**				**Ei-RMU10**					
	Aves Island	Ref #	**Gulf of Venezuela**	Ref #	**NE Sucre State**	Ref #	**Gulf of Venezuela**	Ref #	**Gulf of Paria**	Ref #	**NE Sucre State**	Ref #
Published studies												
Growth rates	N		N		N		N		Y	23	N	
Genetics	Y	2	Y	11	N		N		N		N	
Stocks defined by genetic markers	Y	2	Y	11	N		N		N		N	
Remote tracking (satellite or other)	Y	2	N		N		N		N		N	
Survival rates	Y	1,2,19	N		N		N		N		N	
Population dynamics, population estimates, reproductive biology	Y	1,2,3	N		N		N		Y	23	N	
Foraging ecology (diet or isotopes)	Y	5	N		N		N		N		N	
Capture-Mark-Recapture	Y	1,2	Y	6	Y		Y	6	Y	23	Y	43

Table 5b. Published studies on research topics for RMUs.

	CC-RMU25				**DC-RMU51**					
	Gulf of Venezuela	Ref #	**NE Sucre State**	Ref #	**Gulf of Venezuela**	Ref #	**NE Sucre State**	Ref #	**Margarita Island**	Ref #

Published studies										
Growth rates	N		N		N		N		N	
Genetics	N		N		N		N		N	
Stocks defined by genetic markers	N		N		N		N		N	
Remote tracking (satellite or other)	N		N		N		N		N	
Survival rates	N		N		N		N		N	
Population dynamics, population estimates, reproductive biology	N		N		N		N	36,38	N	
Foraging ecology (diet or isotopes)	N		N		N		N		N	
Capture-Mark-Recapture	Y	6	Y		Y	6	Y	38, 40	Y	56,58,59

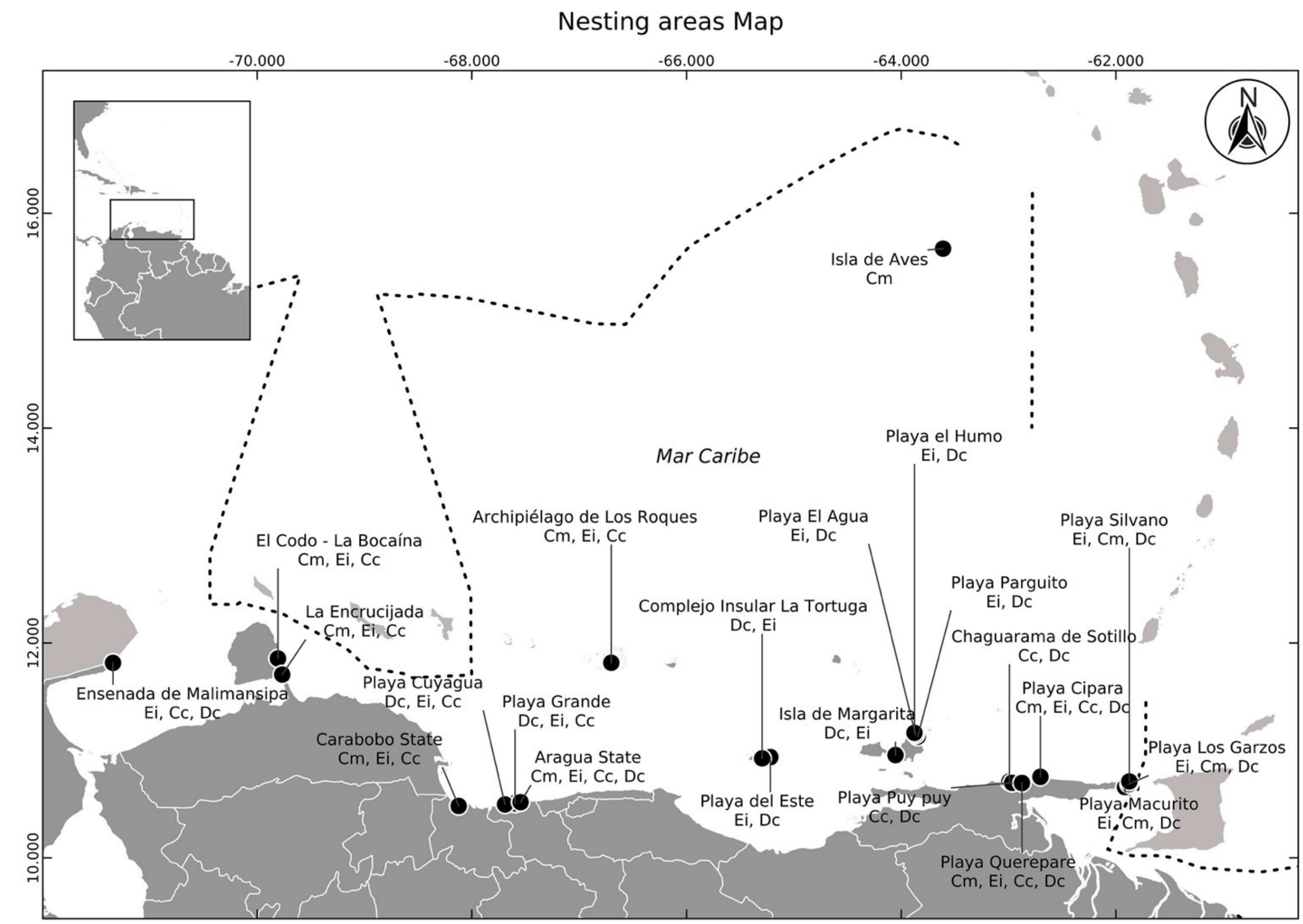

Figure 1. Nesting beaches (black circles) of four sea turtles species *C. mydas* (Cm), *E. imbricata* (Ei), *C. caretta* (Cc) and *D. coriacea* (Dc) along the coast of Venezuela (continental and insular complex) in the Caribbean Sea.

Made by Sergio Zambrano

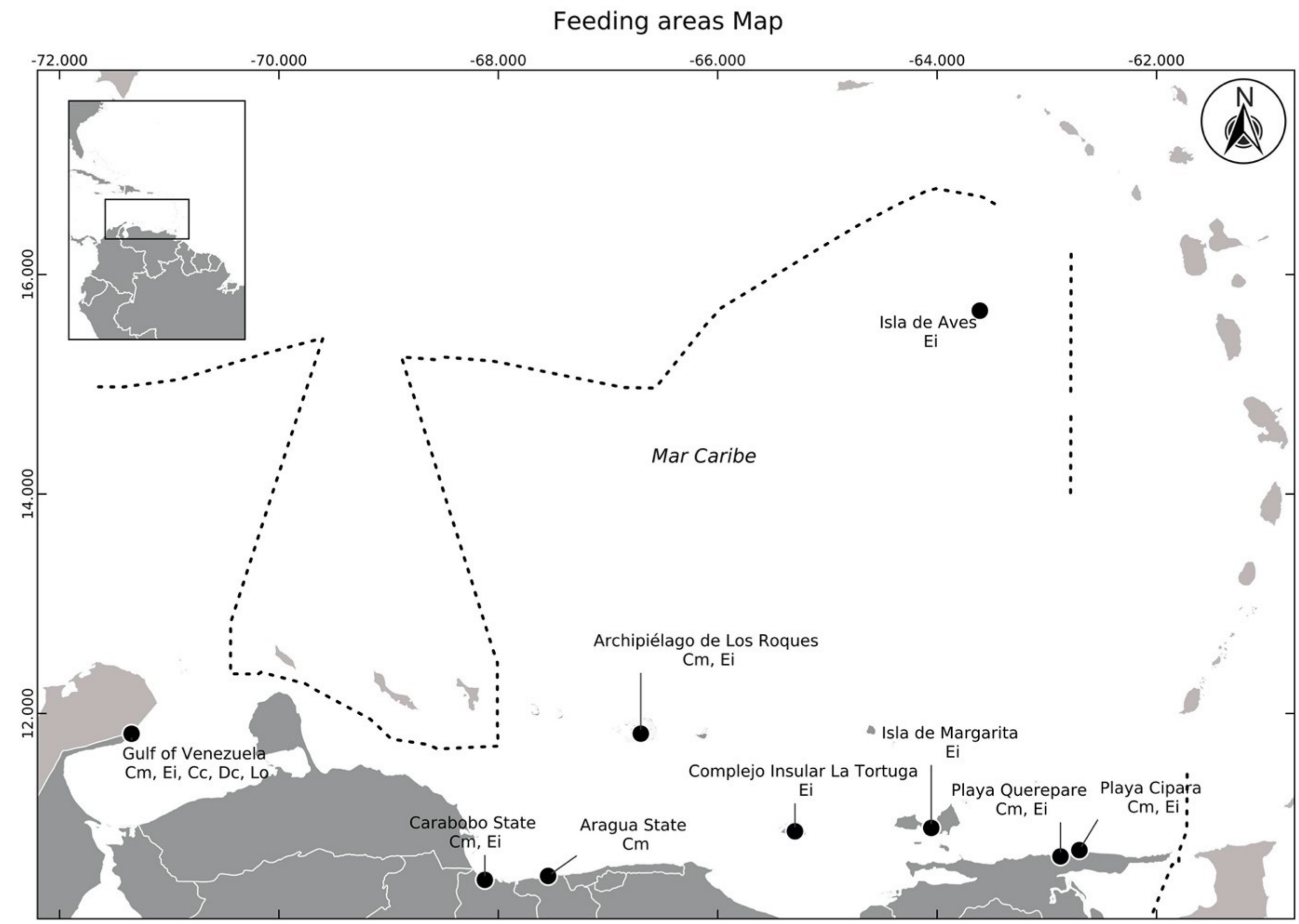

Figure 2. Foraging areas (black circles) of five sea turtles species *C. mydas* (Cm), *E. imbricata* (Ei), *C. caretta* (Cc), *D. coriacea* (Dc) and *L. olivacea* (Lo) along the coast of Venezuela (continental and insular complex) in the Caribbean Sea. Made by Sergio Zambrano