Sea Turtles in the Middle East and South Asia Region
MTSG Annual Regional Report 2020

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Photo: Green turtle (*Chelonia mydas*) at Kuredu Caves, Lhaviyani Atoll, Maldives

Photo Credit: Stephanie Köhnk

Foreword

Much of the 2020 MTSG Annual Regional Report on sea turtles in the Middle East and South Asia was prepared during the COVID-19 pandemic. Authors of the chapters in this report experienced lockdowns that restricted movements and access to usual facilities and resources, quarantine periods away from their homes as they returned from overseas or locations in their home country, and the threat of, or actual infection with, COVID. We thank all involved for their perseverance and patience.

Given the overwhelming personal, social, and financial concerns for everyone during this time, it was likely that some authors would not be able to finish their chapters as planned. Consequently, one country- Eritrea- is absent from this annual report. Supporting the authors of this chapter will be our priority for the 2021 report.

Andrea and ALan

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REGIONAL OVERVIEW

Andrea D. Phillott[1] & ALan F. Rees[2]

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This report presents information on sea turtle populations of Bahrain, Bangladesh, Djibouti, Egypt, Iran, India, Kuwait, Maldives, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Sudan, United Arab Emirates, and Yemen. Five chapters (Bangladesh, Iran, Oman, Pakistan, and UAE) and isolated records from Iraq, Israel and Jordan have been added since the 2019 report [1]. Together, 10 Regional Management Units (RMUs; see [2]) for five sea turtle species (see Figures 1-5) in the Middle East and South Asia (ME & SA) are represented.

1 RMU: *Caretta caretta*, North-East Indian Ocean (CC-NEIO)

ME & SA countries contributing to this summary: Sri Lanka

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

The majority of loggerhead turtle nesting in Sri Lanka is reported from the south to south-west coastline of the country. No clear oldest documented abundance and recent trends for nesting populations of the RMU in Sri Lanka are known.

1.1.2 Marine areas

Specific foraging and inter-nesting areas for this RMU in Sri Lanka have not been identified. No clear documented abundance and recent trends for in-water loggerhead populations in Sri Lanka are known.

1.2 Other biological data

There is a need for the genetic stock of this RMU in Sri Lanka to be determined.

1.3 Threats

1.3.1 Nesting sites

Eggs are lost to illegal take and predators. Hatchlings may be threatened by increased lighting adjacent to nesting beaches.

1.3.2 Marine areas

The consumption of turtle bycatch occurs in coastal villages of Sri Lanka.

1.4 Conservation

Turtles in this RMU are protected by government legislation and coastal sea turtle sanctuaries in Sri Lanka and international conservation agreements. Both *in situ* and *ex situ* protection mechanisms for turtle nests have been used in the past and are ongoing.

1.5 Research

Studies have been conducted to quantify and trial mitigation strategies for sea turtle bycatch in some fisheries. Research on the value of hatcheries as an *ex situ* conservation strategy in Sri Lanka is ongoing. The genetic stock of this RMU in Sri Lanka is identified as a knowledge gap and should be addressed with research.

2 RMU: *Caretta caretta*, North-West Indian Ocean (CC-NWIO)

ME & SA countries contributing to this summary: Oman, Yemen

2.1 Distribution, abundance, trends

Globally important nesting aggregations for this species occur in Oman and, to a lesser extent, Yemen.

2.1.1 Nesting sites

One of the most important nesting populations for loggerhead sea turtles in the world is found on the Island of Masirah, Oman, with additional nesting on ~200 beaches along the country's mainland coast. Recent trends in nest numbers from Oman indicate a large decline in the population since the 1970s, with tracks per day decreasing from 659 on index beaches from 1985 to 1990, compared to 190 from 2009 to 2013. In Yemen, nesting of turtles in this RMU occurs on Socotra Is. in the Gulf of Aden with no recent nesting levels available. Infrequent nesting in Yemen also occurs on the nearby Sharma-Jethmoon-Dhargham coast of the country.

2.1.2 Marine areas

Large scale oceanic foraging areas in Omani and Yemeni waters have been shown for this RMU. No clear oldest documented abundance and recent trends for foraging populations of loggerhead turtles in Oman or Yemen are known.

2.2 Other biological data

Genetic studies of loggerhead haplotypes from six of the nine globally significant RMUs for this species indicate migratory connectivity between the Indian and Atlantic Oceans occurs on a broader scale than previously hypothesised. Genetic studies suggest loggerhead turtles foraging in the SWIO nest in Oman which is supported by tacking data derived from juvenile turtles. Genetic characteristics of the RMU in Yemen still need to be determined and published.

2.3 Threats

2.3.1 Nesting sites

Nesting turtles and their eggs are threatened by human consumption, coastal development, activities associated with tourism, and depredation of nests. Long-term monitoring is required to ascertain the impact of these threats on the RMU.

2.3.2 Marine areas

Fisheries in the Oman Sea and in waters surrounding Masirah Is. pose threats to in-water populations in this RMU, likely exacerbated by the weak enforcement, low compliance, and widespread illegal activities reported for fisheries. Marine pollution and sea level rise resulting from climate change are additional current and future threats to be managed.

2.4 Conservation

Oman and Yemen protect turtles in the CC-NWIO RMU through national and international instruments and protected areas, though effectiveness of these methods is unknown.

2.5 Research

Understanding of this RMU would benefit from unpublished data sets being made available, and further research on the biology, ecology, and threats to loggerhead turtles.

3 RMU: *Chelonia mydas*, North-East Indian Ocean (CM-NEIO)

ME & SA countries contributing to this summary: Bangladesh, India

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

In Bangladesh, green turtle nesting is believed to have been widespread until the 1980s but nesting frequency is now very low. India only reports nesting turtles in the CM-NEIO RMU in the Andaman and Nicobar Islands of India, with no known large nesting sites identified to date. No clear oldest documented abundance and recent trends for nesting populations of this RMU in Bangladesh or the Andaman and Nicobar Islands are known.

3.1.2 Marine areas

Bycatch data indicates green turtles in their NEIO RMU inhabit near- and offshore waters in the Bay of Bengal. No clear oldest documented abundance and recent trends for in-water populations of leatherback turtles in Indian waters are known for either country.

3.2 Other biological data

Biological data for populations of this RMU are unknown and a key knowledge gap.

3.3 Threats

3.3.1 Nesting sites

Nesting sites and threats to nesting turtles, eggs, and hatchlings in Bangladesh are well described. Nesting sites for this RMU in the Andaman and Nicobar Islands are remote, with little known about potential threats.

3.3.2 Marine areas

Fisheries bycatch is the main threats to turtles of this RMU.

3.4 Conservation

National legislation and international agreements protect turtles in this RMU. Nests may be protected or relocated to hatcheries at some locations.

3.5 Research

Green turtles in the NEIO RMU have been well studied in Bangladesh through beach monitoring, flipper tagging, and satellite telemetry. Turtle research in India has not previously focused on this RMU, and activities to determine key biological information and assess the population are required.

4 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

ME & SA countries contributing to this summary: Bahrain, Djibouti, Egypt, India, Iran, Kuwait, Maldives, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Sudan, United Arab Emirates, Yemen

4.1 Distribution, abundance, trends

Oman and Yemen have the two largest NWIO green turtle breeding populations in the region.

4.1.1 Nesting sites

From west to east, nesting green turtle populations in the NWIO RMU were reported by Djibouti, Egypt, Saudi Arabia (Red Sea and Arabian (Persian) Gulf), Yemen, Oman, Kuwait, Iran, Pakistan, India (mainland west coast and Lakshadweep Islands), the Maldives, and Sri Lanka. Egypt, Iran, Kuwait Pakistan report currently stable populations, although the population in Kuwait represents no more than 5 nesting individuals in a season, while the green turtle population in the Maldives is believed to be decreasing. The oldest documented abundance and recent population trends are unknown for other countries.

4.1.2 Marine areas

Important in-water habitats for the RMU have been identified in the Red Sea, Gulf of Aden, Arabian (Persian) Gulf, Arabian Sea, Lakshadweep Islands, and Gulf of Mannar.

4.2 Other biological data

Some key biological data for populations of this RMU in Egypt, Kuwait, Maldives, Pakistan, Saudi Arabia, Sri Lanka, and Yemen is known, but no to little information is available for other populations.

4.3 Threats

4.3.1 Nesting sites

The most common threats at nesting sites include coastal development, beach armouring, pollution, predation, illegal take, and tourism.

4.3.2 Marine areas

Threats from fisheries and consumption of bycatch, coastal development and associated pollution, and directed take are among the major threats to marine areas and populations important for the CM-NWIO RMU. Removal of seagrass beds (vital foraging habitat) by resorts is common in the Maldives.

4.4 Conservation

National legislation and international agreements protect green turtles throughout their distribution in the NWIO RMU. Specific conservation actions by individual countries are reported respectively.

4.5 Research

Egypt, Iran, Kuwait, Maldives, Oman, Pakistan, Sri Lanka, UAE are the only contributing countries that describe recent monitoring to establish key information on the biology, ecology and distribution of turtle population in the CM-NWIO RMU, but further information is required for all countries. Sharing and/or publication of existing, historical data is strongly encouraged.

5 RMU: *Dermochelys coriacea*, North-East Indian Ocean (DC-NEIO)

ME & SA countries contributing to this summary: Bangladesh, India, Sri Lanka

Leatherbacks recorded in waters of Bahrain, Djibouti, Kuwait, Pakistan, Sudan, and Yemen may belong to the NEIO and/or SWIO RMUs for the species.

5.1 Distribution, abundance, trends

5.1.1 Nesting sites

Nesting of leatherback turtles is reported to have occurred in Bangladesh pre-1970s. India and Sri Lanka report current nesting of leatherback turtles in the DC-NEIO RMU in the Andaman and Nicobar Islands and the south to south-west coast of the country respectively. The nesting population known in India is reported as stable for 2008-2017, but the trend for Sri Lankan turtles in the RMU is unknown.

5.1.2 Marine areas

This species is rarely encountered as bycatch in the Bay of Bengal and little is known about its marine habitat in the NEIO. Bangladeshi fishers report observations of the species at sea. No clear oldest documented abundance and recent trends for in-water populations of turtles in this RMU are known.

5.2 Other biological data

Much of the key biological data for this RMU is unknown for turtles in Sri Lanka or collected from only a small number of turtles in the Andaman and Nicobar Islands.

5.3 Threats

5.3.1 Nesting sites

Nesting beaches in the Andaman and Nicobar Islands have reformed since the 2004 Indian Ocean tsunami, but natural debris may still obstruct and, therefore, limit available nesting habitat. Illegal take of leatherback turtle eggs in Sri Lanka is reported.

5.3.2 Marine areas

There are no reports of leatherbacks as bycatch from Bangladesh or Sri Lanka, but the species is recorded from different fisheries in India.

5.4 Conservation

National legislation and international agreements protect turtles in Bangladesh, India and its territories, and Sri Lanka. Nests may be protected or relocated to hatcheries at some of the populated islands among the Andaman and Nicobars and in Sri Lanka, but their contribution to sea turtle conservation is debated in the latter country.

5.5 Research

Long-term monitoring of the DC-NEIO RMU has been ongoing since 2008 in the Andaman Islands. Similar monitoring occurred on Great Nicobar Is. from 2001-2004. Studies have been conducted to quantify and trial mitigation strategies for sea turtle bycatch in some Sri Lankan fisheries. Research on the value of hatcheries as an *ex situ* conservation strategy in Sri Lanka is ongoing.

6 RMU: *Eretmochelys imbricata*, North-East Indian Ocean (EI-NEIO)

ME & SA countries contributing to this summary: Bangladesh, India, Sri Lanka

6.1 Distribution, abundance, trends

6.1.1 Nesting sites

India and Sri Lanka report nesting of hawksbill turtles in the NEIO RMU in the Andaman and Nicobar Islands and the south to south-west coast of the country respectively, but no clear oldest documented abundance and recent trends for nesting populations of this RMU in both India and Sri Lanka are known. The species used to nest in Bangladesh but has not been observed in several decades.

6.1.2 Marine areas

No clear oldest documented abundance and recent trends for in-water populations in Bangladesh, India and Sri Lanka are known, but the species is reported frequently from commercial dive sites on reefs in India.

6.2 Other biological data

Little biological data is available for hawksbill turtles in Bangladesh, India or Sri Lanka.

6.3 Threats

6.3.1 Nesting sites

Illegal take of eggs is reported in India and Sri Lanka, and nests may be depredated in the Andaman and Nicobar Islands of India.

6.3.2 Marine areas

Fisheries operating in Bangladesh, India and Sri Lanka pose a threat to sea turtles, and consumption of turtle bycatch is reported from Sri Lanka.

6.4 Conservation

National legislation and international agreements protect turtles in Bangladesh, India and its territories, and Sri Lanka. Nests may be protected or relocated to hatcheries at some of the populated islands among the Andaman and Nicobars and in Sri Lanka, but their contribution to sea turtle conservation is debated in the latter country.

6.5 Research

In Sri Lanka, studies have been conducted to quantify and trial mitigation strategies for sea turtle bycatch in some fisheries, and research on the value of hatcheries as an *ex situ* conservation strategy in is ongoing. Research on the biology, ecology, and threats to populations of the EI-NEIO RMU in both India and Sri Lanka is required.

7 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

ME & SA countries contributing to this summary: Bahrain, Djibouti, Egypt, India, Iran, Kuwait, Maldives, Oman, Qatar, Saudi Arabia, Sudan, United Arab Emirates, Yemen

ME & SA countries in which nesting of this RMU also occurs: Eritrea

7.1 Distribution, abundance, trends

Regionally important nesting aggregations for this RMU occur in Iran, Oman, Saudi Arabia and the UAE.

7.1.1 Nesting sites

From west to east, nesting hawksbill turtle populations in the NWIO RMU were reported by Djibouti, Sudan, Egypt, Saudi Arabia (Red Sea and Arabian (Persian) Gulf), Yemen, Oman, UAE. Qatar, Kuwait, Iran, Pakistan, Maldives, and India (Lakshadweep Islands). The oldest documented abundance and recent trends for nesting populations of this RMU are unknown for countries other than Kuwait, Oman, Qatar, Sudan, and the UAE. Iran, Kuwait and Qatar report currently stable populations; the UAE describe population trends as variable to stable. Nesting trends are unknown for Sudan, and the possible 'thousands' of nesting pits observed in the early 2000's suggest a comprehensive assessment of current nesting number is needed.

7.1.2 Marine areas

Important in-water habitats for the RMU have been identified in the Red Sea, Arabian (Persian) Gulf, and Lakshadweep Islands.

7.2 Other biological data

Some key biological data for populations of this RMU in Egypt, Iran, Kuwait, Maldives, Oman, Qatar, Saudi Arabia, Sudan, UAE, and Yemen is known, but no information is available from other countries.

7.3 Threats

7.3.1 Nesting sites

The most common threats at nesting sites that were reported by contributing countries include coastal development, beach armouring, pollution, illegal take, predation, tourism, and climate change.

7.3.2 Marine areas

Threats from fisheries, coastal development and associated pollution, and directed take are among the major threats to marine areas and populations important for the EI-NWIO RMU.

7.4 Conservation

National legislation and international agreements protect hawksbill turtles throughout their distribution in their NWIO RMU. Specific conservation actions by individual countries are reported.

7.5 Research

Egypt, Iran, Kuwait, Maldives, Oman and the UAE are the only contributing countries that describe recent monitoring to establish key information on the biology, ecology, and distribution of hawksbill turtle populations in their NWIO RMU, but further information is required for all countries. Genetic stock assessments are limited and would be of benefit to management, especially for popuations in the Maldives which are at the boundary of the presumed NWIO and SWIO RMUs. Sharing and/or publication of existing, historical data is strongly encouraged.

9 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (Arribadas) (LO-NEIO (Arr))

ME & SA countries contributing to this summary: India

9.1 Distribution, abundance, trends

9.1.1 Nesting sites

Two major and one minor *arribada* sites for the LO-NEIO (Arr) RMU are reported by India and its territories. The two current major nesting *arribada* locations (Gahirmatha and Rushikulya) are both located in the state of Odisha on the east coast of India, and the minor site (Cuthbert Bay) in the Andaman Islands. Nesting numbers at all three locations demonstrate a stable or possibly increasing trend.

9.1.2 Marine areas

Between December and April, dense congregations of olive ridley turtles occur in offshore waters adjacent to the major nesting sites. Turtles in the LO-NEIO (Arr) RMU are believed to disperse within the Bay of Bengal and south to Sri Lanka between nesting seasons.

9.2 Other biological data

Known biological data for the LO-NEIO (Arr) RMU is presented in the chapter on India.

9.3 Threats

9.3.1 Nesting sites

Coastal development, nest predation, light pollution, and other common threats at nesting beaches are also experienced in India.

9.3.2 Marine areas

Turtles in this RMU are vulnerable to different fisheries in India.

9.4 Conservation

Seasonal closures in the waters offshore major *arribada* nesting sites protect nesting and inter-nesting turtles, and the nesting beaches of Gahirmatha and Cuthbert Bay are also declared wildlife sanctuaries.

9.5 Research

Long-term monitoring of *arribada* nesting populations of olive ridley turtles continues in India, but our understanding of the RMU would benefit from focused studies on reproductive biology and physiology, which have previously been limited.

10 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (LO-NEIO)

ME & SA countries contributing to this summary: Bangladesh, India, Sri Lanka

10.1 Distribution, abundance, trends

10.1.1 Nesting sites

Olive ridley turtles in their NEIO RMU nest along the coastline of Bangladesh, across the east coast of mainland India and in the Andaman and Nicobar Islands, and in the south to south-west coast of Sri Lanka. The oldest documented abundance for nesting populations of this RMU in all countries is unknown, but the nesting populations in Bangladesh and India are currently believed to be stable.

10.1.2 Marine areas

Bycatch data and observation of tagged nesting females suggest olive ridley turtles in this RMU are widespread in near- and offshore waters of Bangladesh, the eastern coasts of both India and Sri Lanka, and further into the Bay of Bengal. The oldest documented abundance and recent trends for in-water populations are unknown.

10.2 Other biological data

No biological data is available for olive ridley turtles in Sri Lanka, but some key data is available from populations in Bangladesh and India.

10.3 Threats

10.3.1 Nesting sites

Nests are vulnerable to predation and erosion, and emergent hatchlings may be affected by photo-pollution. Major development (industrial and tourist) initiatives at nesting sites is reported from Bangladesh. Illegal take of eggs is reported in Sri Lanka but is now reported to be minimal for this RMU in India.

10.3.2 Marine areas

Fisheries operating in Bangladesh, India and Sri Lanka pose a threat to sea turtles, of note the >50,000 marine-set bag nets in Bangladesh. Consumption of turtle bycatch is reported from Sri Lanka.

10.4 Conservation

National legislation and international agreements protect turtles in Bangladesh, India and its territories, and Sri Lanka. Nests may be protected or relocated to hatcheries on mainland India and in Sri Lanka, but their contribution to sea turtle conservation is debated in the latter country.

10.5 Research

Bangladesh has conducted beach monitoring, flipper tagging and satellite telemetry studies. The majority of research on olive ridley turtles in India has focused on the *arribada* populations. Further research on the biology, ecology, and threats to populations of the LO-NEIO RMU in all countries is required.

11 RMU: *Lepidochelys olivacea*, West Indian Ocean (LO-WIO)

ME & SA countries contributing to this summary: Bahrain, India, Maldives, Oman, Pakistan, Yemen

11.1 Distribution, abundance, trends

Regionally important nesting aggregation for this RMU occurs in India and Oman. The nesting population of Pakistan is believed to be locally extinct.

11.1.1 Nesting sites

The majority of olive ridley turtles in their WIO RMU nest across the west coast of mainland India. The oldest documented abundance for nesting populations of this RMU in India is unknown, but the population is currently believed to be stable.

11.1.2 Marine areas

Bycatch data, stranding records, and telemetry studies from India, the Maldives, Oman, Pakistan, and Yemen suggest olive ridley turtles in this RMU are widespread in near- and offshore waters of the Arabian Sea. No clear oldest documented abundance and recent trends for in-water populations are known.

11.2 Other biological data

Limited key data is available from LO-WIO populations in India and Oman.

11.3 Threats

11.3.1 Nesting sites

Nesting olive ridley turtles from their WIO RMU are vulnerable to predation, erosion, photo-pollution, and recreational activities on beaches.

11.3.2 Marine areas

Fisheries pose a threat to olive ridley turtles of the WIO RMU. Ghost gear, probably originating from countries in South or South-East Asia, is a major threat to olive ridley turtles in Maldivian waters and the greater Indian Ocean.

11.4 Conservation

National legislation and international agreements protect turtles. Nests may be protected or relocated to hatcheries on mainland India.

11.5 Research

Further research on the biology, ecology, and threats to populations of the LO-WIO RMU in India, the Maldives and Oman is required.

Table 1a. Key biological information for sea turtle RMUs (CC-NEIO; CC-NWIO; CM-NEIO; CM-NWIO) in the Middle East and South Asia.

Country Chapters: BH- Bahrain; BD- Bangladesh; DJ- Djibouti; EG- Egypt; IN- India; IR- Iran; KW- Kuwait; MV- Maldives; OM- Oman; PK- Pakistan; QA- Qatar; SA- Saudi Arabia; LK- Sri Lanka; SD- Sudan; AE- United Arab Emirates; YE- Yemen.

	Caretta caretta				***Chelonia mydas***			
RMU	**CC-NEIO**	**Country Chapters**	**CC-NWIO**	**Country Chapters**	**CM-NEIO**	**Country Chapters**	**CM-NWIO**	**Country Chapters**
Occurrence								
Nesting sites	Y	LK	Y	OM, PK, YE	Y	BD, IN	Y	DJ, EG, IN, IR, KW, OM, PK, QA, SA, SD, AE, YE
Pelagic foraging grounds	n/a		Y	OM	Y	BD	Y	EG, IR
Benthic foraging grounds	n/a		Y	OM, YE	Y	BD	Y	BH, DJ, KW, OM, QA, SA, SD, AE, YE
Key biological data								
Nests/yr: recent average (range of years)	17 (2014-2017)	LK	n/a		11 (2013-2020)	BD	~1,700 (1979-2018)	EG, IR, KW, OM, QA, SA.AE
Nests/yr: recent order of magnitude	n/a		1,000	YE	10-13	BD	>1,243	KW, QA, SA, SD, AE, YE
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	LK	5	OM, YE	n/a		32	EG, IR, KW, OM, QA, SA, SD, AE, YE
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	14	LK	206-210	OM, YE	4	BD	>76	EG, IR, KW, OM, QA, SA, SD, AE, YE
Nests/yr at "major" sites: recent average (range of years)	n/a		~1000	YE	5 (2013-2020)	BD	<1,879 (1985-2016)	IR, QA, SA, YE
Nests/yr at "minor" sites: recent average (range of years)	n/a		~100	YE	2 (2013-2020)	BD	>424 (1975-2015)	EG, IR, KW, QA, SA, YE
Total length of nesting sites (km)	35	LK	98-103	OM, YE	22	BD	91	EG, IR, OM, SA.AE
Nesting females / yr	n/a		30,000	OM	11	BD	>1,186	IR, OM, SA, AE, YE
Nests / female season (N)	n/a		5.5	OM	n/a		1.85 (116)	QA, SA, AE
Female remigration interval (yrs) (N)	n/a		n/a		n/a		N	AE
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		n/a		N	AE
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		n/a		20% (74)	QA

	Caretta caretta				*Chelonia mydas*			
RMU	**CC-NEIO**	**Country Chapters**	**CC-NWIO**	**Country Chapters**	**CM-NEIO**	**Country Chapters**	**CM-NWIO**	**Country Chapters**
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		N	AE
Min adult size, CCL or SCL (cm)	n/a		60-89 CCL	OM, PK	91.5 CCL	BD	32.0-67.5 CCL	IR, KW, OM, PK, QA, SA, SD
Age at maturity (yrs)	n/a		n/a		n/a		71.5 ± 3.82	SA
Clutch size (n eggs) (N)	105.2 (5)	LK	107 (161)	OM	122 (25)	BD	90.5 (374)	EG, IR, OM, QA, SD, AE
Emergence success (hatchlings/egg) (N)	n/a		n/a		92% (61)	BD	70% (302)	EG, IR, KW, QA, SA, AE
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a		62% (2,348)	SA, AE
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		Decreasing (1985-2013)	OM	Decreasing (2010-2020)	BD	Variable/Stable (2001-2018)	KW, QA, AE
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		n/a	BD	Stable (2004-2018)	AE
Oldest documented abundance: nests/yr (range of years)	n/a		30,000 (1979)	OM	5.6 (1996-2001)	BD	<554 (1982-2015)	EG, KW, QA, AE
Published studies								
Growth rates	n/a		n/a		N	BD	N	BH, DJ, EG, IN, IR, KW, QA, SD, AE
Genetics	n/a		n/a		N	BD	Y	IR, SA, AE
Stocks defined by genetic markers	n/a		Y	OM, YE	N	BD	Y	IR, SA, AE
Remote tracking (satellite or other)	n/a		Y	OM.PK	Y	BD	Y	IR, KW, OM, QA, AE
Survival rates	n/a		n/a		N	BD	N	BH, DJ, EG, IN, IR, KW, QA, SD, AE
Population dynamics	n/a		n/a		N	BD	N	BH, DJ, EG, IN, IR, KW, QA, SD, AE
Foraging ecology (diet or isotopes)	n/a		n/a		Y	BD	Y	AE
Capture-Mark-Recapture	n/a		n/a		Y	BD	Y	QA

	Caretta caretta				*Chelonia mydas*			
RMU	**CC-NEIO**	**Country Chapters**	**CC-NWIO**	**Country Chapters**	**CM-NEIO**	**Country Chapters**	**CM-NWIO**	**Country Chapters**
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y (PLL, SN)	LK	Y (SN, DN, GN, TR, HL)	OM, PK, YE	Y (DN, SN, LL)	BD	Y (DLL, DN, FP, GN, HL, SN, ST, TR)	BH, DJ, IR, OM, PK, QA, SA, SD, AE, YE
Bycatch: presence of industrial fisheries?	n/a		Y (ST, DN, PT)	OM, PK, YE	Y (ST, FT)	BD	Y (DN, OTH, PLL, SN, ST)	BH, IR, OM, PKSA, YE
Bycatch: quantified?	Y	LK	Y	OM, PK	Y (DN, SN)	BD	Y (FP)	BH, OM, PK, SA
Take. Intentional killing or exploitation of turtles	Y	LK	Y	OM, YE	Y	BD	Y	DJ, EG, OM, SD
Take. Eggs (illegal)	Y	LK	Y	OM, YE	Y	BD	Y	DJ, EG, IR, OM, SD, AE
Coastal Development. Nesting habitat degradation	n/a		Y	OM, YE	Y	BD	Y	EG, IR, KW, OM, QA, SA, AE
Coastal Development. Photopollution	Y	LK	Y	OM, YE	Y	BD	Y	DJ, IR, KW, OM, QA, SA, SD, YE
Coastal Development. Boat strikes	n/a		Y	YE	n/a		Y	BH, IR, SA, AE, YE
Egg predation	Y	LK	Y	YE	Y	BD	Y	EG, IR, OM, QA
Pollution (debris, chemical)	Y	LK	N	PK	Y	BD	Y	IR, SA
Pathogens	n/a		N	PK	Y	BD	N	PK
Climate change	n/a		N	PK	Y	BD	Y	QA, AE
Foraging habitat degradation	n/a		N	PK	Y	BD	Y	BH, IR, QA, SA, SD, AE
Other	n/a		Y	OM	n/a		Y	BH, OM, QA, SD
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	Y (2005-2017)	LK	Y (1977-2020)	YE	Y (1996-Ongoing)	BD	Y (5-28)	EG, IR, KW, OM, QA, SA, AE
Number of index nesting sites	n/a		3	OM, YE	4	BD	32	EG, IR, KW, OM, QA, SA, AE, YE
Monitoring at foraging sites (period: range of years)	n/a		N	PK	Y (2010-Ongoing)	BD	Y (4-15 yr)	EG, IR, KW, QA, SA, AE, YE

	Caretta caretta				*Chelonia mydas*			
RMU	**CC-NEIO**	**Country Chapters**	**CC-NWIO**	**Country Chapters**	**CM-NEIO**	**Country Chapters**	**CM-NWIO**	**Country Chapters**
Conservation								
Protection under national law	Y	LK	Y	OM, PK, YE	Y	BD	Y	BH, DJ, EG, IN, IR, KW, OM, PKQA, SA, SD, AE, YE
Number of protected nesting sites (habitat preservation) (% nests)	2 (U %)	LK	1	YE	4 (90%)	BD	>21 (0-100%)	EG, IN, IR, KW, OM, QA, SA, AE, YE
Number of Marine Areas with mitigation of threats	16	LK	2	PK, YE	0	IN	*9*	BH, DJ, IN, KW, SD, YE
N of long-term conservation projects (period: range of years)	2 (1996-2000; 2005-2012)	LK	1 (43)	OM	1 (2004-Ongoing)	BD, IN	15 (1986-Present)	EG, IR, OM, QA, SA, AE
In-situ nest protection (eg cages)	Y	LK	n/a		Y	BD	Y	IR
Hatcheries	Y	LK	n/a		Y	BD	Y	IR, QA
Head-starting	Y	LK	n/a		Y	BD	N	EG, IR, KW, QA, SA, AE
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		Y	PK	N	BD	Y	PK, SA
Bycatch: onboard best practices	n/a		Y	PK	Y	BD	Y	BH, PK, SA
Bycatch: spatio-temporal closures/reduction	n/a		Y	PK	Y	BD	Y	BH, PK, SA
Other	y	LK	n/a				Y	SA

Table 1b. Key biological information for sea turtle RMUs (DC-NEIO; EI-NEIO; EI-NWIO; EI-SWIO) in the Middle East and South Asia.

Country Chapters: BH- Bahrain; DJ- Djibouti; EG- Egypt; IN- India; IR- Iran; KW- Kuwait; MV- Maldives; OM- Oman; PK- Pakistan; QA- Qatar; SA- Saudi Arabia; LK- Sri Lanka; SD- Sudan; AE- United Arab Emirates; YE- Yemen.

	Dermochelys coriacea		***Eretmochelys imbricata***			
RMU	**DC-NEIO**	**Country Chapters**	**EI-NEIO**	**Country Chapters**	**EI-NWIO**	**Country Chapters**
Occurrence						
Nesting sites	Y	IN, LK	Y	IN, LK	Y	DJ, EG, IN, IR, KW, MV, OM, PK, QA, SA, SD, AE, YE
Pelagic foraging grounds	n/a		N	IN	Y	EG, IR, MV
Benthic foraging grounds	n/a		N	IN	*Y*	BH, DJ, KW, MV, OM, QA, SA, SD, AE, YE
Key biological data						
Nests/yr: recent average (range of years)	1431 (2008-2018)	IN, LK	54 (2014-2017)	LK	~2,000 (1979-2018)	EG, IR, KW, OM, QA, SA, AE
Nests/yr: recent order of magnitude	n/a		*n/a*		>1, 253	KW, MV, QA, SA, SD, AE, YE
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	14	IN, LK	0	LK	32	EG, IR, KW, OM, QA, SA, SD, AE, YE
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	47	IN, LK	17	LK	>86	EG, IR, KW, MV, OM, QA, SA, SD, AE, YE
Nests/yr at "major" sites: recent average (range of years)	97 (2016)	IN	n/a		<1,879 (1985-2016)	IR, QA, SA, YE
Nests/yr at "minor" sites: recent average (range of years)	3 (2016)	IN	n/a		>424 (1975-2015)	EG, IR, KW, QA, SA, YE
Total length of nesting sites (km)	96	LK	40	LK	91	EG, IR, OM, SA.AE
Nesting females / yr	170	LK	n/a		>1,186	IR, OM, SA, AE, YE
Nests / female season (N)	4.9	IN	n/a		1.85 (116)	QA, SA, AE
Female remigration interval (yrs) (N)	1	IN	n/a		N	AE
Sex ratio: Hatchlings (F / Tot) (N)	n/a		n/a		N	AE
Sex ratio: Immatures (F / Tot) (N)	n/a		n/a		20% (74)	QA
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		0.83-0.95	MV

	Dermochelys coriacea		*Eretmochelys imbricata*			
RMU	**DC-NEIO**	**Country Chapters**	**EI-NEIO**	**Country Chapters**	**EI-NWIO**	**Country Chapters**
Min adult size, CCL or SCL (cm)	140 CCL	IN	n/a		32.0-67.5 CCL	IR, KW, MV, OM, PK, QA, SA, SU
Age at maturity (yrs)	n/a		n/a		71.5 ± 3.82	SA
Clutch size (n eggs) (N)	103.8	IN, LK	115.2 (6)	LK	90.5 (374)	EG, IR, OM, QA, SD, AE
Emergence success (hatchlings/egg) (N)	n/a		n/a		69.9% (302)	EG, IR, KW, QA, SA, AE
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		61.5% (2,348)	SA, AE
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2008-2017)	IN	n/a		Variable toStable (2001-2018)	KW, QA, AE
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a		Stable to Increasing (2004-2019)	MV, AE
Oldest documented abundance: nests/yr (range of years)	n/a		n/a		<554 (1982-2015)	EG, KW, QA, AE
Published studies						
Growth rates	N	IN	N	IN	N	BH, DJ, EG, IN, IR, KW, MV, QA, SD, AE
Genetics	Y	IN	N	IN	Y	IR, SA, AE
Stocks defined by genetic markers	Y	IN	N	IN	Y	IR, SA, AE
Remote tracking (satellite or other)	Y	IN	N	IN	Y	IR, KW, OM, QA, AE
Survival rates	N	IN	N	IN	Y	MV
Population dynamics	N	IN	N	IN	Y	MV
Foraging ecology (diet or isotopes)	N	IN	N	IN	Y	AE
Capture-Mark-Recapture	Y	IN, LK	N	IN	Y	MV, QA

	Dermochelys coriacea		*Eretmochelys imbricata*			
RMU	**DC-NEIO**	**Country Chapters**	**EI-NEIO**	**Country Chapters**	**EI-NWIO**	**Country Chapters**
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (PLL)	LK	Y (PLL, SN)	LK	Y (DLL, DN, FP, GN, HL, SN, ST, TR)	BH, DJ, IR, OM, PK, QA, SA, SD, AE, YE
Bycatch: presence of industrial fisheries?	n/a		n/a		Y (DN, OTH, PLL, SN, ST)	BH, IR, OM, PK, SA, YE
Bycatch: quantified?	Y	LK	Y	LK	Y (FP)	BH, OM, PK, SA
Take. Intentional killing or exploitation of turtles	Y	LK	Y	LK	Y	DJ, EG, OM, SD
Take. Eggs (illegal)	n/a		Y	LK	Y	DJ, EG, IR, OM, SD, AE
Coastal Development. Nesting habitat degradation	n/a	LK	n/a		Y	EG, IR, KW, OM, QA, SA, AE
Coastal Development. Photopollution	n/a		Y	LK	Y	DJ, IR, KW, OM, QA, SA, SD, YE
Coastal Development. Boat strikes	Y	IN, LK	n/a		Y	BH, IR, SA, AE, YE
Egg predation	n/a		Y	LK	Y	EG, IR, OM, QA
Pollution (debris, chemical)	n/a		Y	LK	Y	IR, SA
Pathogens	n/a		n/a		N	PK
Climate change	n/a		n/a		Y	QA, AE
Foraging habitat degradation	n/a		n/a		Y	BH, IR, QA, SA, SD, AE
Other	n/a		n/a		Y	BH, MV, OM, QA, SD
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (2005-2018)	IN, LK	1 (2005-17)	LK	5-28	EG, IR, KW, MV, OM, QA, SA, AE
Number of index nesting sites	2	IN	n/a		32	EG, IR, KW, OM, QA, SA, AE, YE
Monitoring at foraging sites (period: range of years)	n/a		n/a		4-15 yr	EG, IR, KW, MV, QA, SA, AE, YE

	Dermochelys coriacea		*Eretmochelys imbricata*			
RMU	**DC-NEIO**	**Country Chapters**	**EI-NEIO**	**Country Chapters**	**EI-NWIO**	**Country Chapters**
Conservation						
Protection under national law	Y	IN, LK	Y	IN, LK	Y	BH, DJ, EG, IN, IR, KW, MV, OM, PK, QA, SA, SD, AE, YE
Number of protected nesting sites (habitat preservation) (% nests)	7 (U %)	IN, LK	3 (U %)	LK	>21 (0-100%))	EG, IN, IR, KW, MV, OM, QA, SA, AE, YE
Number of Marine Areas with mitigation of threats	16	IN, LK	16	LK	*9*	BH, DJ, IN, KW, SD, YE
N of long-term conservation projects (period: range of years)	2	IN, LK	2	LK	19 (1986-Present)	EG, IR, MV, OM, QA, SA, AE
In-situ nest protection (eg cages)	Y	LK	Y	LK	Y	IR
Hatcheries	Y	IN	Y	LK	Y	IR, QA
Head-starting	N	LK	N	LK	Y	MV
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a	LK	Y	PK, SA
Bycatch: onboard best practices	n/a		n/a	LK	Y	BH, MV, PK, SA
Bycatch: spatio-temporal closures/reduction	n/a		n/a	LK	Y	BH, PK, SA
Other	N	LK	Y	LK	Y	SA

Table 1c. Key biological information for sea turtle RMUs (LO-NEIO; LO-NEIO (Arr); LO-WIO) in the Middle East and South Asia.
Country Chapters: BD- Bangladesh; IN- India; MV- Maldives; OM- Oman; LK- Sri Lanka; SD- Sudan.

	Lepidochelys olivacea					
RMU	**LO-NEIO**	**Country Chapters**	**LO-NEIO (Arr)**	**Country Chapters**	**LO-WIO**	**Country Chapters**
Occurrence						
Nesting sites	Y	BD, IN, LK	Y	IN	Y	IN, MV, OM
Pelagic foraging grounds	Y	BD	N	IN	Y	OM, SD
Benthic foraging grounds	Y	BD	N	IN	Y	BH, OM
Key biological data						
Nests/yr: recent average (range of years)	9,417 (2000-2020)	BD, IN, LK	132,248 (2008-2016)	IN	1,795 (2000-2016)	IN, MV
Nests/yr: recent order of magnitude	896-1143 (2013-2020)	BD	14,849-405,784 (2008-2018)	IN	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	39	BD, IN, LK	2	IN	14	IN
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	66	BD, IN, LK	1	IN	23	IN, MV
Nests/yr at "major" sites: recent average (range of years)	7,851 (2000-2020)	BD, IN	n/a		1,730 (2000-2016)	IN
Nests/yr at "minor" sites: recent average (range of years)	509 (2000-2020)	BD, IN	n/a		64 (2000-2016)	IN
Total length of nesting sites (km)	>688	BD, IN, LK	6	IN	>92	IN
Nesting females / yr	n/a		n/a		151 (1982)	MV, OM
Nests / female season (N)	1-3	LK	n/a		n/a	
Female remigration interval (yrs) (N)	1-4 (77)	BD, LK	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)	58.65 CCL	BD	57 CCL	IN	71.5 SCL	OM
Age at maturity (yrs)	n/a		n/a		n/a	

	Lepidochelys olivacea					
RMU	**LO-NEIO**	**Country Chapters**	**LO-NEIO (Arr)**	**Country Chapters**	**LO-WIO**	**Country Chapters**
Clutch size (n eggs) (N)	109.5 (1556)	BD, LK	120.6 (246)	IN	118 (22)	OM
Emergence success (hatchlings/egg) (N)	84% (5, 759)	BD	78% (5362)	IN	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)	Stable (2000-2019)	BD, IN	Stable (2008-2016)	IN	Stable (2000-2016)	IN
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		150 (1982)	OM
Published studies						
Growth rates	N	BD, IN	N	IN	N	IN, MV, SD
Genetics	Y	IN	Y	IN	Y	IN
Stocks defined by genetic markers	Y	IN	Y	IN	Y	IN
Remote tracking (satellite or other)	Y	BD, IN	Y	IN	Y	MV, OM
Survival rates	N	BD, IN	N	IN	N	IN, MV, SD
Population dynamics	Y	IN	Y	IN	N	IN, MV, SD
Foraging ecology (diet or isotopes)	Y	BD	N	IN	N	IN, MV, SD
Capture-Mark-Recapture	Y	BD, LK	N	IN	N	IN, MV, SD
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (DN, PLL, SN)	BD, IN, LK	Y (SN, DN)	IN	Y (SN, DN, ST, MT)	BH, IN, OM, SD
Bycatch: presence of industrial fisheries?	Y (FT, PLL, PT, ST)	BD, IN	Y (PLL, ST, PT)	IN	Y (DN, ST, SN, OTH, PLL, PT)	BH, IN, OM, SV
Bycatch: quantified?	Y (DN, SN)	BD, LK	N	IN	Y	BH, MV, OM

	Lepidochelys olivacea					
RMU	**LO-NEIO**	**Country Chapters**	**LO-NEIO (Arr)**	**Country Chapters**	**LO-WIO**	**Country Chapters**
Take. Intentional killing or exploitation of turtles	Y	BD, LK	n/a		Y	OM
Take. Eggs (illegal)	Y	BD, LK	n/a		N	IN
Coastal Development. Nesting habitat degradation	Y	BD, IN	Y	IN	Y	IN, OM
Coastal Development. Photopollution	Y	BD, IN, LK	Y	IN	Y	IN, OM
Coastal Development. Boat strikes	Y	IN	Y	IN	Y	IN, MV
Egg predation	Y	BD, IN, LK	Y	IN	Y	IN
Pollution (debris, chemical)	Y	BD, IN, LK	Y	IN	Y	IN, MV
Pathogens	Y	BD	n/a		n/a	MV
Climate change	Y	BD	n/a		n/a	
Foraging habitat degradation	Y	BD	n/a		n/a	SD
Other	n/a		n/a		n/a	BH, SD
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y	BD, LK	Y (2008 ongoing)	IN	5 (2004-2008)	OM
Number of index nesting sites	15	BD	3	IN	1	OM
Monitoring at foraging sites (period: range of years)	2 (2010-ongoing)	BD	N	IN	N	BH, IN, MV
Conservation						
Protection under national law	Y	BD, IN, LK	Y	IN	Y	BH, IN, MV, OM, SD
Number of protected nesting sites (habitat preservation) (% nests)	18 (U-95 %)	BD, IN, LK	2 (50%)	IN	100%	MV
Number of Marine Areas with mitigation of threats	16	IN, LK	0	IN	6	BH, SD
N of long-term conservation projects (period: range of years)	>4	BD, IN, LK	>1	IN	5 (8)	MV, OM
In-situ nest protection (eg cages)	Y	BD, IN, LK	Y	IN	n/a	
Hatcheries	Y	BD, IN, LK	Y	IN	Y	IN
Head-starting	Y	BD, LK	N	IN	Y	MV

	Lepidochelys olivacea					
RMU	**LO-NEIO**	**Country Chapters**	**LO-NEIO (Arr)**	**Country Chapters**	**LO-WIO**	**Country Chapters**
Bycatch: fishing gear modifications (eg, TED, circle hooks)	N	IN	N	IN	N	IN
Bycatch: onboard best practices	N	BD, IN	N	IN	Y	BH, MV
Bycatch: spatio-temporal closures/reduction	Y	BD	N	IN	Y	BH
Other	Y	LK	n/a		n/a	

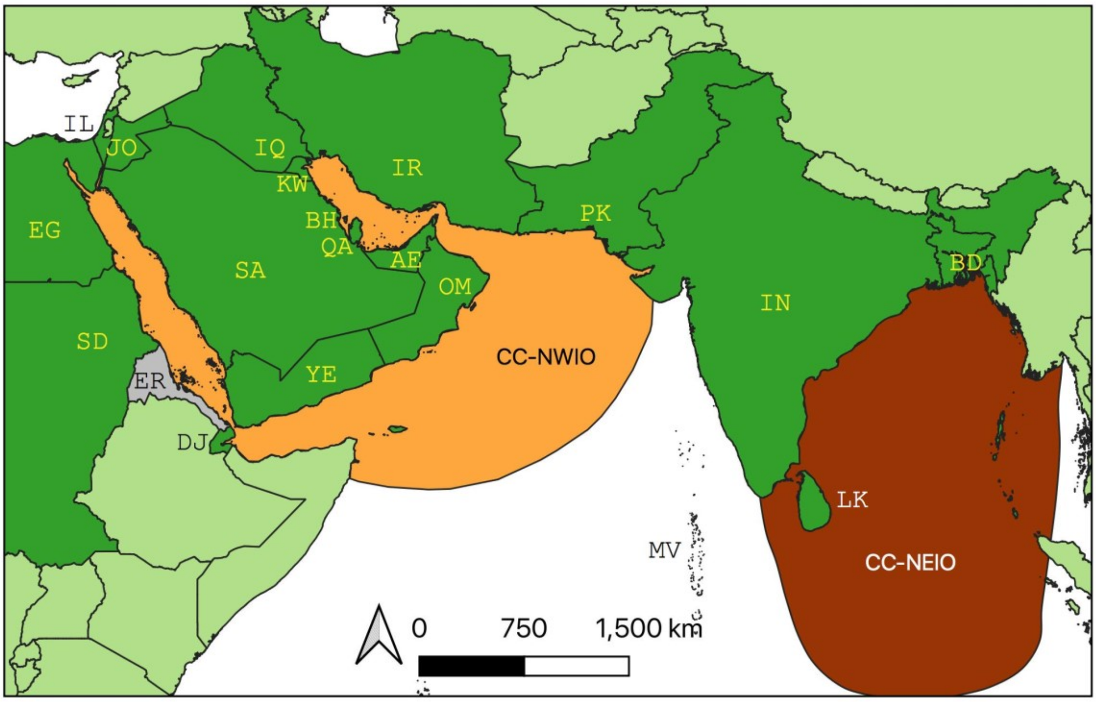

Figure 1. Regional Management Units for loggerhead sea turtles (*Caretta caretta*) in the Middle East and South Asia.

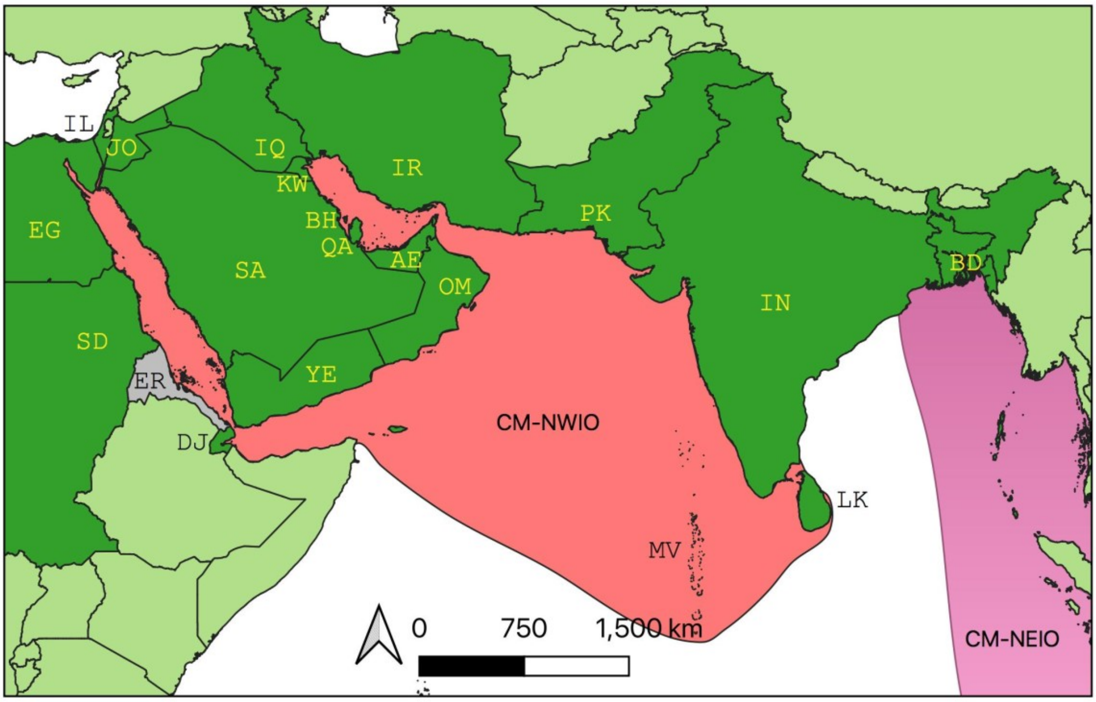

Figure 2. Regional Management Units for green sea turtles (*Chelonia mydas*) in the Middle East and South Asia.

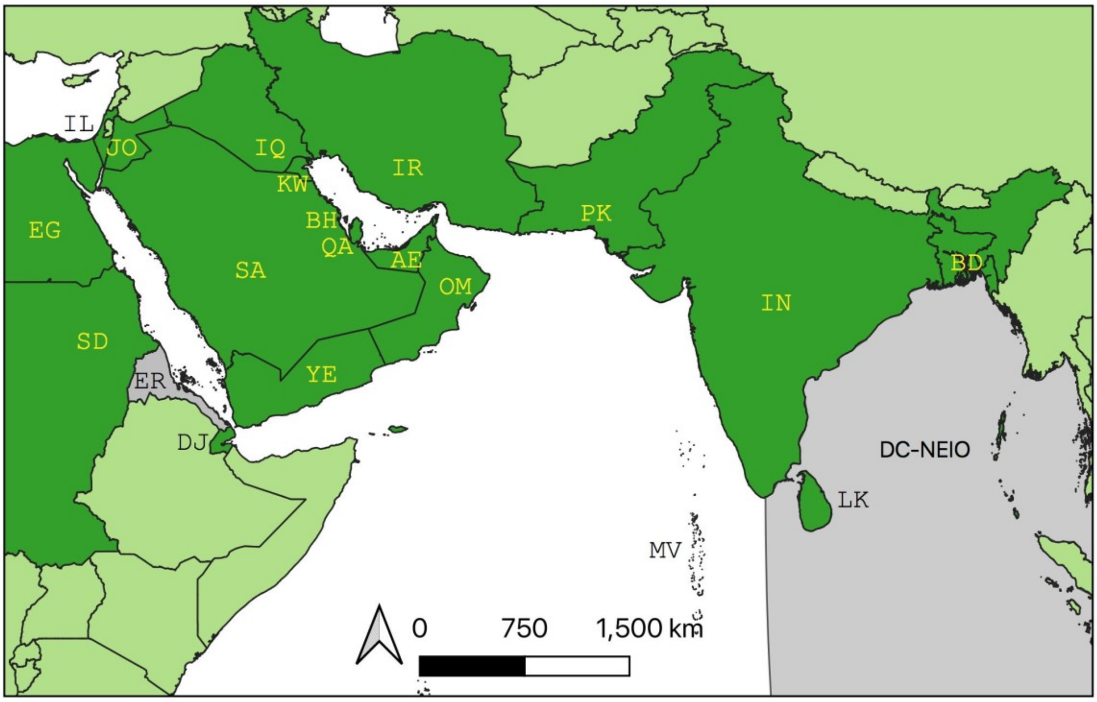

Figure 3. Regional Management Units for leatherback sea turtles (*Dermochelys coriacea*) in the Middle East and South Asia.

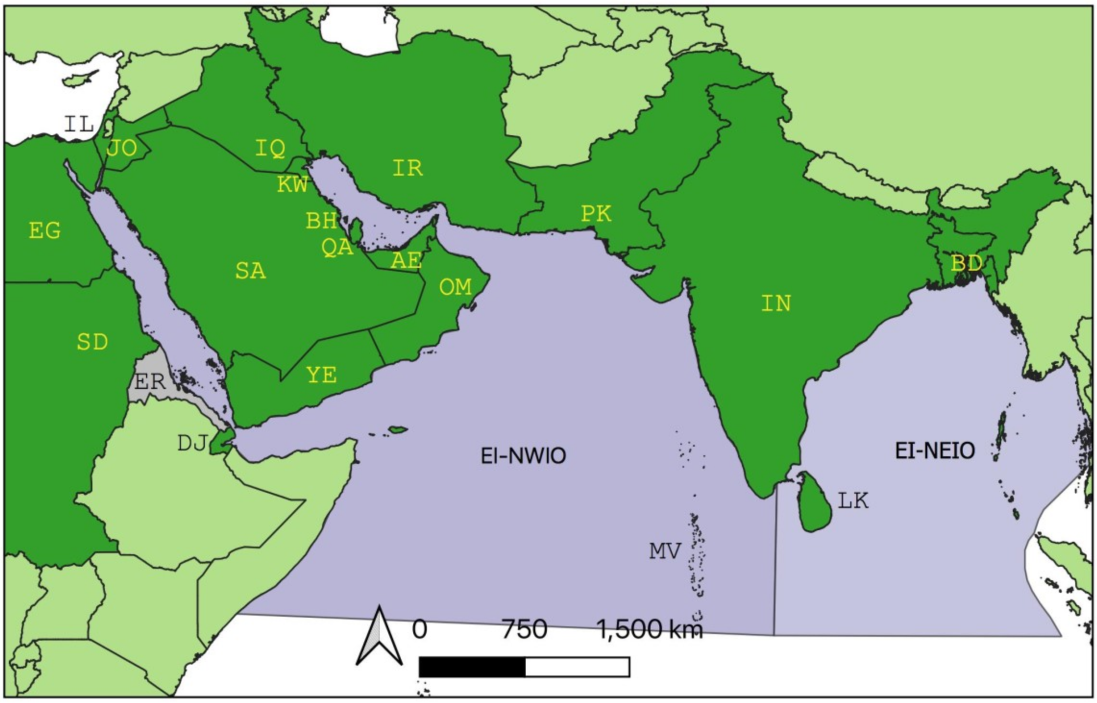

Figure 4. Regional Management Units for hawksbill sea turtles (*Eretmochelys imbricata*) in the Middle East and South Asia.

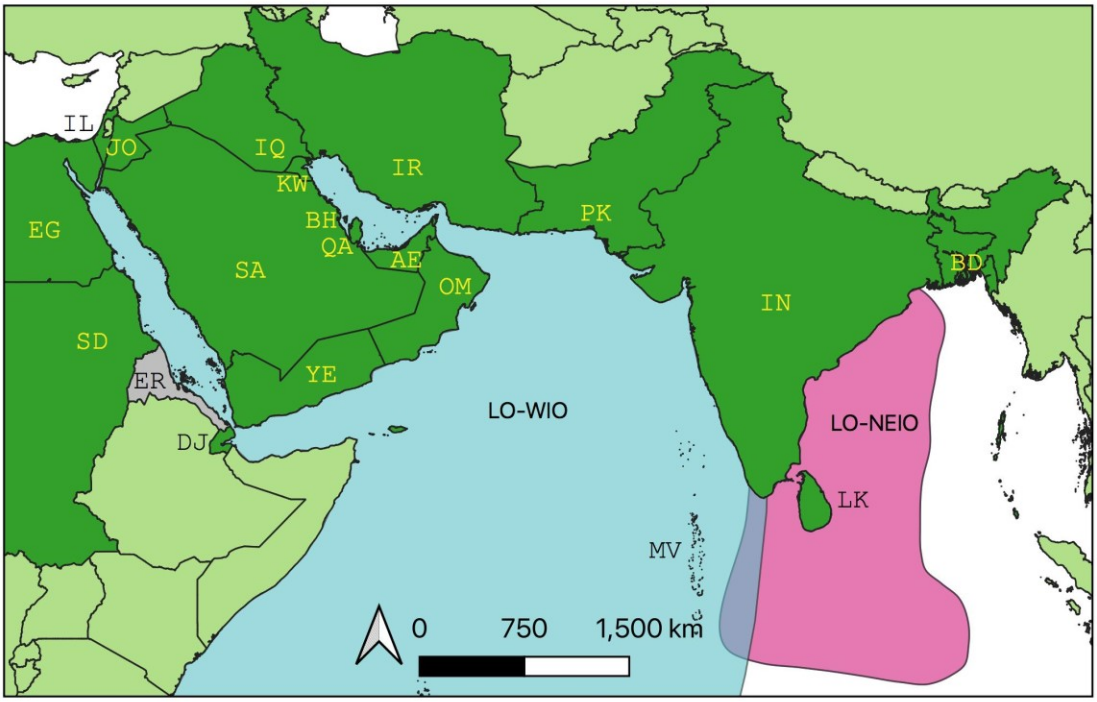

Figure 5. Regional Management Units for olive ridley sea turtles (*Lepidochelys olivacea*) in the Middle East and South Asia.

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BAHRAIN

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Introduction

Sea turtles do not nest in Bahrain and no substantiated historical records indicate they previously did [9]. However, five species of sea turtle have been recorded in Bahrainian waters. Green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) have been frequently observed, and these two species are reported on in detail below. Loggerhead turtles (*Caretta caretta*), leatherback turtles (*Dermochelys coriacea*) and olive ridley turtles (*Lepidochelys olivacea*) are identified in solitary or very infrequent records and are only briefly summarised.

1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Green turtles do not currently nest in Bahrain (Table 1; [9]). However, interviews with fishers suggest that they may have nested here approximately 30 years ago. Further investigation of the potential for nesting is required.

1.1.2 Marine areas

Bahrain's shallow territorial waters, which contain extensive sea grass beds, are inhabited by large numbers of green turtles (Table 1; [1,3,5,6,7,9]), which are the most frequently encountered turtles in Bahrain.

1.2 Other biological data

There is a lack of biological data on this species due to infrequent surveying efforts that focus mainly on the presence–absence of sea turtles (Table 1).

1.3 Threats

1.3.1 Nesting sites

No known nesting sites are currently present in Bahrain (Table 1; [9]). Extensive land reclamation projects that have altered Bahrain's natural coastline are increasingly inhibiting the potential for even low-level, sporadic nesting [8,13]; the exception is the Hawar Islands that remain in a relatively natural condition [7].

1.3.2 Marine areas

Boat-traffic, fisheries and habitat degradation have been identified as threats to green turtles in Bahrain (Table 1 [1,3,6,9]). Reportedly, turtles are not the target catch for consumption [2,45]; however, see [9].

1.4 Conservation

Turtles are afforded nominal legal protection in Bahrain under several international and national regulations (Table 3), with several established Marine Protected Areas [11]. Trawling and some gillnetting fisheries have seasonal closures [1]. Bahrain legislation prohibits the hunting of sea turtles or damaging their habitats (Al-Muhannadi, translation.).

There are a few additional on-going conservation efforts for sea turtles in Bahrain [14]. The Environment Friends Society and Bahrain Turtle Rescue Team have undertaken educational activities and turtle rehabilitation efforts (Al-Muhannadi, unpubl.).

1.5 Research

No research on the biology or ecology of green sea turtles in Bahrain has been published or is available online.

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Nesting of hawksbill turtles does not currently occur in Bahrain (Table 1; [9]). However, interviews with fishers suggest that they may have nested here approximately 30 years ago (Al-Muhannadi, unpubl.). Further investigation of the potential for nesting is required.

2.1.2 Marine areas

Boat-traffic, fisheries and habitat degradation have been identified as threats to hawksbill turtles in Bahrain (Table 1 [1,3,6,9]). Reportedly, turtles are not the target catch for consumption [2,45], However, little information is available [9].

2.2 Other biological data

There is a lack of biological data on this species due to infrequent surveying efforts that focus mainly on the presence-absence of sea turtles (Table 1).

2.3 Threats

2.3.1 Nesting sites

See 1.3.1.

2.3.2 Marine areas

See 1.3.2.

2.4 Conservation

See 1.4.

2.5 Research

No research on the biology or ecology of hawksbill sea turtles in Bahrain is published or available online.

3 Other Species

Loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and olive ridley (*Lepidochelys olivacea*) turtles have been occasionally observed in Bahraini waters [1, 10]. No nesting activity has been reported for these species.

Table 1. Characteristics of nesting marine turtles in Bahrain.

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Occurrence										
Nesting sites	N	9	N	9	N	9	N	9	N	9
Pelagic foraging grounds	n/a		n/a		n/a		n/a		n/a	
Benthic foraging grounds	Y	1,9	Y	1,3,5,6,7,9	U (1 turtle)	10	Y	1,3,6,9,12	Y (few turtles)	1
Key biological data										
Nests/yr: recent average (range of years)	n/a		n/a		n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		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		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)	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	
Sex ratio: Hatchlings (F / Tot) (N)	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	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Min adult size, CCL or SCL (cm)	n/a		n/a		n/a		n/a		n/a	
Age at maturity (yrs)	n/a		n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N)	n/a		n/a		n/a		n/a		n/a	
Emergence success (hatchlings/egg) (N)	n/a		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	
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/a		N		n/a	
Genetics	N		N		n/a		N		n/a	
Stocks defined by genetic markers	N		N		n/a		N		n/a	
Remote tracking (satellite or other)	N		N		n/a		N		n/a	
Survival rates	N		N		n/a		N		n/a	
Population dynamics	N		N		n/a		N		n/a	
Foraging ecology (diet or isotopes)	N		N		n/a		N		n/a	
Capture-Mark-Recapture	N		N		n/a		N		n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Threats										
Bycatch: presence of small scale / artisanal fisheries?	Y	PS	Y	PS	N	PS	Y	PS		
Bycatch: presence of industrial fisheries?	Y (DN, ST, SN, OTH, PLL)	1	Y (DN, ST, SN, OTH, PLL)	1,3,6	n/a		Y (DN, ST, SN, OTH, PLL)	1,3,6	Y (DN, ST, SN, OTH, PLL)	1
Bycatch: quantified?	Y (ST)	1	Y (ST)	1,3	n/a		Y (FP)	1	Y (FP)	1
Take. Intentional killing or exploitation of turtles	N	2,4	N	2,4,5 but see 9	N	2,4	N	2,4	N	2,4
Take. Eggs (illegal)	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Nesting habitat degradation	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Photopollution	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Boat strikes	n/a		Y	9	n/a		Y	9	n/a	
Egg predation	n/a		n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	n/a		n/a		n/a		n/a		n/a	
Pathogens	n/a		n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a		n/a	
Foraging habitat degradation	n/a		Y	9	n/a		Y	9	n/a	
Other	Y	8	Y	8	Y	8	Y	8	Y	8
Long-term projects (>5yrs)										
Monitoring at nesting sites (period: range of years)	n/a		n/a		n/a		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)	N		N		N		N		N	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Conservation										
Protection under national law	Y	1	Y	1,6	Y	1	Y	1,6	Y	1
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	5	11	5	11	5	11	5	11	5	11
N of long-term conservation projects (period: range of years)	n/a		n/a		n/a		n/a		n/a	
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a		n/a		n/a	
Head-starting	n/a		n/a		n/a		n/a		n/a	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a		n/a	
Bycatch: onboard best practices	Y	4	Y	4	Y	4	Y	4	Y	4
Bycatch: spatio-temporal closures/reduction	Y	1	Y	1	Y	1	Y	1	Y	1
Other	Y	1	Y	1,6	Y	1	Y	1,6	Y	1

Table 2. International conventions signed by Djibouti in relation to marine turtle conservation.

International Conventions	Signed
RAMSAR	1998
IOSEA MoU for Marine Turtles	2007
CITES	2012

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BANGLADESH

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Introduction

Including all beaches, islands and sand bars, the Bangladesh coastline is 710km long, of which 400km has a sandy substrate suitable for sea turtle nesting. Regular monitoring of sea turtle nesting began at St. Martin's Island in 1996, and at Sonadia Island and locations on the Cox's Bazar-Teknaf peninsula in 2005/06. Additional locations have been monitored since 2013. The NGO Marinelife Alliance currently coordinates regular monitoring during the winter (October-April), when nesting occurs, and incidental monitoring during the May-September monsoon period. The entire coast is monitored, with specific emphasis on south east and south-central beaches [29,30,38-41]. More than 200km of nearshore area is monitored by local fishers, who have contributed information to a bycatch and stranding monitoring programme over the last 15 years [48-49]. A project in 2018/19 investigated nesting on the coast of the Sundarbans, a large mangrove forest on the border with India [41].

1 RMU: *Chelonia mydas*, North-East Indian Ocean (CM-NEIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Green turtle nesting occurs at several locations on the southeast coast of Bangladesh: St. Martin's Is., Sonadia Is., Haserchar Is., and Sahporirdwip and Shilkhali of Teknaf peninsula (Figure 1) [29,30,39-41]. Incidental nesting of green turtles has been recorded at additional locations of the Teknaf peninsula: Borodail, Teknaf, Monkhali, and at Sandwip Is.. Green turtle nesting is believed to have been widespread until the 1980s [42]. St. Martin's Is. has been considered the most important nesting site for the species, although the nesting frequency is very low (Table 1).

1.1.2 Marine Areas

Juvenile green turtles have been caught in fishing nets while foraging at St. Martin's Is. and Sonadia Is. [38-42]. Adult green turtles have been observed foraging at Sandwip Is. and along the northern Chittagong coast, while sub-adults forage in shallow waters along the south-central coast (Figure 2).

1.2 Other biological data

Summarised in Table 1.

1.3 Threats

1.3.1 Nesting sites

Threats at nesting beaches have been observed since the beginning of sea turtle monitoring and conservation work in 1996 at St. Martin's Is.. The illegal take of eggs was the major threat before conservation activities, especially at Teknaf Is. [5-12, 15, 16, 22, 25, 29]. *Casuarina* plantations at nesting beaches alter beach morphology [22]. Beach seine fishing during high tide at night endangers emerging nesting turtles at Sonadia Is. and peninsular beaches [22,29,30]. Tourism development and Marine Drive (an 80km coastal road) construction has altered nesting habitat and disturbed turtles over the last 15 years at St. Martin's Is. and peninsular beaches due to increased artificial lighting and human activity at night [5-12,15,16,22,25,29,38-42]. Dogs and Asian water monitors (*Varanus salvator*) also depredate turtle nests, even those relocated to hatcheries, and jackals have also recorded searching for nests [29]. Rocks that were stacked during the 1980s to form rockwalls to prevent tidal erosion have been gradually buried and now act as an obstacle for nesting turtle at St. Martin Is.s [12]. Heavy siltation has occurred along the north and north-eastern coast of Sandwip Is. and may have contributed to the decline of nesting green turtles from occasional records in 1985 [43].

1.3.2 Marine areas

The major threat to green sea turtles in Bangladesh waters is bycatch in drifting gill nets, bottom set gill nets, estuarine/marine set bag nets (ESBNs and MSBNs), and mechanised trawl nets. Increased awareness over the last 24 years has changed the attitude of offshore fishers and intentional killing of bycaught turtles due to superstition is now rare [5]. However, many bycaught turtles are still later found stranded dead. MSBNs and trawlers are primarily responsible for most of the bycatch. TED (Turtle Excluder Device) use became mandatory in 2006, but even with a gazetteer notification and legislation requiring TED use, the devices are still not used by the mechanised trawl fleet [29]. There are >50,000 MSBNs in Bangladesh, each a small version of a passive trawl net and hence require TEDs to keep smaller cetaceans and sea turtles safe from bycatch. Juvenile and subadult green turtles are more frequently caught as bycatch, with subadults also trapped in beach seines at Sonadia Is., St. Martin's Is., and Teknaf peninsula [30]. However, each year gravid turtles are found dead during monitoring for nesting turtles [28, 29, 30, 38-42].

1.4 Conservation

Bangladesh Forest Department (BFD) is the sole authority for all wildlife in the country and all permits. Sea turtles were not included in the Bangladesh Wildlife Conservation Act 1973, although BFD and other officials assisted NGOs in their sea turtle conservation efforts. Sea turtles were finally included on the protected list of Bangladesh Wildlife (Preservation & Protection) Act in 2012. Briefly, the laws state that: "*No person may take, harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or attempt to engage in any such conduct to sea turtles, turtle nests, and/or turtle eggs." Any person who knowingly violates any provision of the ACT may be assessed civil penalties and/or up to a certain year imprisonment*.

The Bangladesh government enacted rules for mandatory TED use on all shrimping trawl net in Bangladesh marine waters with the Marine Fisheries Ordinance, 1983 (ordinance No. XXXV of 1983), section 55 BRDs (Rules 14 & 14a), SRO No. 330-Law/2006. Since 2006, TEDs have been mandatory for all trawl nets of vessels fishing in the marine waters of Bangladesh.

Although signatory to international agreements to protect sea turtles (Table 3), the Bangladesh government has no regular programme of sea turtle conservation. Limited government supported activities have been conducted from 2000-2008 under different projects. Sea turtle conservation at St. Martin's Is. began in 1996 by NGO CARINAM and continued for 18 months. The most comprehensive long-term monitoring and conservation project is being conducted by Marinelife

Alliance (MLA) since the 2004-05 season. During 2013-16, the MLA sea turtle programme explored all nesting areas in Bangladesh under a Bangladesh Forest Department Project (SRCWPP) funded by World Bank [29]. The organisation has continued the monitoring and conservation with administrative support and collaboration from the BFD and local and international support [22, 29, 30, 38-41].

1.5 Research

Flipper tagging started in 2000 and is ongoing, with tags applied to turtles nesting along the entire coast [29]. Satellite tracking studies began in 2010 and is also ongoing along the south-central coast [29]. One nesting female and one subadult female have been tracked so far. The nesting female, satellite-tagged at Sonadia Is., travelled northward to the south-central coast, the Sundarbans, then later spent weeks in the shallow habitats of Vitarkanika National Park in India, within the tributaries of Abul Kalam Is. and Kanika Is. (Figure 2). The sub-adult turtle travelled to the shallow water of Myengu Is. of Myanmar, where it remained in a very small area for more than one month (Figure 3) [50]. Additional tracking studies to determine migration pathways are required. Tissue sampling to understand population genetics is ongoing [42].

Fifteen permanent monitoring stations facilitate monitoring and conservation and provide a base for researchers and conservationists. Local community members, numbering 50-60, are regularly deployed for turtle observation and ensure protection of nests, and nesting turtles from predation and illegal take. Bycatch and stranding are monitored at all nesting beaches and at sea by offshore fishers. The captains of >2,200 artisanal fishing vessels along Cox's Bazar and the south-central coast have been trained to reduce bycatch and contribute data.

2 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (LO-NEIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Olive ridley nests have been recorded on sandy beaches of the mainland and coastal islands along the entire Bangladesh coast (Figure 1). Areas of importance on the south-east coast are: Cox's Bazar to Teknaf, St. Martin's Is., Sonadia Is., Ladiarchar, Haserchar, Kutubdia Is., Gohira, and Sandwip Is.. On the south-central coast, important areas are: Nijhum Is., Sonarchar, Leburchar, and Lalkakrar char at Kuakata. Incidental nesting also occurs at Dublarchar, Mandarbaria, Egg Is., Jamtala-Kotka, Putney Is., and Dwipchar on the south-west coast and the Sundarban mangrove coast [29, 30, 41, 42]. However, most nesting occurs on the south-east coast, especially Sonadia Is., Cox's Bazar-Teknaf, and Haserchar (Table 1 and 2).

2.1.2 Marine areas

Non-breeding olive ridley turtles spend much of their time in pelagic waters. Known foraging habitat for olive ridley turtles includes the south-central coast and Sundarbans coastline, as well as open ocean in which they forage during migration. Olive ridley turtles nesting in Bangladesh use multiple migration corridors, which are not yet clearly defined. Nesting turtles tagged in Bangladesh have been tracked to waters off the states of Andhra Pradesh and Orissa in India. Mating olive ridley turtles can be observed during September-October annually within 2-3km of the Bangladesh coast.

2.2 Other biological data

See Table 1.

2.3 Threats

2.3.1 Nesting sites

An LNG port terminal and coal-based power generation project work has been started by the Bangladesh government at Matarbari and Haserchar nesting beaches. In addition, Sonadia Is. has been leased by the Government to Bangladesh Economic Zone Authority (BEZA) for tourism development. Therefore, these nesting hotspots are now under threat [20,21,39-41]. The Sundarban mangrove forest coastline is dynamic and erodes in multiyear cycles. During a 2018 survey, complete erosion was observed at Mandarbaria and Nilkomol [41]. See also Section 1.3.1.

2.3.2 Marine areas

Olive ridley sea turtles foraging and migrating along the Bangladesh coast are threatened by the >50,000 MSBN and other fisheries in Bangladesh waters from Cox's Bazar to the Sundarbans [29,30,41]. See also Section 1.3.2.

2.4 Conservation

Protection of eggs *in situ* and in hatcheries has resulted in a hatching success between 76-98% and release of >750,000 hatchlings since 1996 (29, 30, 38-42). See also Section 1.4.

2.5 Research

Olive ridley turtles have been tagged with flipper tags as described in Section 1.5 and passive integrated transponders (PIT tags). Satellite telemetry studies have shown different post-nesting migration pathways. Travel towards Orissa and Andhra Pradesh in India occurs over the continental shelf, with turtles remaining within 50-100km of the coast. Turtles may also move through open waters of the Bay of Bengal to the east coast of Indian east coast then south to the Chennai coast. Turtles may also traverse the Bay of Bengal to Sri Lankan waters, with some proceeding to the Lakshadweep Islands on the west coast of India and Padam Is. in the Arabian Sea. See also Section 1.5.

3 RMU: *Eretmochelys imbricata*, North-East Indian Ocean (EI-NEIO)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

No hawksbill sea turtles have been recorded nesting in Bangladesh since 1998. Prior to that, the only records were from St. Martin's Is. (see Figure 1 for location).

3.1.2 Marine areas

Juvenile and sub-adult hawksbill turtles have been observed off the Teknaf peninsula, Cepotkhali, Shilkhali and Sonadia Is..

3.2 Other biological data

n/a

3.3 Threats

3.3.1 Nesting sites

Curio item traders in Bangladesh previously tried to collect live or dead hawksbill turtles to make decorative showpieces, and such items of such stuff were seen in shops of Cox's Bazar until 2000 [11]. See also Section 1.3.

3.3.2 Marine areas

Juvenile hawksbill turtles observed in Bangladesh waters were entangled in ghost nets, rescued by fishers, then rehabilitated and released. The species is thought to be vulnerable to entanglement in live-, such as beach seine nests, and ghost-gear because of the shape of its carapace [30, 47].

3.4 Conservation

See also Section 1.4.

4 RMU: *Dermochelys coriacea*, North-East Indian Ocean (DC-NEIO)

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

Community elders at St. Martin's Is. remember leatherback turtles at the remote Badamgonia nesting site (see Figure 1 for location) before the 1970s [12].

4.1.2 Marine areas

The first record of a leatherback turtle in Bangladesh was a dead adult female found washed ashore in St. Martin's Is. in 1997. No observations of live turtles in coastal waters have been reported since 2005, but 57 offshore fishers have seen the species at sea, 50-60kms south-west of St. Martin's Is. [30,38-42].

4.2 Other biological data

n/a

4.3 Threats

4.3.1 Nesting sites

n/a

4.3.2 Marine areas

n/a

4.4 Conservation

Fishers are trained in identification of the species so observations can be reported.

4.5 Research

See also Sections 1.5 and 2.5.

Table 1. Characteristics of nesting marine turtles in Bangladesh.

	Chelonia mydas		*Lepidochelys olivacea*		*Eretmochelys imbricata*		*Dermochelys coriacea*	
RMU	**CM-NEIO**	Ref #	**LO-NEIO**	Ref #	**EI-NEIO**	Ref #	**DC-NEIO**	Ref #
Occurrence								
Nesting sites	Y	29-30,38-42	Y	29-30,38-42	N	12,29-30,38-42	N	29-30,38-42
Pelagic foraging grounds	Y	29-30,38-42	Y	29-30,38-42	Y	28,29-30,38-42	Y	29-30,38-42
Benthic foraging grounds	Y	29-30,38-42	Y	29-30,38-42	Y	28,29-30,38-42	N	29-30,38-42
Key Biological Data								
Nests/yr: recent average (range of years)	11.2 (2013-2020)	29-30,38-42	956.33 (2013-2020)	29-30,38-42	3(1998)	12	N	
Nests/yr: recent order of magnitude	10-13	29-30,38-42	896-1143 (2013-2020)	29-30,38-42	N/A		N	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	N/A		7	29-30,38-42	N/A		N	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	4	29-30,38-42	15	29-30,38-42	N/A		N	
Nests/yr at "major" sites: recent average (range of years)	5 (2013-2020	29-30,38-42	531 (2013-2020)	29-30,38-42	N/A		N	
Nests/yr at "minor" sites: recent average (range of years)	2 (2013-2020)	29-30,38-42	140 (2013-2020)	29-30,38-42	N/A		N	
Total length of nesting sites (km)	22	29-30,38-42	400	29-30,38-42	N/A		N	
Nesting females / yr	11.3	29-30,38-42	N/A		N/A		N	
Nests / female season (N)	N/A		N/A		N/A		N	
Female remigration interval (yrs) (N)	N/A		1 (1)	14	N/A		N	
Sex ratio: Hatchlings (F / Tot) (N)	N/A		N/A		N/A		N	
Sex ratio: Immatures (F / Tot) (N)	N/A		N/A		N/A		N	
Sex ratio: Adults (F / Tot) (N)	N/A		N/A		N/A		N	
Min adult size, CCL or SCL (cm)	91.5 CCL	12,22,29,30	58.7 CCL	12,22,29,30	N/A		138 (1)	12
Age at maturity (yrs)	N/A		N/A		N/A		N	
Clutch size (n eggs) (N)	122 (25)	29,30	114(1526)	29,30	N/A		N	

	Chelonia mydas		*Lepidochelys olivacea*		*Eretmochelys imbricata*		*Dermochelys coriacea*	
RMU	**CM-NEIO**	Ref #	**LO-NEIO**	Ref #	**EI-NEIO**	Ref #	**DC-NEIO**	Ref #
Emergence success (hatchlings/egg) (N)	92.2% (61)	29-30,38-42	84.2% (5,759)	29-30,38-42	N/A		N	
Nesting success (Nests/ Tot emergence tracks) (N)	N/A		N/A		N/A		N	
Trends								
Recent trends (last 20 yrs) at nesting sites (range of years)	Decreasing (2010-2020)	29-30,38-42	Stable (2001-2019)	29-30,38-42	Nil (1996-2019)	29-30,38-42	Nil (2001-2019)	29-30,38-42
Recent trends (last 20 yrs) at foraging grounds (range of years)	N/A		Increasing (2014-19)	29-30,38-42	Increasing (2014-19)	29-30,38-42	Decreasing (2013-19)	29-30,38-42
Oldest documented abundance: nests/yr (range of years)	5.6 (1996-2001) St. Martin Is.	12	95.4 (1996-2001) St. Martin Is.	12	3 (1998)	12	1 (2000-01)	12
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	29,30	Y	29,30	N		N	
Survival rates	N		N		N		N	
Population dynamics	N		N		N		N	
Foraging ecology (diet or isotopes)	Y	29,30	Y	29,30	N		N	
Capture-Mark-Recapture	Y	29,30	Y	29,30	Y	29,30	N	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y (DN,SN, LL)	5-7,9-12,15-16,22-23,25,28,29-42	Y(DN,SN,ll)	5-7,9-12,15-16,22-23,25,28,29-40	Y (DN,SN)	5-7,9-12,15-16,22-23,25,28,29-42	Y (DN,SN)	5-7,9-12,15-16,22-23,25,28,29-42
Bycatch: presence of industrial fisheries?	Y (ST,FT)	5-7,9-12,15-16,22-23,25,28,29-42	Y (ST,FT)	5-7,9-12,15-16,22-23,25,28,29-40	Y (ST)	5-7,9-12,15-16,22-23,25,28,29-42	Y (ST)	5-7,9-12,15-16,22-23,25,28,29-42
Bycatch: quantified?	Y (DN,SN)	23,30,34-42	Y (DN,SN)	23,30,34-40	Y (DN,SN)	23,30,34-42	Y (DN,SN)	23,30,34-42

	Chelonia mydas		*Lepidochelys olivacea*		*Eretmochelys imbricata*		*Dermochelys coriacea*	
RMU	**CM-NEIO**	Ref #	**LO-NEIO**	Ref #	**EI-NEIO**	Ref #	**DC-NEIO**	Ref #
Take. Intentional killing or exploitation of turtles	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-40	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Take. Eggs (illegal)	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-40	N/A		N/A	
Coastal Development. Nesting habitat degradation	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-41	Y	5-7,9-12,15-16,22-23,25,28-41	Y	5-7,9-12,15-16,22-23,25,28-41
Coastal Development. Photopollution	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Coastal Development. Boat strikes	N/A		N/A		Y		Y	
Egg predation	Y	5-7,9-12,15-16,22-23,25,28-45	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Pollution (debris, chemical)	Y	5-7,9-12,15-16,22-23,25,28-46	Y	5-7,9-12,15-16,22-23,25,28-46	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Pathogens	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Climate change	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Foraging habitat degradation	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42	Y	5-7,9-12,15-16,22-23,25,28-42
Other	N/A		N/A		N/A		N/A	
Long-Term Projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	Y (1996-Ongoing)	6-7,9,15-16,22,24,27,29-30,34,36,38-42	Y (1996- Ongoing)	6-7,9,15-16,22,24,27,29-30,34,36,38-42	Y (1996- Ongoing)	6-7,9,15-16,22,24,27,29-30,34,36,38-42	Y (1996- Ongoing)	6-7,9,15-16,22,24,27,29-30,34,36,38-42
Number of index nesting sites	4	29,30	15	6-7,9,15-16,22,24,27,29-30,34,36,38-42	1	29,30	1	29,30

	Chelonia mydas		*Lepidochelys olivacea*		*Eretmochelys imbricata*		*Dermochelys coriacea*	
RMU	**CM-NEIO**	Ref #	**LO-NEIO**	Ref #	**EI-NEIO**	Ref #	**DC-NEIO**	Ref #
Monitoring at foraging sites (period: range of years)	2 (2010-Present)	6,7,9,15,16,22,24, 27,29,30,34,36,39,42	2 (2010-Present)	6,7,9,15,16,22,24, 27,29,30,34,36,39,42	2 (2010-Present)	6,7,9,15,16,22,24, 27,29,30,34,36,39,42	2 (2010-Present)	6,7,9,15,16,22,24, 27,29,30,34,36,39,42
Conservation								
Protection under national law	Y	29,30	Y	29,30	Y	29,30,38-42	Y	29,30,38-42
Number of protected nesting sites (habitat preservation) (% nests)	4(90%)	29,30	11(95%)	29,30	1(95%)	29,30,38-42	1(95%)	29,30,38-42
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)	1 (2004-Ongoing)	29,30	1 (2004-ongoing)		1 (2004-ongoing)	6,7,9,15,16,22, 24,27,29,30,34, 36,39,42	1(2004-ongoing)	6,7,9,15,16,22, 24,27,29,30,34, 36,39,42
In-situ nest protection (eg cages)	Y	6,7,9,15,16,22,24, 27,29,30,34,36,39,42	Y	6,7,9,15,16,22,24, 27,29,30,34,36,39,42	Y	29,30,38-42	Y	29,30,38-42
Hatcheries	Y	6,7,9,15,16,22, 24,27,29,30,34, 36,39,42	Y	6,7,9,15,16,22, 24,27,29,30,34, 36,39,42	Y	29,30,38-42	Y	29,30,38-42
Head-starting	Y	38-42	Y	38-42	Y	38-42	Y	38-42
By-catch: fishing gear modifications (eg, TED, circle hooks)	N		N		N		N	
By-catch: onboard best practices	Y	23,30,34-42	Y	23,30,34-42	Y	23,30,34-401a	Y	23,30,34-401a
By-catch: spatio-temporal closures/reduction	Y	29-30	Y	29-30	Y	29-30	Y	29-30
Other	Y	29,30	Y	29,30	Y	29,30,38-42	Y	29,30,38-42

Table 2. RMU Index nesting beaches of sea turtles in Bangladesh.

RMU 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)
				Long	Lat	Long	Lat	Long	Lat					
CM-NEIO														
St. Martin Is.	Y	11.25 (1996-2020)	9.23 (1996-2020)					92.32262	20.608516	5	100	6,7,9,11,12,16	1	A,B
Cox's Bazar-Teknaf Peninsula	Y	2.1 (2004-2013)	1 (2004-2013)	92.34526	20.73198	91.94401	21.45881			25	80	29,30	1,2	A,B
Teknaf Peninsula	Y	2.1 (2013-2020)	1 (2013-2020)	92.34526	20.73198	91.94401	21.45881			98	100	29,30,38-42	1	A,B
Sonadia Is.	Y	3.1 (2004-2020)	2 (2004-2020)					91.872059	21.489034	13	100	20-23, 29,30,38-42	1	A,B
Haserchar, Dholghata	Y	3.1 (2013-2020)	3 (2013-2020)					91.84877	21.6719	6	100	29,30, 40-42	1	A,B
LO-NEIO														
St. Martin Is.	Y	82.8 (1996-2020)	33.0 (1996-2020)					92.32262	20.608516	5	100	6-7,9,11-12,16,29-30,38-42	1	A,B
Cox's Bazar-Teknaf Peninsula	Y	88.9 (2004-2013)	23.9 (2004-2013)	92.34526	20.73198	91.94401	21.45881			25	80	30	1,2	A,B
Teknaf Peninsula	Y	283.7 (2013-2020)	65 (2013-2020)	92.34526	20.73198	91.94401	21.45881			98	100	29,30	1	A,B
Sonadia Is.	Y	215.1 (2004-2020)	35.2 (2004-2020)					91.872059	21.489034	13	100	20-23, 29,30,38-42	1,2	A,B
Kaladia, Laldia	Y	5 (2013-2020)	3 (2013-2020)					91.852421	21.586081	6	50	29,30,38-42	1,3	A,B
Haserchar, Dholghata	Y	55.3 (2013-2020)	14.7 (2013-2020)					91.84877	21.67190 -	6	100	29,30,38-42	1,4	A,B
Matarbari	N	12.7 (2013-2020)	4.3 (2013-2020)					91.876649	21.724694	4	100	29,30,38-42	1,5	A,B
Kutubdia	N	14.3 (2013-2020)	6.2 (2013-2020)					91.837074	21.847621	5	100	29,30,38-42	1,6	A,B

RMU 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)
				Long	Lat	Long	Lat	Long	Lat					
Bashkhali	N	2.0 (2013-2020)	1 (2013-2020)					91.870319	22.005259	2	50	29,30,38-42	1,7	A,B
Gohira	N	2.7 (2013-2020)	1 (2013-2020)					91.843283	22.118190,	3	50	29,30,38-42	1,8	A,B
Kuakata	Y	8.7 (2013-2020)	4.2 (2013-2020)					90.141330°	21.795939	5	80	29,30,38-42	1,10	A,B
Sonar Char	N	9.3 (2013-2020)	4.2 (2013-2020)					90.380613	21.838968	2	30	29,30,38-42	1,11	B
Dimer Char	N	4 (1991)						89.858962	21.826689,		5 obs	40-43	2	F
Dublar Char	N	3 (1994)						89.571103	21.721580,	1	5 obs	40-44	2	F
Mandarbaria Beach	N	3 (2003)						89.25795	21.658968,	1	1 obs	40-42,44	2	F
EI-NEIO														
St. Martin Is.	Y	3 (1998-1999)						92.32262	20.608516	5	100	12	1	A
DC-NEIO														
St. Martin Is.	Y	1 (2000-01)						92.32262	20.608516	5	100	12	1	A

Table 3. International conventions signed by Bangladesh in relation to marine turtle conservation.

Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions
Convention on International Trade in Endangered Species of Flora & Fauna (CITES, Washington, 1973)	1981 Ratified in 1982	Country must adopt national legislation under the framework established by the CITES.	All marine turtles.	All marine turtle species.	
United Nations Framework Convention on Climate Change, New York,	1992		All marine turtles.	All marine turtle species.	
Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn 1979)	2000	This convention is an inter-governmental treaty that Becomes legally binding when agreements are signed and included into national legislation.	All marine turtles.	All marine turtle species.	
Indian Ocean South East Asian Memoranda of Understanding (MoU)on Marine turtles	2004	Latest report 2014	All marine turtles.	All marine turtle species.	
Convention on Biological Diversity (CBD, Rio 1992)	1992 Ratified in 1994	Internationally binding Treaty	Implemented in signatory countries by national committees that have to prepare national action plans and ensure their implementation.	All marine turtle species.	Aiming at conserving biodiversity in signatory countries, promoting sustainable use of resources and fair sharing of benefits from genetic resources.
United Nations Convention on the Law of the Sea (UNCLOS, Montego Bay 1972)	1984	Aiming at establishing guidelines for the use of marine resources.		All marine turtle species.	
International Convention on Oil Pollution Preparedness, Response and Cooperation, London, 1990.	1990				

Table 4. Current and past marine turtle projects in Bangladesh.

#	RMU	Region / Location	Project Name or descriptive title	Key words	Start Date	End Date	Leading Organisation	Public Private	Reports / Information Material
T4.1	CM-NEIO LO-NEIO EI-NEIO	St. Martin Is., Cox Bazar	Marine turtle project at St. Martin Is.,	Nesting Female, survey	1996	1998	CARINAM	Private	12, 40,41
T4.2	CM-NEIO LO-NEIO EI-NEIO	St. Martin Is., Cox Bazar	St. Martin Pilot Project, NCSIP-1, MOEF	Nesting Female, survey, Flipper Tagging	2000	2001	MOEF NCSIP-1	Public	9
T4.3	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Cox Bazar	St. Martin Project, MOEF	Nesting Female, survey	2001	2005	MOEF	Public	16
T4.4	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Sahporirdwip, Ruppoti, Inani, Pechardwip, Sonadia Is.	Sea turtle Monitoring & Conservation along the Coast of Cox's Bazar, Bangladesh.	Nesting female survey, in situ & ex situ conservation, education & awareness programme	2004	2007	Marinelife Alliance	Private	www.seaturtlebd.org
T4.5	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Sahporirdwip, Ruppoti, Inani, Pechardwip, Sonadia & BOB	Marine megafauna bycatch reduction effort in Bangladesh marine territory.	Nest protection, monitoring, conservation, offshore fishermen bycatch training,	2007	2011	Marinelife Alliance	Private	www.seaturtlebd.org
T4.6	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Sahporirdwip, Ruppoti, Inani, Pechardwip, Sonadia & BOB	Sea turtle Monitoring & Conservation along the Coast of Cox's Bazar, Bangladesh.	Nest protection, monitoring, conservation, offshore fishermen bycatch training,	2007	2013	Marinelife Alliance	Private	www.seaturtlebd.org
T4.7	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Sahporirdwip, Ruppoti, Inani, Pechardwip, Sonadia & BOB	community based Sea turtle conservation project in Cox's Bazar,	nesting protection, monitoring, conservation, bycatch training, Satellite tracking	2008	2010	Marinelife Alliance	Private	www.seaturtlebd.org
T4.8	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Teknaf-Cox Bazar, Sonadia; South Central coast, BOB	Community based sea turtle conservation project in Cox's Bazar,	Nesting protection, monitoring, conservation, offshore fishermen bycatch training, Satellite tracking, flipper & PIT tagging	2013	2017	Marinelife Alliance	Private	www.seaturtlebd.org

T4.9	CM-NEIO LO-NEIO EI-NEIO	St. Martin Is., Cox Bazar	Study of ecology and habitat of Green sea turtle around St. Martin Is., Bangladesh	Green Turtle, Sea Grass, Foraging ST. Martin Is.	2008	2009	Marinelife Alliance	Private	www.seaturtlebd.org
T4.10	CM-NEIO LO-NEIO EI-NEIO	Cox Bazar coast	Sea turtle Bycatch Survey and reduction effort	Bycatch reduction, survey, monitoring, fishermen training, outreach	2009	2010	Marinelife Alliance	Private	www.seaturtlebd.org
T4.11	CM-NEIO LO-NEIO EI-NEIO	St. Martin, Teknaf-Cox Bazar, Sonadia; South Central coast, BOB	Conservation of Sea Turtle in Bangladesh Coastal & Marine Territory	Nest monitoring, conservation, bycatch training, Satellite tracking, flipper/PIT tagging	2013	2016	Marinelife Alliance	Private	www.seaturtlebd.org
T4.12	CM-NEIO LO-NEIO EI-NEIO	Whole Southeast, south central and southwest Coast	Community Based sea turtle restoration programme in Bangladesh	Nest monitoring, conservation, bycatch training, Satellite tracking, flipper & PIT tagging	2017	2018	Marinelife Alliance	Private	www.seaturtlebd.org
T4.13	CM-NEIO LO-NEIO EI-NEIO	Whole Bangladesh Coast: southeast, south central and southwest	Sea turtle restoration programme along entire Bangladesh coast and Myanmar.	Nest protection, monitoring, conservation, bycatch reduction & training, Satellite tracking, flipper & PIT tagging	2017	2019	Marinelife Alliance	Private	www.seaturtlebd.org

#	Current Sponsors	Primary Contact (name and email)	Other Contacts (name and Email)	Beginning of the Time Series	End of the Time Series	Nest Data	Flipper Tagging	Remote Tracking
T4.1	IUCN/MTSG	SMA Rashid carinam.bangladesh@gmail.com	M. Zahirul Islam msi@marinelifealliance.org	1996	1998	Y	N	N
T4.2	MOEF/GOB /NORAD	MOEF (M. Z. Islam worked as Project Officer)	M. Sazedul Islam (sazed_marine@yahoo.com)	2000	2001	Y	Y	N
T4.3	MOEF/GOB	MOEF (M. Z. Islam was in charge of Turtle activity)	M. Sazedul Islam (sazed_marine@yahoo.com)	2001	2005	Y	Y	N
T4.4	KNCF-Japan	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2005	2006	Y	Y	N
T4.5	KNCF-Japan	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2006	2008	Y	Y	N
T4.6	US Fish & Wildlife Service	M. Zahirul Islam marinelife.al@gmail.com	M. Sazedul Islam (sazed_marine@yahoo.com)	2008	2009	Y	Y	Y
T4.7	Whitley Fund for Nature (WFN)-UK	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2008	2010	Y	Y	Y
T4.8	US FWS WFN-UK	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2009	2010	Y	Y	Y
T4.9	PADI Foundation	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam	2009	2009	Y	Y	N

			(sazed_marine@yahoo.com)					
T4.10	Duke University, USA	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2009	2009	Y	Y	N
T4.11	Bangladesh Forest The World Bank	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2013	2016	Y	Y	Y
T4.12	US Fish & Wildlife Service	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2010	2014	Y	Y	Y
T4.13	Whitley Fund for Nature (WFN)-UK	M. Zahirul Islam (marinelife.al@gmail.com)	M. Sazedul Islam (sazed_marine@yahoo.com)	2013	2015	Y	Y	Y

Figure 1. Known nesting sites for sea turtles in Bangladesh.

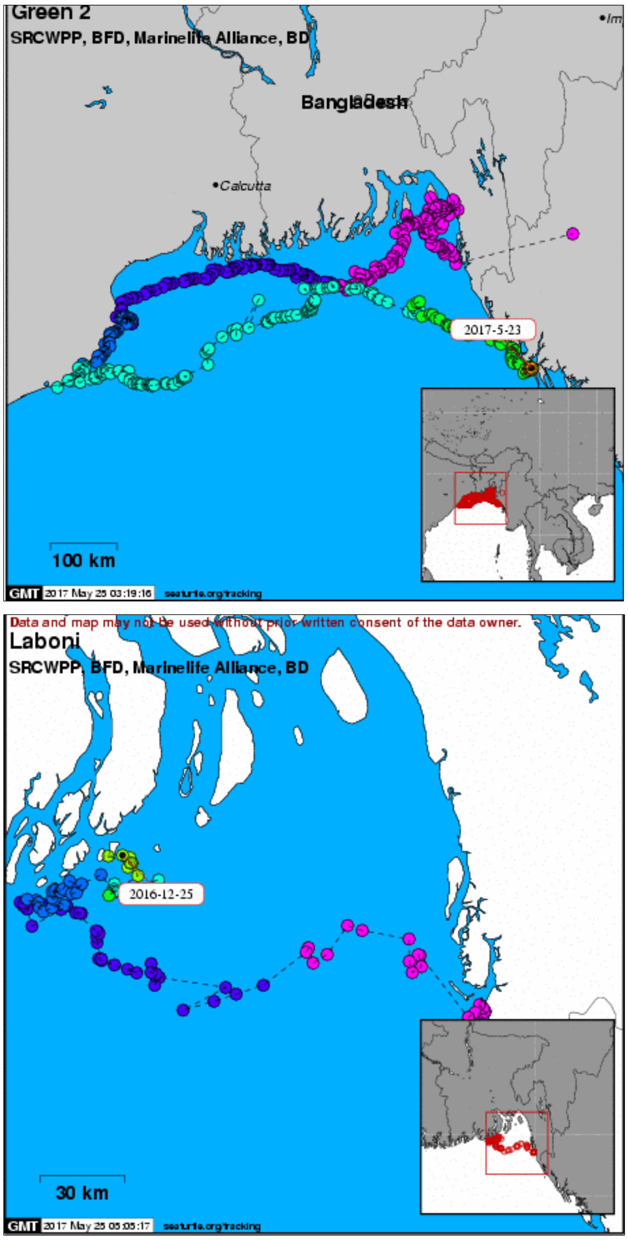

Figure 2. The migration routes and foraging areas of green turtles nesting in Bangladesh.

Figure 3. The foraging habitat of a post-nesting green turtle tagged in Bangladesh. The area is near Sittwe, Myanmar, and is heavily used for fishing.

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DJIBOUTI

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Introduction

Four species of sea turtle have been recorded in Djiboutian waters. Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles are more frequently observed and have a low-density nesting population; these two species are further detailed below. Foraging loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles are identified from solitary or very infrequent records and are only summarised briefly in the following text.

1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Green turtles appear to be the most common nesting species of sea turtle in Djibouti; however, the only available population estimate is ~100 in 2003 (Table 1; [1,5]).

1.1.2 Marine areas

There are limited records of in-water green turtles, but these include green turtles tagged in Sri Lanka [1,3], Oman and Yemen [3]. No data on distribution, abundance or trends is available.

1.2 Other biological data

There is a lack of biological data on this species (Table 1).

1.3 Threats

1.3.1 Nesting sites

Threats on nesting beaches include the take of sea turtles and their eggs, habitat degradation due to coastal development, litter, photopollution and noise pollution (Table 1; [3,4,6]).

1.3.2 Marine areas

Artisanal fisheries are considered the greatest threat to foraging sea turtles in Djibouti (Table 1 [3]). Stuffed turtles were previously reported as widely available and openly sold in 2000 [9].

1.4 Conservation

Turtles are afforded legal protection under several international and national regulations in Djibouti (Table 3) and in several Marine Protected Areas [5,8].

1.5 Research

No research on the biology or ecology of sea turtles, assessment of threats to turtles or their habitats in Djibouti is published or available online.

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Hawksbill turtles are reported to nest in Djibouti (Table 1; [3,5]); however, there are no records of distribution, abundance or trends.

2.1.2 Marine areas

No data on the distribution or abundance of hawksbill turtles in Djiboutian waters is available (Table 1).

2.2 Other biological data

There is a lack of biological data on this species (Table 1).

2.3 Threats

2.3.1 Nesting sites

See 1.3.1.

2.3.2 Marine areas

See 1.3.2.

2.4 Conservation

See 1.4.

2.5 Research

See 1.5.

3 Other Species

Loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles have been occasionally observed in Djibouti [1,5]. No nesting activity of either of these species has been reported. Further, no information about their biology or ecology is available.

Table 1. Characteristics of nesting marine turtles in Djibouti.

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence								
Nesting sites	N		Y	1,5	N		Y	3,5
Pelagic foraging grounds	N		N		Y	1	N	
Benthic foraging grounds	Y	1,5	Y	1,5	N		Y	5,6
Key biological data								
Nests/yr: recent average (range of years)	n/a		n/a		n/a		n/a	n/a
Nests/yr: recent order of magnitude	n/a		~100	5	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	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)	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
Sex ratio: Hatchlings (F / Tot) (N)	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
Sex ratio: Adults (F / Tot) (N)	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
Age at maturity (yrs)	n/a		n/a		n/a		n/a	n/a
Clutch size (n eggs) (N)	n/a		n/a		n/a		n/a	n/a

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**
Emergence success (hatchlings/egg) (N)	n/a		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
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	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	N		N		N		N	N
Foraging ecology (diet or isotopes)	N		N		N		N	N
Capture-Mark-Recapture	N		N		N		N	N
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y	1,6	Y	1,6,9	Y	1,6	Y	1,6,9
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	Y	4	Y	4	Y	4	Y	4,7
Take. Eggs (illegal)	n/a		Y	4	n/a		Y	4

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**
Coastal Development. Nesting habitat degradation	n/a		Y	6	n/a		n/a	
Coastal Development. Photopollution	Y	3	Y	3	Y	3	Y	3
Coastal Development. Boat strikes	n/a		n/a		n/a		n/a	
Egg predation	n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	n/a		Y	6	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		Y	6	n/a		n/a	
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)	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) (% nests)	n/a		n/a		n/a		n/a	
Number of Marine Areas with mitigation of threats	2	5,8	2	5,8	2	5,8	2	5,8
N of long-term conservation projects (period: range of years)	n/a		n/a		n/a		n/a	
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	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a	
Bycatch: onboard best practices	n/a		n/a		n/a		n/a	
Bycatch: spatio-temporal closures/reduction	n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		n/a	

Table 2. Index nesting sites in Djibouti.

RMU/ Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
CM-NWIO								
Maskali Is	n/a	n/a	n/a	n/a	n/a	1,5	2	n/a
Moucha Is	n/a	n/a	n/a	n/a	n/a	1,5	2	n/a
Ras Siyyan	n/a	n/a	n/a	n/a	n/a	5	2	n/a
Sept Freres Is.	n/a	n/a	n/a	n/a	n/a	5	2	n/a
EI-NWIO								
Ras Siyyan	n/a	n/a	n/a	n/a	n/a	1,5	2	n/a
Sept Freres Is.	n/a	n/a	n/a	n/a	n/a	1,5	2	n/a
Unknown Species								
Il de l'Est	n/a	n/a	n/a	n/a	n/a	9	2	n/a
Grand Isle	n/a	n/a	n/a	n/a	n/a	9	2	n/a

Table 3. International conventions signed by Djibouti in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions
Marine Fishery Administration Law for the Red Sea State	Y	n/a	n/a	All	n/a
African onvention on the Conservation of Nature and Natural Resources	Y	n/a	n/a	All	n/a
CITES	Accession	n/a	n/a	All	n/a
CMS	Y	n/a	n/a	All	n/a
CBD	Accession	n/a	n/a	All	n/a
RAMSAR	Y	n/a	n/a	All	n/a
Jeddah	Y	n/a	n/a	All	n/a
UNCLOS	Y	n/a	n/a	All	n/a
National Conventions					
Decree 80-62/PR/MCTT 25th May 1980	Y	n/a	n/a	All	n/a
Fishery Laws	Y	n/a	n/a	All	n/a

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EGYPT

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1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Green turtles are widely distributed along the Egyptian Red Sea coast (low level, sporadic nesting activities) and on most islands [1,2,4,5,6]. Fourteen beaches have been identified as being of high value for green turtle nesting activities [1], but monitoring has occurred only at three sites: Zabargad Is., Ras Bagdai and Um El-Abas.

Zabargad Is. has been monitored almost annually from 2001 to present and is considered the most important nesting site for green turtles in Egypt, if not the Red Sea (*Editors' Note: See also chapter on Saudi Arabia*), with approximately 500-600 nests recorded every year [1,2,4,7] (Figure 1, Table 1). Ras Bagdadi and Um El-Abas have been monitored annually from 2001 to 2008, with respectively an average of 19.3 and 16.3 nests on each site.

The three sites occur within the boundaries of the Red Sea Protectorates [1], so they are all protected however some poaching of nests has been observed (estimated 0-10%; Mancini and ElSadek, pers. obs.).

1.1.2 Marine areas

For green turtles, at least five important feeding grounds have been identified [3,8,9,10] and approximately 157 sites have been monitored by a citizen science project between 2011 and 2015 [3,13] (Figure 2).

1.2 Other biological data

Little information is available on genetics of green turtles in the Egyptian Red Sea as only one study has been conducted [10]. In the study, samples from 11 green turtles nesting on Zabargad Is. were analyzed and showed similarities with the Saudi Arabian Red Sea populations.

Four adult nesting females were tagged with satellite tags in 2010, which demonstrated migrations in all directions: north towards Hurghada and Sharm El-Sheik, south towards Eritrea, west towards the Egyptian coastline and around Zabargad Is. [11]. Flipper tagging data have shown that green turtles nesting on the Saudi Arabian coast (Ras Baridi) use foraging grounds on the Egyptian side after the nesting season (Mancini, unpubl.).

1.3 Threats

1.3.1 Nesting sites

No study exists in Egypt quantifying the impact of threats to nesting grounds, nevertheless previous surveys and studies have shown that eggs are occasionally subject to illegal takeby people living along the coast and fisher-folk with access to remote islands and predated by feral dogs and wildlife [7]. Intensified traffic on roads close to the shoreline and therefore to nesting sites is also a cause of concern (Hanafy, unpubl.).

1.3.2 Marine areas

Main threats to marine turtles in marine areas are: directed harvest for sale (there are reports of turtles being caught for sale to tourists or for the Asian market where powder obtained from carapaces and bones is used as medicine (Elsadek and Mancini, unpubl.) and consumption [4,7]; bycatch [7,12]; pollution (including oil spills and marine debris) [2,7]; harassment (Montagna, pers. comm.); and boat strikes (reports of turtles with broken carapaces have been shared through a citizen science platform; Montagna, Mancini and Taher, unpubl.) [7, 9].

1.4 Conservation

In Egypt, marine turtles and their most commonly used habitats are protected by many national laws and decrees, but the most important one is Law 4/1994 then modified by Law 9/2009 on the Environment, which states in article 28 that “It is forbidden to hunt, kill, or catch the species of wild birds and animals determined in the executive regulations of this Law or to possess, transport, circulate with, sell or offer to sell such birds and animals either dead or alive”. The law includes marine turtles and other species mentioned in international conventions for which Egypt is a signatory country (see Table 3 for a non-exhaustive list) [7].

As marine turtles are protected by law, the Egyptian Environmental Affairs Agency (EEAA) and local NGOs like the Hurghada Environmental Protection and Conservation Association (HEPCA) are working towards enforcing the existing law, nevertheless the area to monitor is extensive and the enforcement in place is not sufficient to cover it all [7].

1.5 Research

Consistent efforts have been put in place to monitor Zabargad Is., a major nesting ground for green turtles in the Red Sea [1,4,10] (Table 4).

A three-year monitoring of green turtles in their most important feeding grounds has been conducted between 2011 and 2013, monthly. Partial results have been published, showing monthly abundance of green turtles at index sites [3,8,10] (Table 4).

A citizen science programme has been launched in 2011 and is on-going, more than 2,000 reports have been collected mostly for green and hawksbill turtles [9,13] (Table 4). This project is providing information on population structure, species distribution, short-term migrations, sex ratio, and site fidelity (Mancini, unpubl.) [8,9,13].

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Hawksbill turtles' most important nesting sites are located on islands in the northern area of the Egyptian Red Sea (Figure 1): Big Giftun, Small Giftun and Shedwan Islands. Big Giftun Is. was monitored annually from 2001 to 2015 with an average of 15.3 nests per year annually [1, 14], while Small Giftun Is. was monitored annually between 2001 and 2008, with an average of 8.2 nests per year [1]. For Shedwan Is., only qualitative data are available, as access to the island is forbidden [1].

Both Big Giftun and Small Giftun Islands are within the boundaries of the Red Sea Protectorates [1], so the nesting sites are protected, however some illegal take of eggs is possible (estimated at 0-10% of total nests; Mancini and Elsadek, pers. obs.). Shedwan Is. is not yet protected but a proposal has been made to put it under the jurisdiction of the Red Sea Protectorate (Hanafy, unpubl.).

2.1.2 Marine areas

Approximately 157 sites have been monitored by a citizen science project between 2011 and 2015 [3,13] (Figure 2). Hawksbill turtles have been observed at most dive and snorkeling sites, in association with coral reefs, but limited data is available on their abundance and distribution [8,13].

2.2 Other biological data

n/a

2.3 Threats

2.3.1 Nesting sites

No study exists in Egypt quantifying the impact of threats to nesting grounds. Nevertheless, previous surveys and studies have shown that eggs are occasionally subject to illegal take by people living along the coast and fisher-folk with access to remote islands and predated by feral dogs and wildlife [7]. Intensified traffic on roads close to the shoreline and therefore to nesting sites is also a cause of concern (Hanafy, unpubl.). In a recent study focused on Big Giftun Is., the presence of rubbish and the degradation of the shoreline have been identified as a possible cause of decreased nesting numbers in the area [14].

2.3.2 Marine areas

See 1.3.2.

2.4 Conservation

See 1.4.

2.5 Research

Many gaps exist in our knowledge of hawksbill turtles in the Egyptian Red Sea. Nesting activities for hawksbill turtles have been monitored in the past but we lack recent information [1, 2] (Table 4). We have no information on population genetics or migrations. Through a citizen science initiative, data on population structure, abundance and seasonality at popular sighting spots are being collected but are not yet published [9, 13] (Table 4).

3 Other species

Loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and olive-ridley (*Lepidochelys olivacea*) turtles have been occasionally observed in the Egyptian Red Sea. No nesting activity has been reported for any of these species. Their occurrence in marine habitats is considered rare [5, 7].

Table 1. Characteristics of nesting marine turtles in Egypt.

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence				
Nesting sites	Y	1,7	Y	1, 14
Pelagic foraging grounds	JA	4,5,10	JA	3, 9, 10
Benthic foraging grounds	JA	3	n/a	
Key biological data				
Nests/yr: recent average (range of years)	570.7 (2012-2014)	10	15.3 (2001-20015)	1, 14
Nests/yr: recent order of magnitude	500-600	1, 10	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	1	1, 2, 4, 10	0	1
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	2	1	2	1
Nests/yr at "major" sites: recent average (range of years)	570.7 (2012-2014)	10	n/a	
Nests/yr at "minor" sites: recent average (range of years)	17.7 (2001 - 2007)	1	15.3 (2001-20015)	1, 14
Total length of nesting sites (km)	7	1	13	1
Nesting females / yr	228 (2012-2014)	10	n/a	
Nests / female season (N)	2.5	10	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)	89 CCL	10	n/a	
Age at maturity (yrs)	n/a		n/a	
Clutch size (n eggs) (N)	100.1 (12)	1	74 (13)	1
Emergence success (hatchlings/egg) (N)	87.2% (8 nests)	1	66.5% (11 nests)	1
Nesting success (Nests/ Tot emergence tracks) (N)	32% (246, 2012-2014)	10	n/a	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2001-2014)	1,4,10	unknown	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	~700 (2003)	2	< 200 females (1982)	5
Published studies				
Growth rates	N		N	
Genetics	Y	10	N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	Y	11	N	
Survival rates	N		N	
Population dynamics	N		N	
Foraging ecology (diet or isotopes)	N		N	
Capture-Mark-Recapture	Y	8	N	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y, various types of nets	12	N	12
Bycatch: presence of industrial fisheries?	N		N	
Bycatch: quantified?	N	12	N	12
Take. Intentional killing or exploitation of turtles	Y	5,7	Y	5,7
Take. Eggs (illegal)	Y	7	Y	2
Coastal Development. Nesting habitat degradation	Y	7	Y	7, 14
Coastal Development. Photopollution	n/a		n/a	
Coastal Development. Boat strikes	Y	7	n/a	
Egg predation	Y	1	y	5
Pollution (debris, chemical)	n/a		n/a	
Pathogens	n/a		n/a	
Climate change	n/a		n/a	
Foraging habitat degradation	n/a		n/a	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	Y (2001-ongoing)	1,2,4,5,6,10	Y (2001 - 2008)	1,2
Number of index nesting sites	1	1,2,4	2	1,2
Monitoring at foraging sites (period: range of years)	Y (2011 - 2015)	3,8,9,10	Y (2011 - 2015)	3,8,9,10
Conservation				
Protection under national law	Y	7	Y	7
Number of protected nesting sites (habitat preservation) (% nests)	3 (0-10%)*	1	3 (0-10%)*	1
Number of Marine Areas with mitigation of threats	N		N	
N of long-term conservation projects (period: range of years)	3 (2001 – ongoing)	1, 3, 8,9,10	2 (2001 – ongoing)	1, 9
In-situ nest protection (eg cages)	N		N	
Hatcheries	N		N	
Head-starting	N		N	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	N		N	
Bycatch: onboard best practices	N		N	
Bycatch: spatio-temporal closures/reduction	N		N	
Other	N		N	

*estimated, based on observed poached nests (Mancini and Elsadek, pers.obs.)

Table 2. Index nesting sites in the Egyptian Red Sea.

Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Central point		Length (km)*	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
				Long	Lat				
CM-NWIO									
Umm-Al Abas	N	16.3 (2001-2007)	29.4 (2001-2007)	35.13717	24.52597	1.0	2, Google Earth Pro	2	3 to 10 consecutive days during nesting season (possibly towards end of season)
Ras Bagdadi	N	19.3 (2001-2006)	29.8 (2001-2006)	35.10153	24.66622	2.0	2, Google Earth Pro	2	3 to 10 consecutive days during nesting season (possibly towards end of season)
Zabargad Is.	Y	570.7 (2012-2014)	1660 (2012-2014)	35.80281	23.83475	3.0	2, 10, Google Earth Pro	1	F (but based on 3-11 consecutive night surveys
EI-NWIO									
Big Giftun	NA	18.6 (2001, 2003-2007)	93.8 (2001, 2003-2007)	33.95281	27.25975	8.0	2, Google Earth Pro	2	3 to 10 consecutive days during nesting season (possibly towards end of season)
Small Giftun	NA	8.2 (2001, 2003-2007)	26.8 (2001, 2003-2007)	33.98989	27.2155	2.0	2, Google Earth Pro	2	3 to 10 consecutive days during nesting season (possibly towards end of season)

*In reference 2, table 3 and 4 there is a column with 'area length meter', this length refers to the portion of the beach monitored during that time but the nesting beaches are longer so the approx. Length was estimated using Google Earth Pro based on surveys done by the authors in recent years.

Table 3. International conventions signed by Egypt in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on biological Diversity (CBD)	Y	Y		ALL		Internationally binding treaty aiming at conserving biodiversity in signatory countries, promoting sustainable use of resources and fair sharing of benefits from genetic resources.
Convention on International Trade of Endangered Species (CITES)	Y	Y		ALL		All species of marine turtles are listed in appendix I which forbids trade of these species in all signatory countries except in exceptional circumstances. In order to be legally binding, each signatory country must adopt national legislation under the framework established by CITES.
Convention on Migratory Species (CMS)	Y	N		ALL		All species of marine turtles are listed in Appendix 1 (listing migratory species threatened with extinction) and Appendix 2 (migratory species for which conservation status would benefit from international cooperation).
MoU on Marine Turtles and their Habitats of the Indian Ocean and South-East Asia	Y	N		ALL		

Table 4. Current and past marine turtle projects in Egypt.

#	RMU	Project Name or descriptive title	Key words	Start date	End date	Leading organisation	Public/ Private	Reports / Information material	Primary Contact (name and Email)	Database available	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	Ref #
T4.1	CM-NWIO	Marine turtles of the Red Sea	In-water monitoring; snorkeling transect; feeding grounds	2011	2013	HEPCA	Public	HEPCA (2012)	Agnese Mancini (agnee.mancini01@gmail.com)	Y		2010	2013	n	n	n	n	3,9
T4.2	CM-NWIO	Monitoring of nesting activities in Zabargad Is.	Nesting; Green turtles; Egypt; Red Sea	2000	On-going	EEAA	Public		Dr Hanafy, Islam Elsadek	Y	Zabargad	2001	2016	y	y	y	n	1,2, 10, 11
T4.3	CM-NWIO	TurtleWatch Egypt	Citizen science; in-water monitoring; photo-id	2011	On-going	HEPCA, BEC	Public	HEPCA (2012); Montagna et al (2017); Mancini and Elsadek (in press)	Agnese Mancini (agnee.mancini01@gmail.com)	y		2011	2015	n	n	n	n	3,9, 13
T4.4	EI-NWIO	TurtleWatch Egypt	Citizen science; in-water monitoring; photo-id	2011	On-going	HEPCA, BEC	Public	HEPCA (2012); Montagna et al (2017); Mancini and Elsadek (in press)	Agnese Mancini (agnee.mancini01@gmail.com)	y		2011	2015	n	n	n	n	3,9,13
T4.5	EI-NWIO	Monitoring of nesting activities	Nesting; hawksbill turtles; Egypt; Red Sea	2001	2008	EEAA	Private	Hanafy, pers. comm.	Dr Hanafy	N		2001	2008	y	y	n	n	Hanafy, pers. comm.

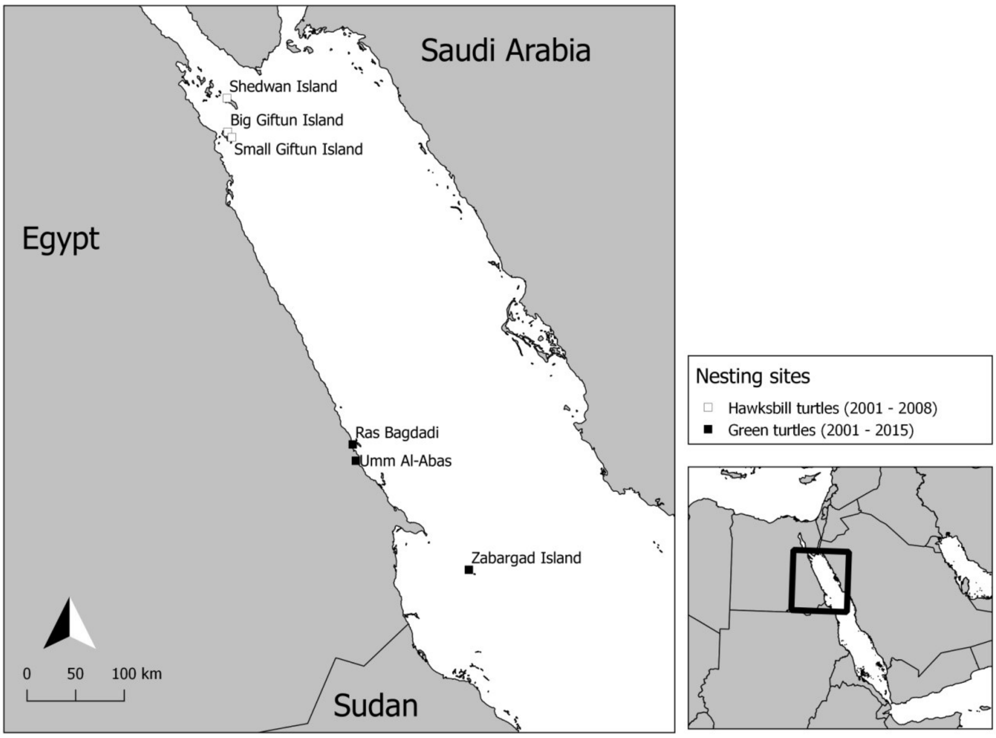

Figure 1. Known nesting sites along the Egyptian Red Sea coast.

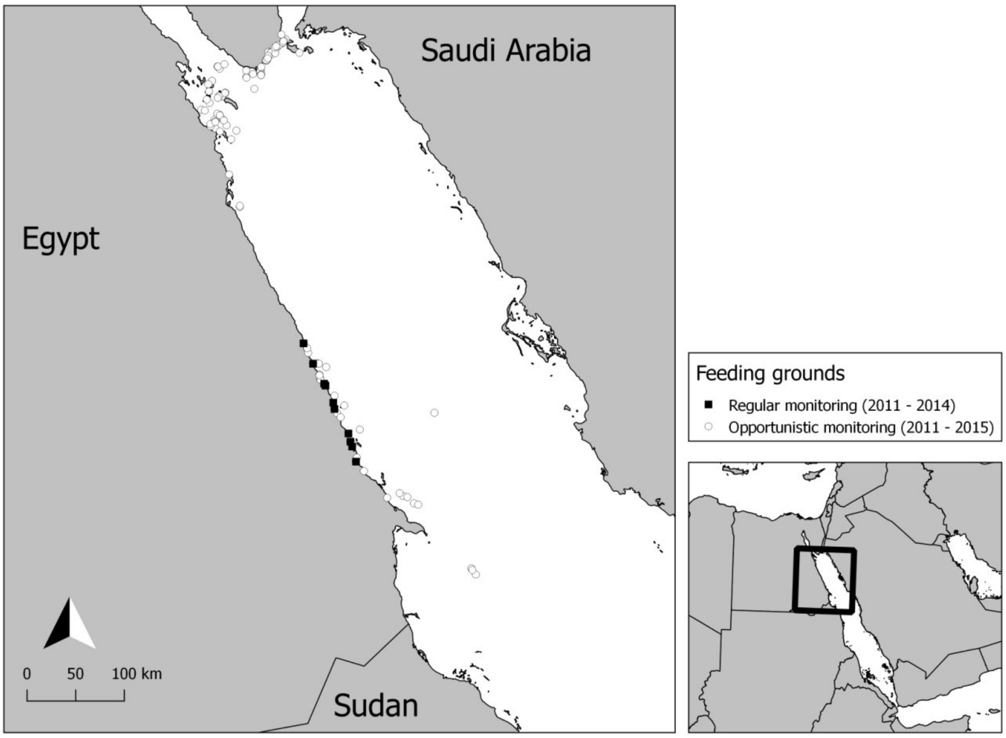

Figure 2. Map of marine areas monitored regularly (monthly, between 2011 and 2013) and opportunistically through a citizen science project (2011 – 2015) in Egypt.

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INDIA

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1 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (*Arribada*) ((LO-NEIO) (Arr))

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

There are currently there major *arribada* nesting sites on the east coast of Odisha, Gahirmatha and Rushikulya [1,17], and recently a minor *arribada* site reported from Cuthbert Bay in the Andaman Islands [3]. The nesting estimates at all three rookeries are undertaken by the Government agencies in each state (Ministry of Environment, Forests and Climate Change) following a standardised protocol [1,18]. The nesting numbers seem to indicate a stable or even an increasing trend in the last decade [18].

1.1.2 Marine areas

The offshore waters of Gahirmatha and Rushikulya also host dense congregations of breeding turtles between the months of December and April [17]. These regions come under seasonal fishing regulations enforced by the state agencies to reduce incidental fisheries associated mortality. Satellite telemetry studies on the nesting populations in Odisha have been carried out and the post nesting migration seems to suggest that they remain largely within the Bay of Bengal travelling south towards Sri Lankan waters. [1]

1.2 Other biological data

Other biological data on the LO-NEIO *arribada* population in India is presented in Table 1.

1.3 Threats

1.3.1 Nesting sites

Threats to nesting sites include light pollution, coastal development, nest predation, etc [17]. These are indicated in Table 1.

1.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gear (Table 1).

1.4 Conservation

Nest protection and conservation measures are taking place at all three *arribada* sites. The beaches of Gahirmatha and Cuthbert Bay are also declared wildlife sanctuaries [3,17,18]. The nesting beach and offshore waters at Rushikulya also receive seasonal protection between from December until May with restrictions on public access and intensive fishing.

1.5 Research

The *arribada* nesting population of olive ridleys have been extensively researched since the discovery of the nesting beaches in 1973 (Gahirmatha) and 1994 (Rushikulya) [17]. Most of the pioneering research and conservation measures for marine turtles began from the work that has been carried out in Odisha. Long-term monitoring of the nesting populations at Rushikulya has also involved the presence of research institutions and NGOs who have carried out a variety of work in the last decade [18]. Most of the research that has been carried out has largely looked at nesting biology and population dynamics while there have been limitations on any work that would involve any invasive sampling methodology such as reproductive biology or physiology of the species.

2 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (LO-NEIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

The olive ridley is known to nest all across the east coast of mainland India as well as throughout the Andaman and Nicobar Islands [1]. It is the most widespread and common species of marine turtles found on the Indian coast.

2.1.2 Marine areas

The olive ridley is commonly encountered as bycatch all across the coast [1], which suggests a widespread distribution in both the nearshore and offshore waters in the Bay of Bengal.

2.2 Other biological data

All biological data on the solitary nesting olive ridleys in India are presented in Table 1.

2.3 Threats

2.3.1 Nesting sites

There is minimal illegal take of eggs in recent years due to increased protection and conservation measures. The major threats include nest predation, erosion, and photo-pollution. This has largely been tackled by a large network of hatcheries being set up state environment agencies and NGOs across the entire coast.

2.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

2.4 Conservation

There are extensive nest protection measures and hatcheries being maintained across the mainland coast.

2.5 Research

Most of the research on olive ridleys in India have focused on the mass nesting populations with limited attention given to the solitary nesting populations. Most of the work that has been carried out has focused on the conservation aspects, with limited attention to their biology and behaviour.

3 RMU: *Lepidochelys olivacea*, West Indian Ocean (LO- WIO)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

The olive ridley is known to nest all across the west coast of mainland India as well on the islands of Lakshadweep [1]. It the most widespread and common species of marine turtles found on the Indian coast.

3.1.2 Marine areas

The olive ridley is commonly encountered as bycatch all across the coast which suggests a widespread distribution in both the nearshore and offshore waters in the Arabian Sea [7,11].

3.2 Other biological data

All biological data on the solitary nesting olive ridleys of the WIO RMU in India are presented in Table 1.

3.3 Threats

3.3.1 Nesting sites

There is minimal illegal take of eggs in recent years due to increased protection and conservation measures. The major threats include nest predation, erosion and photo-pollution [1,7]. This has largely been tackled by a large network of hatcheries being set up state environment agencies and NGOs across the entire coast [1,14].

3.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

3.4 Conservation

There is extensive nest protection measures and hatcheries being maintained across the mainland coast [11,15].

3.5 Research

Most of the research on olive ridleys has focused on the mass nesting populations of LO NEIO RMU with limited attention given to the solitary nesting population of both the NEIO and WIO RMU's. Most of the work that has been carried has focused on purely the conservation aspects with limited interests to their biology and behaviour [1,15,13].

4 RMU: *Chelonia mydas*, North-East Indian Ocean (CM-NEIO)

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

The NEIO RMU of the green turtle in India is known to nest only in the Andaman and Nicobar Islands [2]. It is widespread across the islands though no large nesting sites have been identified so far.

4.1.2 Marine areas

The green turtle is infrequently encountered as bycatch all across the coast, which suggests a distribution in both the nearshore and offshore waters in the Bay of Bengal [1].

4.2 Other biological data

All biological data on the NEIO green turtles in India are presented in Table 1.

4.3 Threats

4.3.1 Nesting sites

Most of the nesting beaches in the Andaman and Nicobar Islands are remote with limited monitoring that takes place [2].

4.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1) [2].

4.4 Conservation

There are nest protection measures and hatcheries at some of the populated islands that are maintained by the state environment agency [2].

4.5 Research

There has been no focused research that has been carried out on green turtles in this region.

5 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

5.1 Distribution, abundance, trends

5.1.1 Nesting sites

The NWIO RMU of the green turtle is known to nest in the Lakshadweep Islands and on the Gujarat coast of the mainland [9,12,13].

5.1.2 Marine areas

The green turtle is infrequently encountered as bycatch all across the coast, which suggests a distribution in both the nearshore and offshore waters in the Arabian Sea. In recent years there has been a lot attention on the increased foraging populations in the lagoons of the Lakshadweep islands and impacts on the seagrass meadows due to overgrazing [29].

5.2 Other biological data

All biological data on the NWIO green turtles in India are presented in Table 1.

5.3 Threats

5.3.1 Nesting sites

There are extensive nest protection measures and hatcheries being maintained across the mainland coast [9] while there is minimal illegal take or predation events that have been observed in Lakshadweeps. Nesting beaches on populated islands have mostly been impacted by beach armouring that have been carried out to prevent erosion and reduced nesting beach area [12,13].

5.3.2. Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

5.4 Conservation

There are nest protection measures and hatcheries being maintained by the state environment agency on mainland coast in the state of Gujarat [9].

5.5 Research

There has been no focused research carried out on green turtles in this region apart from their foraging impacts on seagrass over the last decade [29].

6 RMU: *Dermochelys coriacea*, North-East Indian Ocean (DC-NEIO)

6.1 Distribution, abundance, trends

6.1.1 Nesting sites

The NEIO RMU of the leatherback turtle is known to nest in the islands of the Andaman and Nicobar Islands [2,23,24].

6.1.2 Marine areas

The leatherbacks on rare occasions are encountered as bycatch in both the Arabian Sea and the Bay of Bengal [1].

6.2 Other biological data

All biological data on the NEIO leatherbacks in India are presented in Table 1.

6.3 Threats

6.3.1 Nesting sites

The recent survey in 2016 revealed that most of the beaches in this region have reformed after the 2004 Indian Ocean earthquake and tsunami. Regions which were severely damaged by the 2004 tsunami, still have dead trees and tree debris along the coast, particularly on Great Nicobar Is., probably obstructing sea turtles from entering the nesting beach and also reducing the nesting area.

6.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

6.4 Conservation

There are nest protection measures and hatcheries being maintained at some of the populated islands that are maintained by the state environment agency [1].

6.5 Research

There has been a long-term monitoring project carried out since 2008 at two sites in Little Andaman by Dakshin Foundation in collaboration with Andaman Nicobar Environment Team (ANET), Indian Institute of Science, Bangalore, Madras Crocodile Bank Trust and the Department of Environment and Forests Andaman and Nicobar Islands [23,25]. A similar monitoring programme was also carried out in Great Nicobar Is. prior to the December 2004 tsunami, between 2000-2004 [27].

7 RMU: *Eretmochelys imbricata*, North-East Indian Ocean (EI-NEIO)

7.1 Distribution, abundance, trends

7.1.1 Nesting sites

The NEIO RMU of the hawksbill turtle is known to nest only in the Andaman and Nicobar Islands. There are no records of high-density nesting [2].

7.1.2 Marine areas

The hawksbill is frequently encountered in the reefs by divers at commercial dive sites.

7.2 Other biological data

All biological data on the NEIO hawksbill turtles in India are presented in Table 1.

7.3 Threats

7.3.1 Nesting sites

Little illegal take has been observed in the Andaman and Nicobar Islands in recent years [2]. Predation by water monitor lizards have been observed, though it is thought not to have a severe impact on the population.

7.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

7.4 Conservation

There are nest protection measures and hatcheries being maintained at some of the populated islands that are maintained by the state environment agency [2].

7.5 Research

There has been no focused research carried out on hawksbill turtles in this region.

8 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

8.1 Distribution, abundance, trends

8.1.1 Nesting sites

The NWIO RMU of the hawksbill turtle is known to nest in the islands of the Lakshadweep [12,13], however, nesting levels are not quantified.

8.1.2 Marine areas

The hawksbill is frequently encountered in the reefs by divers at commercial dive sites.

8.2 Other biological data

All biological data on the NWIO hawksbill turtles in India are presented in Table 1.

8.3 Threats

8.3.1 Nesting sites

Nesting beaches on populated islands have mostly been impacted by beach armouring that has been carried out to prevent erosion and reduced nesting beach area [12,13].

8.3.2 Marine areas

Threats to offshore sites include fisheries bycatch in different fishing gears (Table 1).

8.4 Conservation

There are currently no directed activities for the conservation of hawksbill turtles in the region.

8.5 Research

There has been no focused research carried out on hawksbill turtles in this region.

Table 1. Characteristics of nesting marine turtles in India.

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence																
Nesting sites	Y	1	Y	1	Y	1	Y	1	Y	1	Y	2	Y	2	Y	2
Pelagic foraging grounds	N		N		N		n/a		Y	29	n/a		N		N	
Benthic foraging grounds	N		N		N		n/a		N		n/a		N		N	
Key biological data																
Nests/yr: recent average (range of years)	132,248 (2008-2016)	18	7,689 (2000-2016)	21	1794 (2000-2016)	1	n/a		n/a		All of Nicobar and Little Andaman 1299 (2016) and Little Andaman 118 (2008-2017)	23	n/a		n/a	
Nests/yr: recent order of magnitude	14,849-405,784 (2008-2018)		n/a		n/a		n/a		n/a		n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	2	18	20	1, 21	14	1	n/a		n/a		13	24,25	n/a		n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	1	3	23	1, 21	21	1	n/a		n/a		10	24	n/a		n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a	18	7,320 (2000-201)	1, 21	1,730 (2000-2016)	1	n/a		n/a		97.5 (2016)	23	n/a		n/a	

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Nests/yr at "minor" sites: recent average (range of years)	n/a	18	369 (2000-2016)	1, 21	64 (2000-2016)	1	n/a		n/a		3.4 (2016)	24	n/a		n/a	
Total length of nesting sites (km)	6	18, 3	>193	1, 21	>92	1	n/a		n/a		n/a		n/a		n/a	
Nesting females / yr	n/a		n/a		n/a		n/a		n/a		Na		n/a		n/a	
Nests / female season (N)	n/a		n/a		n/a		n/a		n/a		4.9	2	n/a		n/a	
Female remigration interval (yrs) (N)	n/a		n/a		n/a		n/a		n/a		Min: 1	23	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)	57 CCL	18	n/a		n/a		n/a		n/a		140 CCL	23	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)	120.58 (246)	18	n/a		n/a		n/a		n/a		107 (110)	25	n/a		n/a	
Emergence success (hatchlings/egg) (N)	0.78 (5362)	18	n/a		n/a		n/a		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	

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Trends																
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2008-2016)	18	Stable (2000-2016)	1, 21	Stable (2000-2016)	1	n/a		n/a		Stable (2008-2017)	23, 25	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		n/a		n/a		n/a	
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	N		N		N		N		N		N		N		N	
Genetics	Y	1	Y	1	Y	27	N		N		Y	27	N		N	
Stocks defined by genetic markers	Y	1	Y	1	Y	27	N		N		Y	27	N		N	
Remote tracking (satellite or other)	Y	1	Y	1	N		N		N		Y	23, 26	N		N	
Survival rates	N		N		N		N		N		N		N		N	
Population dynamics	Y	21	Y	21	N		N		N		N		N		N	
Foraging ecology (diet or isotopes)	N		N		N		N		Y	29	N		N		N	
Capture-Mark-Recapture	N		N		N		N		N		Y	25	N		N	

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Threats																
Bycatch: presence of small scale / artisanal fisheries?	Y (SN,DN)	1	Y (SN,DN)	1	Y (SN,DN,ST,MT)	1	n/a		n/a		n/a		n/a		n/a	
Bycatch: presence of industrial fisheries?	Y (PLL, ST,PT)	1	Y (PLL, ST,PT)	1	Y (PT)	1	n/a		n/a		n/a		n/a		n/a	
Bycatch: quantified?	N		N		N		n/a		n/a		n/a		n/a		n/a	
Take. Intentional killing or exploitation of turtles	n/a		n/a		N		n/a		n/a		n/a		n/a		n/a	
Take. Eggs (illegal)	n/a		n/a		N		n/a		n/a		n/a		n/a		n/a	
Coastal Development. Nesting habitat degradation	Y	1	Y	1	Y	1	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Photopollution	Y	1	Y	1	Y	1	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Boat strikes	Y	1	Y	1	Y	1	n/a		n/a		n/a		n/a		n/a	
Egg predation	Y	1	Y	1	Y	1	n/a		n/a		Y	23, 25, 28	n/a		n/a	
Pollution (debris, chemical)	Y	1	Y	1	Y	1	n/a		n/a		Y	2, 24	n/a		n/a	
Pathogens	n/a		n/a		n/a		n/a		n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a		n/a		n/a		n/a		n/a	
Foraging habitat degradation	n/a		n/a		n/a		n/a		n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		N		N		N		N		N	

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Long-term projects (>5yrs)																
Monitoring at nesting sites (period: range of years)	Y (2008 - ongoing)	18	Y	1	N		n/a		n/a		Y (2008 - ongoing)	23,25,28	n/a		n/a	
Number of index nesting sites	3	18	N		N		n/a		n/a		2	23,25,28	n/a		n/a	
Monitoring at foraging sites (period: range of years)	N		N		N		n/a		n/a		n/a		n/a		n/a	
Conservation																
Protection under national law	Y	1	Y	1	Y	1	Y	1	Y	1	Y	1	Y	1	Y	1
Number of protected nesting sites (habitat preservation) (% nests)	2 (50%)	1	0	1	n/a		0		0		0		0		0	
Number of Marine Areas with mitigation of threats	0	1	0	1	0		0		0		0		0		0	
N of long-term conservation projects (period: range of years)	>1	1	>1	1	n/a		0		0		0		0		0	
In-situ nest protection (eg cages)	Y	1	Y	1	n/a		n/a		n/a		n/a		n/a		n/a	
Hatcheries	Y	1	Y	1	Y	1	n/a		n/a		Y	2	n/a		n/a	
Head-starting	N		N		N		n/a		n/a		n/a		n/a		n/a	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	N		N		N		n/a		n/a		n/a		n/a		n/a	

	Lepidochelys olivacea						*Chelonia mydas*				*Dermochelys coriacea*		*Eretmochelys imbricata*			
RMU	**LO-NEIO (Arr)**	**Ref #**	**LO-NEIO**	**Ref #**	**LO-WIO**	**Ref #**	**CM- NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**	**EI-NEIO**	**Ref #**	**EI-NWIO**	**Ref #**
Bycatch: onboard best practices	N		N		N		n/a		n/a		n/a		n/a		n/a	
Bycatch: spatio-temporal closures/reduction	N		N		N		n/a		n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		N		N		N		N		N	

Table 2. Nesting beaches in India.

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit Long	Western limit Lat	Eastern limit Long	Eastern limit Lat	Central point Lon	Central point Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
LO-NEIO (*Arribada*)														
Gahirmatha (Wheeler, ekakula, habalikati)	Y	>100000		87.06874	20.72294	86.968	20.659			20		17	1	F
Rushikulya	Y	>100000		85.09804	19.40769	85.066	19.37234			5		18	1	F
Cuthbert Bay	Y	5000						92.964678	12.703949			3		
LO-NEIO														
Bahuda River – Kapaskudi		550		84.79714	19.13169	84.721	19.01855			10		5		
Elichetladibba		245		80.92596	15.7259	80.832	15.71595			8		5		
Goutami Godavari R - Neelarevu		685		82.36305	16.7385	82.307	16.59893			10		6		
Hope Is.		36		82.32591	16.98991	82.363	16.92122			5		6		
Krishna R – Lankevenidibba		125		80.82713	15.71441	80.773	15.80155			12		5		
Kunduvanipeta – Nagavali R		150		83.97057	18.22767	83.944	18.21311			3		6		
Muthiyavanipalem		96		83.11763	17.54813	83.094	17.53887			3		6		
Pennaru R – Mypadu		40		80.19596	14.57924	80.18	14.50626			5		6		
Sacremento Is.		1119		82.31629	16.59318	82.287	16.56796			3		6		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Sriharikota – Durgarajapalem		100		80.17019	13.98709	80.241	13.8152			15		6		
Vamsadhara R - Bandarvanipeta		200		84.14273	18.35114	84.13	18.31732			5		5		
Bahuda				84.79452	19.12797							16		
Bali Harachandi				85.67846	19.74477							16		
Barunei				86.77773	20.51927							16		
Chinchiri		~200-300		86.8591	20.58869							16		
Dhamra				86.96458	20.80768							16		
Gopalpur				84.96712	19.3068							16		
Habalikhati		~200		86.99969	20.67859							16		
Hawa Khana		~200		86.47592	20.09955							16		
Jhatadri		<100		86.53522	20.18301							16		
Keluni		~100-200		86.23889	19.90861							16		
Kushabhadra		<100		86.0521	19.84986							16		
Mahanadi				86.81211	20.38786							16		
Markandi				84.82509	19.17461							16		
Nuanai				85.92508	19.82293							16		
Paradeep				86.67586	20.25862							16		
Prayagi		~50		85.17177	19.46658							16		
Ramtara		<101		86.48653	20.11464							16		
Sahana		~100-200		86.36411	19.95561							16		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Sonapur				84.78614	19.11217							16		
Agarnasi		~300-400		86.80545	20.50289							17		
Akashdia Is. (Devi)		2000		86.43729	20.06009	86.385	19.97877					17		
Pentha		~500		86.81936	20.56252							17		
Mamallapuram - Pondichery		36								50		19		
Nagapattinam		30								30		21		
Nallavadu				79.81718	11.86314	79.806	11.83135			10		21		
Marina - Neelankarai		121		80.28901	13.06613	80.258	12.92775			14		21	1	B
Alikuppam				80.13814	12.43815	80.067	12.34714					20		
Neelankarai – Uthandi		6		80.2581	12.92775	80.248	12.8431			10		21		
Dadanpatra				87.82572	21.71896	87.75	21.69676					22		
Digha				87.75667	21.68975	87.701	21.6622					22		
Junput				87.58284	21.63822	87.552	21.6364					22		
Shankarpur				87.54731	21.62987	87.474	21.60723					22		
LO-WIO														
Morjim		6		73.72121	15.63529	73.737	15.6136			3		7		
Mandrem		3		73.70619	15.67529	73.715	15.65356			2		8		
Agonda		9		73.98024	15.05408	73.988	15.02901			3		7		
Galgibaga		5		74.04429	14.97229	74.052	14.95753			1.5		7		
Kharakhetar-Kuranga		102		69.12525	22.0563	69.158	22.0221			5		9		

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit Lon	Western limit Lat	Eastern limit Lon	Eastern limit Lat	Central point Lon	Central point Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
Lamba-Sethala Mata Mandir		153		69.29193	21.88901	69.335	21.85338			5		9		
Mithapur-Mojap		96		68.97726	22.40348	68.959	22.36855			4		9		
Mojap-Shivrajpur		127		68.9588	22.36855	68.951	22.33191			4		9		
Navadra-Lamba		171		69.24611	21.93242	69.292	21.88901			5		9		
Okhamadhi-Kharakhetar		79		69.09344	22.09436	69.125	22.0563			5		9		
Sethala Mata Mandir-Harshad Mata Mandir		131		69.33481	21.85338	69.37	21.83181			4		9		
Lohej–Maktupur		137		70.04745	21.15745	70.077	21.12764			4.5		9		
Maktupur–Mangrol		75		70.07707	21.12764	70.098	21.10807			3		9		
Mangrol–Bara		169		70.10473	21.10553	70.136	21.07742			4.5		9		
Shil–Lohej		127		70.02879	21.17836	70.047	21.15745			3		9		
Kantela-Kuchhadi		169		69.51153	21.70122	69.544	21.67186			4.5		9		
Navibandar-Ratiya		76		69.77639	21.45963	69.808	21.42501			5		9		
Ratadi–Kantela		118		69.48404	21.72807	69.512	21.70122			4		9		
Alungal				75.83988	11.08499	75.849	11.05438					10		
Kolavipalam				75.59176	11.56951	75.617	11.47755					10		
Thaikkadappuram				75.07557	12.31109	75.12	12.2018					11		
Agatti								72.193788	10.853976			12		
Minicoy								73.0645	8.2963417			13		
Suheli Valliakara								72.285751	10.043093			13		
Tinnakara								72.318502	10.94713			13		

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit Lon	Lat	Eastern limit Lon	Lat	Central point Lon	Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
Karingikuppu								72.31484	10.061446			13		
Dabhol		4		73.16579	17.58774	73.175	17.58408			2		7		
Diveagar		4		72.97084	18.20425	72.989	18.15756			4		7		
Guhagar		7		73.17345	17.51837	73.192	17.46238			5		14		
Harihareshwar		4		73.02919	17.99189	73.042	17.98592			4		14		
Kelashi		1		73.04877	17.93099	73.052	17.90728			3		7		
Kolthare		4		73.13182	17.65612	73.136	17.64422			2		7		
Maral		1		73.00942	18.01066	73.021	17.99307					15		
Murud Janjira		1		72.96843	18.30473	72.97	18.30023					7		
Sandkhol		1		73.21905	17.26992	73.223	17.26299					7		
Velas		14		73.04036	17.97798	73.029	17.95337			2		14		
CM-NEIO														
Akupa and Maka Chua								93.655229	7.3707769			1		
Alexandra river mouth								93.704807	7.0077952			1		
Bivaye								93.66254	7.2561169			1		
Car Nicobar								92.767804	9.216226			1		
Dahvu								93.630638	7.2995565			1		
Gota Bay								93.70971	7.4232086			1		
Katchal								93.402538	7.9936732			1		
Kwangtung								93.847831	6.791118			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Llaful Auch Creek								93.878984	7.175208			1		
Meroe								93.542533	7.5170657			1		
Navy Dhara								93.885008	7.1256931			1		
Pulo Baha								93.638148	7.3260114			1		
Pulo Bahi								93.754149	6.9115159			1		
Pulo Kiyang								93.636775	7.2603075			1		
Pulo Kunji								93.674326	7.0355821			1		
Pulo Milo								93.689067	7.4030581			1		
Pulo Pahan								93.714999	7.307309			1		
Pulo Ulan								93.686074	7.2909312			1		
Renhong								93.662138	7.091513			1		
Rokoret								93.682308	7.1528662			1		
Saphed Balu								93.844099	6.7776369			1		
Teressa								93.125417	8.2785161			1		
Trak								93.633058	7.4774159			1		
Treis								93.650422	7.4753256			1		
Anderson								92.709128	12.767068			1		
Beale Bay								92.846146	13.376155			1		
Beele								92.564801	11.568187			1		
Bluff								92.697004	12.245546			1		
Boat								92.55651	11.525831			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Butler Bay								92.577587	10.673696			1		
Casuarena Bay								92.840567	13.303445			1		
Coffree Dera								92.8228	13.283951			1		
Corbyn's Cove								92.746743	11.642551			1		
Craggy								93.057729	13.225697			1		
Cuthbert Bay								92.964678	12.703949			1		
Delgarno								93.077693	13.432564			1		
East								93.045251	13.639888			1		
East Coast of Baratang								92.831748	12.166925			1		
East Twin								92.563151	11.394676			1		
Excelsior								93.098037	13.431276			1		
Flat								92.681297	12.531811			1		
Grub								92.594286	11.588676			1		
Havelock								93.000185	12.031477			1		
Hump								92.700985	12.639494			1		
Iki Bay								92.616978	11.992471			1		
Inglish								93.119474	12.135428			1		
Interview								92.666926	12.890229			1		
Jolly Buoy								92.613397	11.5082			1		
Karmatang								92.927068	12.873685			1		
Lamia Bay								93.033407	13.181736			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Landfall								93.000479	13.645807			1		
Latouche								92.728729	13.093706			1		
Long								92.943113	12.400659			1		
Madhuban beach								92.748191	11.709755			1		
Middle Button								93.029418	12.277774			1		
Neil								93.056806	11.814798			1		
North and South of Jackson Creek								92.401156	10.782827			1		
North Brother								92.660236	10.983045			1		
North Button								93.064424	12.316314			1		
North Cinque								92.712829	11.310701			1		
North of Hut Bay								92.562046	10.647049			1		
North Passage								92.935066	12.285988			1		
North Reef								92.706918	13.08428			1		
North Sister								92.727978	11.14623			1		
Outram								93.102372	12.2224			1		
Pagget								92.821877	13.422651			1		
Paikat Bay								92.933382	12.779671			1		
Passage								92.676051	11.184459			1		
Pine Bay								93.004718	13.559342			1		
Pocock								93.051903	13.563931			1		
Point								92.818101	13.412575			1		

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit Lon	Western limit Lat	Eastern limit Lon	Eastern limit Lat	Central point Lon	Central point Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
Red Skin								92.584899	11.548327			1		
Reef								92.874084	13.504881			1		
Robert Bay								92.735478	12.685308			1		
Ross								93.075056	13.302858			1		
Rutland								92.615154	11.451498			1		
Sir Hugh Rose								93.08059	11.788258			1		
Smith								93.072487	13.324261			1		
Snark								92.755994	13.200999			1		
Sound								92.981973	12.950676			1		
South Bay								92.433386	10.548002			1		
South Brother								92.614789	10.935351			1		
South Button								93.020371	12.224083			1		
South Cinque								92.704675	11.28846			1		
South of Burmala Creek								92.489905	10.888202			1		
South Reef								92.656208	12.772491			1		
South Sister								92.725725	11.143493			1		
Spike								92.703978	12.279546			1		
Tage								93.071414	13.425801			1		
Tarmugli								92.53473	11.58489			1		
Temple								93.062525	13.383681			1		
Trilby								93.087394	13.414819			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Tuft								92.709374	12.721207			1		
West								92.898417	13.590843			1		
West Bay								92.413817	10.635745			1		
West Twin								92.550472	11.397215			1		
Whitecliff								92.877806	13.538596			1		
Woteng								92.964565	12.726035			1		
CM-NWIO														
Agatti		360						72.193788	10.853976			12		
Minicoy		10						73.0645	8.2963417			13		
Suheli Valliakara		358						72.285751	10.043093			13		
Tinnakara		54						72.318502	10.94713			13		
Karingikuppu		5						72.31484	10.061446			13		
Kharakhetar-Kuranga		102		69.12525	22.0563	69.158	22.0221			5		9		
Lamba-Sethala Mata Mandir		153		69.29193	21.88901	69.335	21.85338			5		9		
Mithapur-Mojap		96		68.97726	22.40348	68.959	22.36855			4		9		
Mojap-Shivrajpur		127		68.9588	22.36855	68.951	22.33191			4		9		
Navadra-Lamba		171		69.24611	21.93242	69.292	21.88901			5		9		
Okhamadhi-Kharakhetar		79		69.09344	22.09436	69.125	22.0563			5		9		
Sethala Mata Mandir-Harshad Mata Mandir		131		69.33481	21.85338	69.37	21.83181			4		9		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Lohej–Maktupur		137		70.04745	21.15745	70.077	21.12764			4.5		9		
Maktupur–Mangrol		75		70.07707	21.12764	70.098	21.10807			3		9		
Mangrol–Bara		169		70.10473	21.10553	70.136	21.07742			4.5		9		
Shil–Lohej		127		70.02879	21.17836	70.047	21.15745			3		9		
Kantela-Kuchhadi		169		69.51153	21.70122	69.544	21.67186			4.5		9		
Navibandar-Ratiya		76		69.77639	21.45963	69.808	21.42501			5		9		
Ratadi–Kantela		118		69.48404	21.72807	69.512	21.70122			4		9		
DC-NEIO														
Alexandra river mouth								93.704807	7.0077952			1		
Dahvu								93.630638	7.2995565			1		
Galathea	Y	830						93.85603	6.819313			2		
Katchal								93.402538	7.9936732			1		
Llaful Auch Creek								93.878984	7.175208			1		
Navy Dhara								93.885008	7.1256931			1		
Pulo Baha								93.638148	7.3260114			1		
Pulo Kiyang								93.636775	7.2603075			1		
Pulo Kunji								93.674326	7.0355821			1		
Renhong								93.662138	7.091513			1		
Rokoret								93.682308	7.1528662			1		
Saphed Balu								93.844099	6.7776369			1		

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit Lon	Western limit Lat	Eastern limit Lon	Eastern limit Lat	Central point Lon	Central point Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
South Bay								93.877401	6.8057409			1		
Teressa								93.125417	8.2785161			1		
Coffree Dera								92.8228	13.283951			1		
Rutland								92.615154	11.451498			1		
South Bay	Y	90						92.433386	10.548002	4		4	1	E
West Bay	Y	135						92.413817	10.635745	6.8		4	1	E
Cuthbert Bay								92.964678	12.703949			3		
EI-NWIO														
Agatti								72.193788	10.853976			12		
EI-NEIO														
Dahvu								93.630638	7.2995565			1		
Gota Bay								93.70971	7.4232086			1		
Meroe								93.542533	7.5170657			1		
Pulo Baha								93.638148	7.3260114			1		
Pulo Kiyang								93.636775	7.2603075			1		
Pulo Milo								93.689067	7.4030581			1		
Saphed Balu								93.844099	6.7776369			1		
Trak								93.633058	7.4774159			1		
Treis								93.650422	7.4753256			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Anderson								92.709128	12.767068			1		
Bluff								92.697004	12.245546			1		
Craggy								93.057729	13.225697			1		
Delgarno								93.077693	13.432564			1		
East								93.045251	13.639888			1		
East Coast of Baratang								92.831748	12.166925			1		
Excelsior								93.098037	13.431276			1		
Flat								92.681297	12.531811			1		
Hump								92.700985	12.639494			1		
Inglish								93.119474	12.135428			1		
Interview								92.666926	12.890229			1		
Landfall								93.000479	13.645807			1		
Latouche								92.728729	13.093706			1		
Madhuban beach								92.748191	11.709755			1		
Middle Button								93.029418	12.277774			1		
Neil								93.056806	11.814798			1		
North Button								93.064424	12.316314			1		
North Reef								92.706918	13.08428			1		
Point								92.818101	13.412575			1		
Ross								93.075056	13.302858			1		
Sir Hugh Rose								93.08059	11.788258			1		

RMU / 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)
				Lon	Lat	Lon	Lat	Lon	Lat					
Snark								92.755994	13.200999			1		
Sound								92.981973	12.950676			1		
South Button								93.020371	12.224083			1		
Temple								93.062525	13.383681			1		
Trilby								93.087394	13.414819			1		
Tuft								92.709374	12.721207			1		

Table 3. International conventions signed by India in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species
IOSEA NIOMTTF	Y	N	Y	All
CBD	Y	Y	Y	All
CITES	Y	Y	Y	All
CMS-Appendix 1	Y	N	n/a	All

Table 4. Long-term sea turtle projects in India.

RMU	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organisation
LO NEIO (*Arribada*)	Rushikulya, Odisha	Long-term monitoring of olive ridley populations in Odisha	*Arribada*, olive ridley	2008	Ongoing	Dakshin Foundation/Indian Institute of Science
DC NEIO	Little Andamans	Long-term monitoring of leatherbacks in the Andaman and Nicobar Islands	Leatherback	2009	Ongoing	Dakshin Foundation/Indian Institute of Science

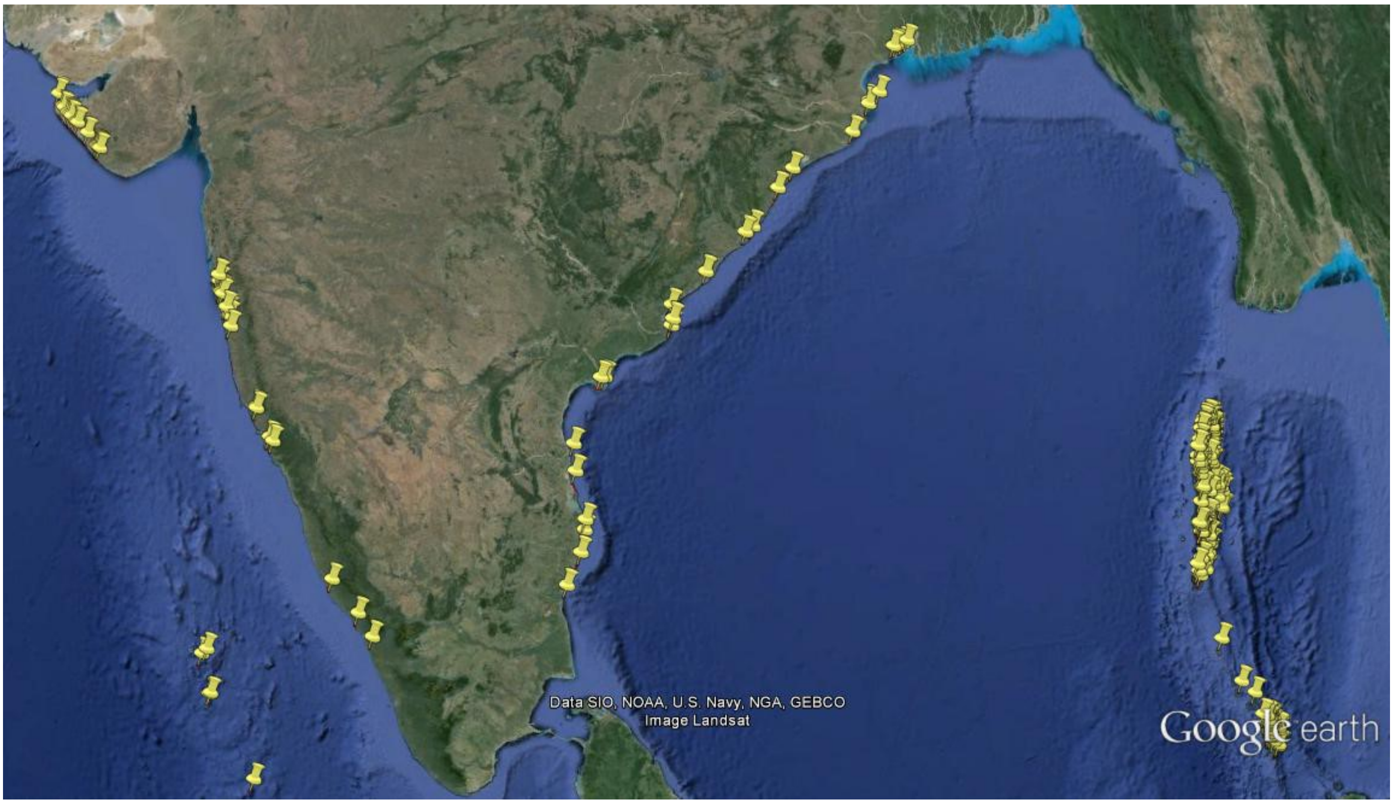

Figure 1. Nesting areas for all sea turtle species in India. [1]

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IRAN

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Introduction

Iran has the longest coastline in contact with the two major north-west Indian Ocean water bodies, the Persian Gulf and Oman Sea. The coastline includes numerous islands in the Persian Gulf. The terrestrial and aquatic habitats of Iran support nesting and foraging sea turtles. The hawksbill sea turtle is the most abundant nesting species, mainly concentrated on the Persian Gulf islands of Nakhiloo, Ommolkaram, Sheedvar, Hendourabi, Hengam, Queshm, and Kish. The green sea turtle is the most abundant foraging species across the Gulf and Oman Sea, with sporadic nesting along the Oman Sea coast. All sea turtle species are classified as nationally endangered species according to national laws and regulations of the country, and any harvest or intentional killing is illegal and subject to fine.

1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Nesting of green turtles in Iran is very sporadic and mainly occurs on the Oman Sea coast, in Sistan and Baluchestan Province and the east Hormozgan Province. There has been occasional nesting of the species on some of the Persian Gulf Islands, namely Sheedvar, Hendourabi and Khargoo [19,2,5,26]. On the Oman Sea coast, Tang, Khacho, and Kohpansar are the largest nesting sites but with <30 nests per year in total. After the first record of green turtle nesting in Iran [2], the potential importance of the area for green turtles was recognised and in the last years there has been regular monitoring of the nesting beaches and establishment of hatcheries by the Provincial and local DOE offices with support of the Marine Environment Deputy of Department of Environment (DOE). Data are presented in Tables 1 and 2.

1.1.2 Marine areas

The coastal waters of the Gulf and Oman Sea, especially the coastal waters surrounding islands, include suitable foraging grounds for green turtles at different life stages. It is quite common to see feeding green turtles along the Oman Sea coastline [2, 19]. In the Gulf region, waters surrounding the islands Queshm, Hengam, Faroor, Lavan, and Larak and Nayband Bay on the mainland of Bishehr province are important foraging grounds [19]. Data are presented in Table 1.

1.2 Other biological data

A tagging and monitoring project of foraging turtles has been conducted over the past 5 years [19]. Monitoring and tagging programmes are ongoing in Kish, Hendourabi, Queshm, Sheedvar, and Nakhiloo-Ommolkaram. Data are presented in Table 1.

1.3 Threats

1.3.1 Nesting sites

Illegal take of eggs, development of coastal areas, and light pollution and debris are probably the greatest threats at nesting sites [2,4]. Data are presented in Table 1.

1.3.2 Marine areas

Development of coastal areas, pollution, sea debris and plastic, boat strike, degradation of feeding grounds, and, most importantly, bycatch in fishing activities are the priority threats to in-water populations of turtles [4,5,25]. Data are presented in Table 1.

1.4 Conservation

All sea turtle species are in Iran are protected by national laws and regulations. All are classified as a "national endangered" reptilian species and any harvest of eggs or turtles is prohibited and subject to fine (more than US$1,000 equivalent). Engagement of local people with monitoring of nesting sites has occurred for several years, and is supposed to continue. Turtles are also protected in Iran under international treatise (Table 3).

1.5 Research

Monitoring nesting sites and nesting turtles, including tagging, has been the most regular sea turtle research work in Iran. Tagging and a population genetics study of foraging green turtle has begun, and there are plans to extend and develop this research.

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

The majority of hawksbill turtle nesting occurs on islands in the Persian Gulf, at the key sites of Nakhiloo and Ommolkaram in Bushehr province, and Sheedvar, Hendourabi, Hengam, Kish and Queshm in Hormozgan province. Very few hawksbill turtles nest on mainland sites at Nayband Bay and Parsian. Queshm and Kish Islands are the most important economic free zones (EFZ) in the country and have been under direct monitoring and protection with support of the EFZ authority. Data are presented in Tables 1 and 2.

2.1.2 Marine areas

A very low number of juvenile hawksbill turtles only have been observed during our in-water studies.

2.2 Other biological data

Tagging of the nesting hawksbill turtle populations started in 2005. Genetic studies have been conducted at most sites and the results published [1,3,4,5,6,10,11,20]. Data are presented in Table 1.

2.3 Threats

2.3.1 Nesting sites

Illegal take of eggs still occurs in some areas but has reduced considerably; in specific locations it is now very rare. Development of the nesting sites, especially in economic free zones (EFZ), is very harmful and a controversial subject at nesting sites in Hendourabi, Kish, Quesh, Hengam and Nayband. Light pollution, debris, feral dogs and foxes are the main threats on mainland nesting sites [1,4]. Data are presented in Table 1.

2.3.2 Marine areas

Fisheries by catch and boat strike remain are the most critical threats to sea turtles in marine environments. The degradation of habitats and effects of climate change could be emerging challenges for hawksbill turtle too [4,5,25]. Data are presented in Table 1.

2.4 Conservation

The main nesting sites of the species, e.g., Sheedvar, Hendourabi, Nakhiloo and Ommolkaram, are designated as protected areas and have specific regulations to prevent habitat degradation. Hatcheries have been established in Queshm and Hengam for direct protection of the nests. See also 1.4.

2.5 Research

A three year cooperative project among researchers from Iran, Oman, Qatar, and UAE, with partnership of WWF-EWS, conducted satellite tracking of hawksbills in the Gulf region; the project finished in 2015 (EWS-WWF, 2015). Other important research on hawksbill turtles in Iran includes genetic studies [6,10,11,20].

Table 1. Characteristics of nesting marine turtles in Iran.

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence				
Nesting sites	Y	2,4,18,19	Y	1,3,4,5,15,18, 19,17
Pelagic foraging grounds	JA	19,2,5	Y	4,5
Benthic foraging grounds	JA	19,2,5	n/a	
Key biological data				
Nests/yr: recent average (range of years)	<30 (2010-2019)	18,22	<1000 (2001-present)	1,3,4,5,15, 18,19,17,23
Nests/yr: recent order of magnitude	n/a	16,17,23, 15	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	3	1,2,4,10	7	1,3,4,5,15,18, 19,17, 23
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	5	2	4	1,3,4,5,16
Nests/yr at "major" sites: recent average (range of years)	<30	18,22	<1000	1,3,4,5,15, 18,19,17
Nests/yr at "minor" sites: recent average (range of years)	<5	18	<20	5,14,13
Total length of nesting sites (km)	n/a		20	1,3,4,5,15, 18,19,17
Nesting females / yr	<10 (2012-2018)	18,2,22	500	
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		58 CCL	1,3,4,5,15, 18,19,17,23
Age at maturity (yrs)	n/a		n/a	
Clutch size (n eggs) (N)	100 (n<30)	22	93	1,3,4,5,15, 18,19,17,23
Emergence success (hatchlings/egg) (N)	n/a		>80%	1,3,4,5,15, 18,19,17
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a	
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2010-2019)	22,4,20	stable (2005-present	1,3,4,5,15, 18,19,17,23
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	N		N	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Genetics	Y	21	Y	6,9,11,12,13
Stocks defined by genetic markers	Y	21	Y	6,9,11,12,13
Remote tracking (satellite or other)	N		Y	7,8, 14
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?	SN, DN,ST, PLL	12	Y	4,5
Bycatch: presence of industrial fisheries?	Y	4,5	Y	4,5
Bycatch: quantified?	N		N	
Take. Intentional killing or exploitation of turtles	N		Y	5,7
Take. Eggs (illegal)	Y	5,4	Y	4,5
Coastal Development. Nesting habitat degradation	Y	5,4	Y	4,5
Coastal Development. Photopollution	Y	4,5	Y	4,5
Coastal Development. Boat strikes	Y	5,4	Y	4,5
Egg predation	Y	5,4	Y	4,5
Pollution (debris, chemical)	Y	5,4	Y	4,5
Pathogens	n/a		n/a	
Climate change	n/a		n/a	
Foraging habitat degradation	Y	5,4	Y	4,5
Other	n/a		n/a	
RMU	**CM-NWIO**	Ref #	**EI-NWIO**	Ref #
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	15 (2005-Present)	1,2,4,5,6,10	7 (208 - present)	1,2
Number of index nesting sites	1	1,2,4	7	1,2
Monitoring at foraging sites (period: range of years)	5 (2014 - 2018)	3,8,9,10	5 (2014 - 2018)	3,8,9,10

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Conservation				
Protection under national law	Y	7	Y	7
Number of protected nesting sites (habitat preservation) (% nests)	n/a	1	8 (almost 100%)	1
Number of Marine Areas with mitigation of threats	N		4	4,5,24
N of long-term conservation projects (period: range of years)	1 (2005 - Present)	1, 3, 8,9,10	7 (2008 - Present)	1, 9
In-situ nest protection (eg cages)	Y	22,20	Y	18,19,23
Hatcheries	N		Y	18,19,23
Head-starting	N		N	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	N		N	
Bycatch: onboard best practices	N		N	
Bycatch: spatio-temporal closures/reduction	N		N	
Other	N		N	

Table 2. Index nesting sites in Iran.

RMU / 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)
				Long	Lat	Long	Lat							
CM-NWIO														
Tang	Y	<10	n/a					25.3660	59.8586	0.6	90	2,22,18	2	5-10 consecutive days during nesting season
Lipar, Koohpansar & Kachoo	Y	<20	n/a	25.2379	60.8649	25.1755	61.1414			40	90	2,22,18	1	most part of nesting season
Karati	N	<5	n/a											
EI-NWIO														
Sheedvar Is.		<50	~100					53.4107	25.7915				1	5-10 consecutive days during nesting season
Beach A	Y	<50	100	53.4067	26.7953	53.4096	26.7954			0.2	100	1,3,4,5,		
Beach B	Y	<20	20	53.4124	26.7938	53.4208	26.7933			0.8	100	1,3,4,5,		
Beach C	N	n/a	n/a	53.4208	26.7933	53.4155	26.7884			0.08	100	1,3,4,5,		
Hendourabi Is.	N							53.6325	26.6727					
All sandy beaches in the south	N	>400	100s	53.6132	26.6650	53.6457	26.6551			4	90	1,3,4,5	1	covered all nesting season
Nakhiloo Is.		>150	300-400					563.4718	26.8225				2	5-10 consecutive days during nesting season
Beach A (S)	Y	>100	>100	53.4688	27.8212	51.4723	27.8189			0.3	100	1,3,4,5,15		
Other beaches	N	50	n/a					51.4718	27.8224	1.6	70	1,3,4,5,15		
Ommolkaram Is.		>150	100s					51.5593	27.8339				2	5-10 consecutive days during nesting season
Beach A (NE)	Y	>100	>100	51.5671	27.8385	51.5686	27.8384			0.2	100	1,3,4,5,15		
Beach B (SW)	N	<50	10s	51.5507	27.8387	51.5582	27.8332							
Other beaches	Y	<30	10s							1.8	50	1,3,4,5,15		
Qushm Is.								55.5857	25.7742				1	during whole nesting season
Shib Deraz	Y	<100	n/a	55.9281	26.6857	55.9379	26.6891			1	100	4,5,17		

Hengam Is.								55.8812	26.6425				1	main part of nesting season up to 3 year before
Beah A (old hengam)	Y	<50	n/a	55.8715	26.6114	55.8844	26.6130			0.8	100	4,5,23		
Kish Is.								53.9715	26.5310				1	whole nesting season
Beach A	Y	<50	n/a	54.0375	26.5018	54.0357	26.5019			0.8	100	17		

Table 3. International conventions signed by Iran in relation to marine turtle conservation.

International Conventions	Signed	Binding	Species	Relevance to sea turtles
Convention on Biological Diversity (CBD)	Y	Y	ALL	Internationally binding treaty aiming at conserving biodiversity in signatory countries, promoting sustainable use of resources and fair sharing of benefits from genetic resources.
Convention on International Trade of Endangered Species (CITES)	Y	Y	ALL	All species of marine turtles are listed in appendix I which forbids trade of these species in all signatory countries except in exceptional circumstances. In order to be legally binding, each signatory country must adopt established by the CITES.national legislation under the framework
Convention on Migratory Species (CMS)	Y	Y	ALL	All species of marine turtles are listed in Appendix 1 (listing migratory species threatened with extinction) and Appendix 2 (migratory species for which conservation status would benefit from international cooperation).
MoU on Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)	Y	Y	ALL	

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IRAQ, ISRAEL, AND JORDAN

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No nesting of any sea turtle species has been recorded on the short coastlines of Iraq (58km), Israel (12km), or Jordan (27km) in the region. Records of in-water or stranded turtles are available, but some need to be verified from the original source.

1 RMU: *Caretta caretta*, North-West Indian Ocean (CC-NWIO)

Loggerhead turtles are included on checklists of herpetofauna for Iraq [1].

2 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

Green turtles are included on checklists on herpetofauna for Iraq [1]. One (82cm CCL; sex not given) was recently caught in Al-Masab Al-Aam by fishers [2]. The authors speculated that the turtle migrated to the location for nesting or due to rising sea levels, but the distance inland of the capture location (see Figure 1 in [2]) suggests this is unlikely.

3 RMU: *Dermochelys coriacea*, Unknown (DC-U)

A stranded leatherback turtle was found in Basrah Province of Iraq; a plaster model based on morphometrics of the specimen is available at the Iraq Natural History Research Center and Museum [3].

4 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

Sub-adult and adult, but not juvenile, hawksbill turtles have been observed at dive sites in Jordan [4]. Hawksbill turtles are included on checklists of herpetofauna for Iraq [1,3,5].

A captive breeding programme for hawksbill turtles operated in Israel for 16 years. Four female and one male turtle were originally captured from the Red Sea; some of the resulting offspring have been released back into the Red Sea [6].

5 RMU: *Lepidochelys olivacea*, North-West Indian Ocean (LO-WIO)

Olive ridley turtles are included in checklists of herpetofauna for Iraq [1], and an adult female (61cm CCL) was recently caught in Khor Al-Zubair Lagoons by fishers [7]. These lagoons are several kilometres up-river; the turtle may have swum there independently or been caught and released in the location.

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KUWAIT

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1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Kuwait used to have two nesting sites for green turtles (Qaru and Umm Al-Maradim; Figure 1) but since extending a coast guard station on Umm Al-Maridim in 2005, no green turtle nesting has been recorded there (Table 1; [1,4]). Due to the very low number of nests, no trend in nest numbers is discernible (Table 1). Description of the nesting areas is given in Table 2.

1.1.2 Marine areas

Four of five successfully tracked adult sized female turtles established long-term residencies around Failaka Is. (Figure 2; [2]). No other marine areas have been verified and published.

1.2 Other biological data

Biological data on the green turtles are presented in Table 1 and associated references [1,2,3,4,5]

1.3 Threats

1.3.1 Nesting sites

Threats to green turtles in Kuwait include beach use by tourists, in the summer, and are presented in Table 1.

1.3.2 Marine areas

Threats to green turtles in marine areas include tidal traps (*hadrah*) constructed around Failaka Is., that trap turtles and expose them to high day-time air temperatures and potential consumptive use by the fishers (Table 1 [1]).

1.4 Conservation

Turtles are at least nominally afforded legal protection in Kuwait under several international and national regulations (Table 3).

There are no known ongoing conservation efforts for sea turtles in Kuwait, but the authors suggest better signage and regulation of human activities at the nesting area is warranted.

1.5 Research

Adult female green turtles have been tracked in Kuwait (Table 4). More research on the abundance of turtles around the identified foraging hotspot of Failaka Is. should be prioritised, together with genetic characterisation of the turtles foraging there.

Monitoring of Qaru Is. green turtle nesting should be established as an on-going research priority. Genetic characterisation of the small population is warranted to determine its independence or linkage with the proximate larger population in Saudi Arabia.

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Kuwait has three nesting areas for hawksbill turtles (Qaru, Umm Al-Maradim and Ras Al Zour; Figure 1, Table 1; [2,3,5]). Due to the very low number of nests, no trend in nest numbers is discernible (Table 1). Description of the nesting areas is given in Table 2.

2.1.2 Marine areas

Very limited information on hawksbill marine areas in Kuwait has been published. One adult male was known to be resident at Qaru [6], a single adult female migrated to Kuwait's coastal waters from a distant nesting area [7] and two turtles tracked after nesting on the Is.s remained in Kuwait's territorial waters, one for over two years.

2.2 Other biological data

Biological data on the hawksbill turtles are presented in Table 1 and associated references [2,3,5,6,7,9]

2.3 Threats

2.3.1 Nesting sites

Same as for green turtles, see section 1.3.1 and Table 1.

2.3.2 Marine areas

The lack of information on important marine habitats for hawksbills predicates lack of information on threats in the marine realm.

2.4 Conservation

See 1.4.

2.5 Research

Adult female hawksbill turtles have been tracked from Qaru and Um Al-Maradim Islands (Table 4), and the data have been analysed and published [8]. Further tracking from the third nesting area (Ras Al Zour) should be undertaken to build a more complete understanding of hawksbill migrations and distribution.

Monitoring of all three nesting areas should be established as an on-going research priority. Genetic characterisation of the tiny population(s) is warranted.

Table 1. Characteristics of nesting marine turtles in Kuwait.

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence				
Nesting sites	Y	1,2,3	Y	1,2,3
Pelagic foraging grounds	N/A		N/A	
Benthic foraging grounds	Y (A)	1,2	Y (A)	6,7
Key biological data				
Nests/yr: recent average (range of years)	2-7 (2008-2015)	1,2,3	7-32 (2008-2015)	1,2,3
Nests/yr: recent order of magnitude	<10	1,4	<40	3
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	1,4	0	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	1	1,4	3	2
Nests/yr at "major" sites: recent average (range of years)	n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	5 (2008-2015)	1,4	ca. 20 (2008-2015)	3
Total length of nesting sites (km)	0.65	1,4	n/a	
Nesting females / yr	3	1	n/a	
Nests / female season (N)	5 (N=1)	1	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)	96 CCL	2,3	64.5 CCL	2,3
Age at maturity (yrs)	N/a		n/a	
Clutch size (n eggs) (N)	N/a		77.1+/-17.8 SD (16)	9
Emergence success (hatchlings/egg) (N)	N/a		41.2+/-30.5% SD (16)	9
Nesting success (Nests/ Tot emergence tracks) (N)	N/a		N/a	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (1998-2015)	2,3	Stable (2008-2015)	2,3
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		n/a	
Oldest documented abundance: nests/yr (range of years)	<10, 2008-2015	1, 2, 3	<40, 2008-2015	1, 2, 3
Published studies				
Growth rates	N		N	
Genetics	Y	4	N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	Y	1,2	Y	2,7,8
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?	Y	1,2,4	N	
Bycatch: presence of industrial fisheries?	N		N	
Bycatch: quantified?	N		N	
Take. Intentional killing or exploitation of turtles	N		N	
Take. Eggs (illegal)	N		N	
Coastal Development. Nesting habitat degradation	Y	4,5	Y (Summer tourism)	5
Coastal Development. Photopollution	Y	4,5	Y	4,5
Coastal Development. Boat strikes	n/a		n/a	
Egg predation	N		N	
Pollution (debris, chemical)	N		N	
Pathogens	n/a		n/a	
Climate change	n/a		n/a	
Foraging habitat degradation	n/a		n/a	
Other:	n/a		n/a	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Number of index nesting sites	1	1,2,3	3	1,2,3
Monitoring at foraging sites (period: range of years)	n/a		n/a	
Conservation				
Protection under national law	Y		Y	
Number of protected nesting sites (habitat preservation) (% nests)	0		0	
Number of Marine Areas with mitigation of threats	0		0	
N of long-term conservation projects (period: range of years)	0		0	
In-situ nest protection (eg cages)	N		N	
Hatcheries	N		N	
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	N		N	

Table 2. Nesting beaches in Kuwait.

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Central point Long	Central point Lat	Length (km)	% Monitored	Reference #	Monitoring Level (1-2)	Monitoring Protocol	Ref. #
CM-NWIO											
Qaru Is. - Beach A	A	7 (2004-2015)	12 (2004-2015)	48.776344	28.817623	0.65	100	1,4		*	1
Umm Al-Maradim Is. – beach b (west)	B	15 (2004)	N/A	48.650499	28.678678	0.19	100	1,4		*	
EI-NWIO											
Qaru Is. -Beach A	A	17 (2008-2011), 4 (2013), 25 (2015)	33 (2008-2011), 11 (2013), 31 (2015)	48.776344	28.817623	0.65	100	2,3,5		*	
Umm Al-Maradim Is.- Beach B (West)	B	1 (2013), 1 (2015)	3 (2013), 1 (2015)	48.650499	28.678678	0.19	100	2,3,5		*	
Umm Al-Maradim Island- Beach C (North)	C	13 (2008-2011), 4 (2013), 10 (2015)	18 (2008-2011), 4 (2013)	48.682345	28.652999	0.23	100	2,3,5		*	
Ras Al Zour -beach d	D	N/A	N/A	48.391319	28.741793	2.6	100	2			

*Monthly fieldwork comprising periods of ca.8 d were undertaken between May and August. Patrols were undertaken at hourly intervals between dusk and dawn on Qaru. Track surveys were undertaken on UAM at least once per field period to look for green turtle emergences. In 2012, the islands were surveyed once near the end of the nesting season (August) to confirm levels of green turtle nesting for that season. Environmental conditions in the area, calm weather, and limited trampling of the beach were such that evidence of nesting from the entire season was still easily discernible (Papathanasopoulou Pers.Obs).

Table 3. International conventions signed by Kuwait in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES (2002)	Y	Y	Y	All turtle species		
CBD (1992)	Y	N	N	All turtle species		
Kyoto Protocol (1997)	Y	N	N			
United Nations Convention on the Law of the Sea	Y	Y	Y	All turtle species	The Public Authority for Agriculture an Fisheries applies a non-consumption of sea turtle meat-eggs policy, a combination of CITES and UNCLOS	
MARPOL 73/78	Y	Y	n/a			
RAMSAR (2015)	Y	n/a	n/a			Protection of Boubiyan Is. area, reportedly an important foraging area for sea turtles
United Nations Framework Convention on Climate Change (1992)	Y	n/a	n/a			Preventing climate change leading to warmer seas and reclamation of turtle foraging/mating habitat as well as rising of sea level leading to reclamation of turtle nesting grounds.

Table 4. Marine turtle projects and databases in Kuwait.

#	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-NOW	State of Kuwait	Arabian Peninsula, Middle East, Asia	Kuwait 2010: Hawksbill and Green Turtle Tracking	Satellite telemetry; tracking; Middle East; Kuwait; green turtles	2010	2011	University of Exeter	Public	TOTAL Foundation, Kuwait Scientific Center, Kuwait Voluntary Work Center, Kuwait Coast Guard	http://www.seaturtle.org/tracking/?project_id=503		ALan F Rees a.f.rees@exeter.ac.uk	Nancy Papathanasopoulou nancyktcp@gmail.com
T4. 2	EI-NWIO	State of Kuwait	Arabian Peninsula, Middle East, Asia	Kuwait 2010: Hawksbill and Green Turtle Tracking	Satellite telemetry; tracking; Middle East; Kuwait; hawksbill turtles	2010	2011	University of Exeter	Public	TOTAL Foundation, Kuwait Scientific Center, Kuwait Voluntary Work Center, Kuwait Coast Guard	http://www.seaturtle.org/tracking/?project_id=503		ALan F Rees a.f.rees@exeter.ac.uk	Nancy Papathanasopoulou nancyktcp@gmail.com
T4. 3	CM- NWIO	State of Kuwait	Arabian Peninsula, Middle East, Asia	Kuwait 2013: Green Turtle Tracking	satellite telemetry; tracking; Middle East; Kuwait; green turtles	2013	2013	University of Exeter	Public	Al Nowair Initiative, Wataniya Telecom, Kuwait Coast Guard	http://www.seaturtle.org/tracking/?project_id=921		ALan F Rees a.f.rees@exeter.ac.uk	Nancy Papathanasopoulou nancyktcp@gmail.com

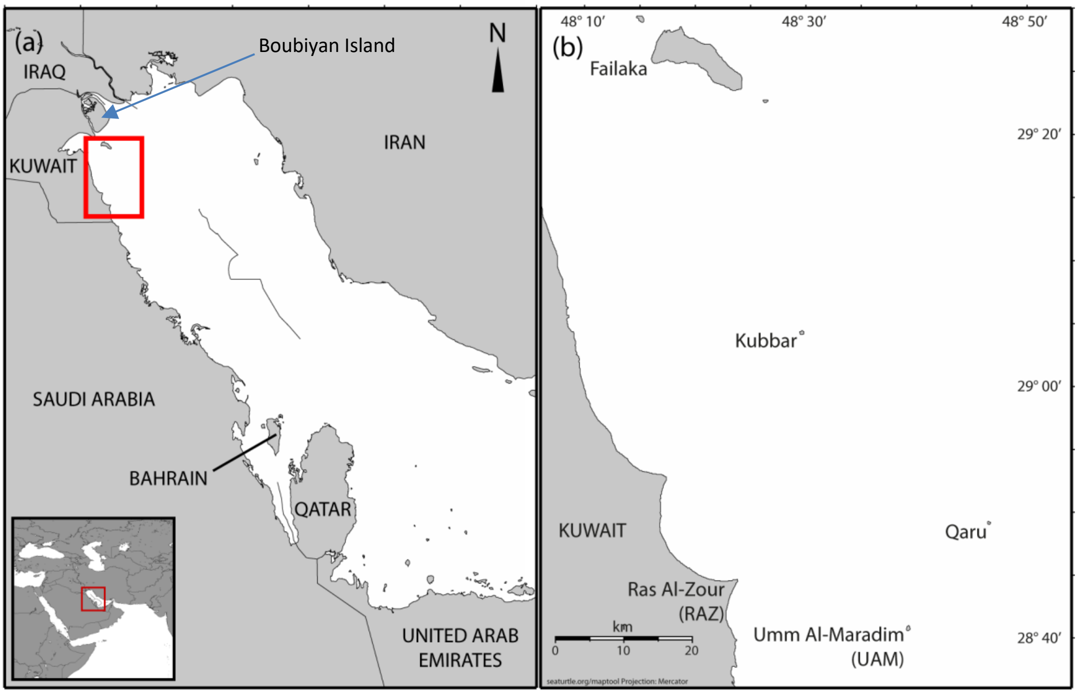

Figure 1. Nesting areas in Kuwait.

Hawksbill nesting occurs at Qaru, RAZ and UAM. Green turtle nesting now only occurs at Qaru [2].

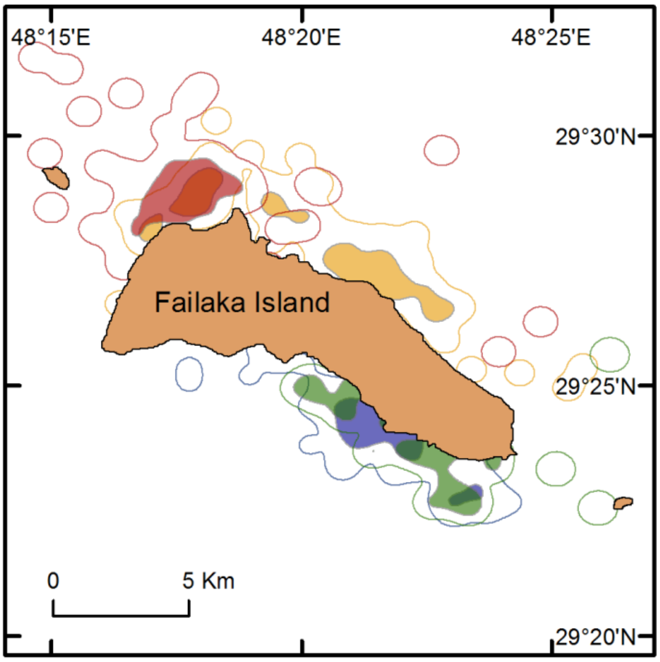

Figure 2. Marine habitats for sea turtles in Kuwait.

Tracked adult female green turtles utilise the waters around Failaka Is. as a foraging / overwintering area. Home ranges of four green turtles are presented here. Figure reproduced from [2].

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MALDIVES

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1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Green sea turtles are the most common species found nesting in the Maldives [1,3], with nesting confirmed on 37 islands. The actual number of nesting sites is likely much greater than the recorded number. Many islands report turtle nesting activity but the species and number of nests on these islands are yet to be confirmed. Most recorded nesting islands are concentrated in central and northern Maldives, but this may be because these are the areas where most research effort has taken place (Figure 1; Table 1, 2).

There has been a significant decline in nesting activity observed in Maldives. Estimated number of nests per year has decreased from the 1980s [1,2] (Table 1).

1.1.2 Marine areas

Green sea turtles can be observed all throughout the archipelago and, as of March 2020, a citizen science photo ID initiative that began in 2013 has identified at least 828 individual green turtles across 13 atolls [17]. Both juveniles and adults are seen in these waters, suggesting that the Maldives serves as both a breeding ground and a developmental habitat. The number of adult females observed is significantly greater than males and more adults are observed than juveniles [1,3].

Green sea turtles are notably more abundant in Lhaviyani Atoll as, unlike most other atolls, it has numerous sea grass beds that serve as feeding grounds for the species. Lhaviyani Atoll hosts significantly more adult green turtles than juveniles and may be an important aggregating hotspot for adults of this species [3]. Green turtles are also abundant in Laamu Atoll [17].

1.2 Other biological data

Hatching success varies between 0 to 100%, with an average of 95.5%. Average emergence success is 89%. Average nest incubation time is 57.3 days [3,17].

1.3 Threats

1.3.1 Nesting sites

The illegal take of eggs and turtles from nesting sites is a common occurrence in the Maldives. In just an 11-month period in 2015, eggs from 37 nests and 14 green sea turtles were illegally taken [1]. In 2019, 39% of 56 nests recorded on Laamu Gaadhoo also experienced illegal take [17]. Eggs and turtles are usually taken for personal consumption as food. Hunting of turtles seem to be more opportunistic than through organised effort on most islands.

Hatchlings are taken from nests and kept as pets, often in poor conditions which negatively impacts development and decreases their chances of survival once released in to the wild [1] (Table 1). It was once common practice to keep hatchlings in fresh water although this practice is now on the decrease [PS]. Often, hatchlings taken from nests die in captivity or develop complications due to improper handling. Only a few are of these turtles are taken to sea turtle rehabilitation centers for observation prior to release and provided “saltwater treatment” if previously kept in freshwater.

Coastal development and activity are major threats in inhabited islands. Sea walls constructed to prevent erosion might obstruct a turtle’s path to their nesting beach, forcing them to find another beach to lay their eggs. Islands historically well known for nesting have also been leased for resort and airport development which impacts the availability of nesting grounds within Maldives.

Dumping of waste on the beach is a common practice in many islands; this causes pollutants and debris to accumulate on beaches leading to the degradation of their condition. Light pollution due to night-time activity can disrupt turtle nesting and can confuse hatchlings as well [1] (Table 1).

Severe erosion of beaches, a common issue in the Maldives, can reduce the length of beach available for nesting activity. Increasing frequency of sea swells and storm generated waves over the last decade and unsustainable development on the coast have been identified as potential causes for erosion [16].

1.3.2 Marine areas

Removal of sea grass beds is a common practice, especially in resorts, as they are considered unsightly. The illegal take of turtles from foraging grounds is especially prevalent in some islands but may not be as common as illegal take from nesting sites (Table 1).

Bycatch of turtles is reported in long line fisheries (Table 3) but, as the species of the turtles caught are not reported, the number of green sea turtles caught cannot be estimated. Approximately 90% of turtles caught as bycatch are released without evidence of injury (Figure 2; [5]).

More than 700 strandings have been documented since 2010, with green sea turtles making up approximately 3% of the turtles found stranded [PS]. Stranded green sea turtles have been found entangled in ghost nets and other debris, with injuries from boat strikes, and with injuries from unknown causes [6].

1.4 Conservation

Turtles are protected under national legislature (Environmental Protection and Preservation Act 4/93) since 2016. Illegal take of turtles and turtle eggs, as well as trade of turtles and turtle parts is prohibited under this legislature. Maldives has also been a signatory to the CITES convention since 2012. The worldwide enforcement of the CITES convention may have been an important factor which contributed to the decline of the Maldivian turtle shell industry. Maldives is also a signatory to the Indian Ocean and South-East Asian Memorandum of Understanding on Marine Turtles (IOSEA-MoU) (Table 4).

A moratorium on the catching and killing of turtles was introduced in 1995 by a presidential decree and was in effect until 2015. Take of eggs was not banned under this moratorium. In 1996 the trade of all species of turtles were banned by the Ministry of Trade. In 2006, take of turtle eggs was banned from 14 islands of the Maldives identified as significant nesting hotspots. Eggs could legally be taken from other islands until 2016, when sea turtle conservation was moved under the Environmental Protection and Preservation Act 4/93. There is still some misinformation about the legal status of take of eggs. Some citizens erroneously believe that take of eggs is still legal [PS].

Although turtles and their eggs are legally protected, illegal take of turtles and eggs is still quite common in the country. Better enforcement of existing legislation through the development of a management plan can better help conserve turtles. It is also recommended that nesting and foraging sites of significance be made protected areas. More needs to be done to raise awareness of the importance of turtles to the marine ecosystem as well as their importance for the ecotourism industry.

1.5 Research

Limited information is available in general but especially lacking in the following areas: genetic stocks and migratory patterns.

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-SWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Hawksbill turtles are confirmed to nest on nine islands of the Maldives. Hawksbill nesting activity is quite low throughout the country. However, it is likely that the number of islands where nesting activity occur is greater than the recorded number. Long term research at nesting sites has not been carried out so trends are not known (Figure 3; Table 1, 2).

2.1.2 Marine areas

Juvenile and adult hawksbill turtles can be observed all throughout the archipelago. Hawksbill turtles are the most frequently sighted species of turtle in most atolls [1,3,11,17] although this may be due to data mainly being obtained from coral reef surveys, the preferred habitat of hawksbill turtles (Table 1).

Maldivian waters are home to at least 3,968 hawksbill turtles [17], and an ongoing capture-mark-recapture study indicates that the population size of hawksbill turtles at foraging grounds is increasing [15]. The number of adult females is significantly greater than males [1,3] and the number of juvenile hawksbill turtles observed is greater than the number of adults [1,3]. The atolls of Baa and North Male may be particularly important habitat for juveniles [3,17] (Table 1).

2.2 Other biological data

None available.

2.3 Threats

2.3.1 Nesting sites

Illegal take of hatchlings for pet trade. Destruction and degradation of nesting sites due to coastal development, erosion, and pollution [1] (Table 1).

2.3.2 Marine areas

Coastal development especially the development of water villas and other such structures on reefs is a major threat to hawksbill turtles in Maldives. These activities can destroy stretches of coral reef habitats or can make them uninhabitable for turtles due to sedimentation and increased disturbances (Table 1).

Also see the description of captures by long line fisheries in section 1.3.2.

2.4 Conservation

See 1.4.

2.5 Research

See 1.5.

3 RMU: *Lepidochelys olivacea*, West Indian Ocean (LO-WIO)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

No significant nesting of this species occurs in the Maldives. Only four nesting events have been recorded to date. Three of these were recorded in late 2018 to early 2019, and one was recorded in January 2020. Two nests were recorded on the island of Hanimaadhoo in Haa Dhaalu atoll, an unsuccessful nesting event at Coco Palm Dhunikolhu in Baa atoll, and two hatchlings were found on the island of Muravandhoo in Raa atoll (Figure 4; Table 1, 2).

3.1.2 Marine areas

Olive ridleys are rarely spotted in Maldivian waters but they make up most of the turtles entangled in ghost nets. 129 olive ridley turtles found entangled between 1988 and 2014 [6]. An additional 703 entangled or stranded olive ridley turtles were found between 1 January 2014 and 31 December 2019 [PS] (Table 1).

3.2 Other biological data

None available.

3.3 Threats

3.3.1 Nesting sites

Unknown**.**

3.3.2 Marine areas

Discarded fishing nets are a major threat to olive ridley turtles in Maldivian waters and the greater Indian Ocean. 752 ghost nets were documented in Maldives between 2013 and 2017. These ghost nets entangled a total of 131 turtles with olive ridley turtles making up 97% of entangled turtles [13].

3.4 Conservation

See section 1.4.

3.5 Research

Genetic analyses of entangled *Lepidochelys olivacea* found in the Maldives were compared to nesting populations in Oman, East India, Sri Lanka and Northern Australia. Results indicate that the majority of entangled turtles found in the Maldives originate from the eastern Indian and Sri Lankan populations with migrant visitors from further afield occasionally becoming entangled. Analyses suggests that ghost nets may impact yearly recruitment of Sri Lankan olive ridley populations by 41% suggesting small populations are most impacted by ghost nets in the region [12].

Random Forest and logistic regression models were used to determine key factors driving *Lepidochelys olivacea* entanglement. It was found that seasonality (north east monsoon), large mesh size and absence of floats increase the likelihood of turtle entanglement. In addition, cluster analyses identified trawl and gill nets as the main contributors of ghost nets found in the Maldives [13].

New research to age ghost nets in combination with ocean modelling using Lagrangian drifters show high risk fisheries operating in the western Indian Ocean, predominantly purse seine fisheries, are likely contributors to ghost gear found in the Maldives in addition to artisanal gill nets in the immediate area. The report also highlights the likely presence of IUU fishing within the EEZ of the Maldives due to short drift times of ghost gear found in the Maldives [14].

Table 1. Key biological information for sea turtles in the Maldives.

	Chelonia mydas		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref#**
Occurrence						
Nesting sites	Y	1	Y	1	Y	PS
Pelagic foraging grounds	JA	1	JA	1	n/a	
Benthic foraging grounds	JA	1	JA	1	n/a	
Key biological data						
Nests/yr: recent average (range of years)	305 (2015)	1	n/a		1	PS
Nests/yr: recent order of magnitude	100s to 1000s	PS	10s	PS	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	6	PS	n/a		0	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	31	PS	10	PS	3	PS
Nests/yr at "major" sites: recent average (range of years)	27 (2018-2019)	PS	n/a		n/a	
Nests/yr at "minor" sites: recent average (range of years)	3-18 (2013-2019)	PS	n/a		n/a	
Total length of nesting sites (km)	n/a		n/a		n/a	
Nesting females / yr	103	1	n/a		1	PS
Nests / female season (N)	5	PS	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)	0.87 (704)-0.93 (668)	1,3	0.83 (1293)-0.95 (714)	1,3	n/a	
Min adult size, CCL or SCL (cm)	85 CCL	PS	63 SCL	PS	n/a	
Age at maturity (yrs)			n/a		n/a	
Clutch size (n eggs) (N)	94.5	PS	n/a		n/a	

	Chelonia mydas		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref#**
Emergence success (hatchlings/egg) (N)	89%	PS	n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	58%	PS	n/a		n/a	
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	Dec. (1984-2015)	1,2	n/a		n/a	
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a		Inc. (2012-2019)	PS	n/a	
Oldest documented abundance: nests/yr (range of years)	1018 (1984)	2	n/a		n/a	
Published studies						
Growth rates	N		N		N	
Genetics	N		N		Y	12
Stocks defined by genetic markers	N		N		Y	12
Remote tracking (satellite or other)	Y	8	N		Y	10
Survival rates	Y	PS	Y	PS	N	
Population dynamics	Y	PS	Y	PS	N	
Foraging ecology (diet or isotopes)	N		N		N	
Capture-Mark-Recapture	Y	PS, 17	Y	PS, 17	N	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (PLL)	4,5	n/a		N	
Bycatch: presence of industrial fisheries?	n/a		n/a		N	
Bycatch: quantified?	N		N		25 (OTH)	13
Take. Intentional killing or exploitation of turtles	Y	1,2	n/a		n/a	
Take. Eggs (illegal)	Y	1,2	n/a		n/a	
Coastal Development. Nesting habitat degradation	Y	1	n/a		n/a	

	Chelonia mydas		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CM-NWIO**	Ref #	**EI-NWIO**	Ref #	**LO-WIO**	Ref#
Coastal Development. Photopollution	Y	1	n/a		n/a	
Coastal Development. Boat strikes	Y	PS	n/a		Y	PS
Egg predation	n/a		n/a		n/a	
Pollution (debris, chemical)	Y	6,7	n/a		Y	6,7
Pathogens	n/a		n/a		Y	PS
Climate change	n/a		n/a		n/a	
Foraging habitat degradation	n/a		n/a		n/a	
Other- pet trade	Y	PS	Y	PS	n/a	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (2012-2019)	PS	Y (2012-2019)	PS	N	
Number of index nesting sites	0		0		N	
Monitoring at foraging sites (period: range of years)	Y (7: 2012-2019)	PS	Y (7: 2012-2019)	PS	N	
Conservation						
Protection under national law	Y	16	Y	16	Y	16
Number of protected nesting sites (habitat preservation) (% nests)	100%	16	100%	16	100%	16
Number of Marine Areas with mitigation of threats	0		0		0	
N of long-term conservation projects (period: range of years)	4	4	4	4	4	4
In-situ nest protection (eg cages)	N		N		N	
Hatcheries	N		N		N	
Head-starting	2		2		2	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	U		U		U	
Bycatch: onboard best practices	Y	4	Y	4	Y	4
Bycatch: spatio-temporal closures/reduction	N		N		N	

Table 2. Nesting beaches in Maldives.

RMU / Nesting beach name	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Central point		Reference #
				Long	Lat	
CM-NWIO						
Anhenfushi (Baa)	N	3 (2015)		5.3419444	72.9686111	10
Alidhuffarufinolhu (Haa Dhaalu)	N	1 (2018)		6.8609	73.1048	PS
Boduhithi (Kaafu)	N	3 (2015)		4.430296	73.384685	1
Cocoa (Kaafu)	N	2 (2018)		3.9178639	73.4701361	PS
Dhanbidhoo (Laamu)	N	1 (1984)		2.095416	73.546141	2
Dhangethi (Alif Dhaalu)	N	3 (1984)		3.607849	72.955516	2
Dhunikolhu (Baa)	N	14 (2013-2015)	33 (2015)	5.039783	72.881977	PS
Emboodhoo (Baa)	N	1 (2013-2015)		5.0634	72.8561	PS
Eydhafushi (Baa)	N	1 (1984)		5.103462	73.070084	2
Finolhu (Baa)	N	22 (2018)	51 (2018)	5.01125	72.9516583	PS
Fenfushi (Raa)	N	10 (2014-2015)		5.3819444	72.9019444	10
Funaddoo (Thaa)	N	18 (2015)		5.012335	72.958938	1
Gaadhoo (Laamu)	N	59 (2018-2019)		2.198367	73.128615	PS
Gangehi (Alif Alif)	N	2 (2018)		1.821844	73.452293	PS
Hanimaadhoo (Haa Dhaalu)	N	1 (2018)		5.3819444	72.9019444	
Hithadhoo (Laamu)	N	2 (1984)		6.7431	73.1659	2
Hukurelhi (Kaafu)	N	24 (1984)		1.797552	73.388456	2
Hurasdhoo (Alif Dhaalu)	N	4 (1984)		3.6671139	72.7754222	2
Isdhoo (Laamu)	N	20 (1984)		3.666932	72.77466	2
Kandoodhoo (Thaa)	N	18 (2015)		2.124596	73.581127	1
Kani (Kaafu)	N	1 (1984)		2.321933	72.917165	2
Kanimeedhoo (Thaa)	N	98 (2015)		4.343866	73.608452	1
Kanufushigaathufinolhu (Baa)	N	1 (2017)		2.195721	73.111564	PS
Kashidhoo (Baa)	N	2 (2013)		5.013259	72.961517	PS
Kuda Bandos (Kaafu)	N	1 (1984)		4.2638056	73.500125	2
Kuredu (Lhaviyani)	N	9 (2018)	22 (2018)`	4.263987	73.499994	PS
Landaa Giravaru (Baa)	N	1 (2013)		5.5496	73.4682	PS
Maadhoo (Baa)	N	296 (1984)		5.2859	73.10826	2

Maafilaafushi (Lhaviyani)	N	16 (2019)		4.173738	73.485532	
Maarikilu (Baa)	N	6 (2013)		5.3347861	72.9527528	9
Medufinolhu (Baa)	N	11 (2017)	16 (2017)	5.337	72.9514	PS
Milaidhoo (Baa)	N	1 (2018)		5.016184	72.966779	PS
Olhuveli (Laamu)	N	13 (2012-2019)	16(2012-2019)	1.81504	73.40717	PS
+Rannaalhi (Kaafu)	N	3 (1984)		3.9033083	73.3575944	2
Reethi Rah (Kaafu)	N	4 (2017)	14 (2017)	3.903401	73.357486	PS
Velaa (Noonu)	N	13 (2018)	22 (2018)	5.8310778	73.2093444	1
Vilingili (Kaafu)	N	2 (1984)		4.1736556	73.4852306	2
EI-NWIO						
Anhenfushi (Baa)	**N**	1 (2015)		5.3419444	72.9686111	10
Baros (Kaafu)	N	2 (2015)		4.284812	73.42724	PS
Emboodhoo (Baa)	N	1 (2013-2015)		5.0634	72.8561	PS
Finolhu (Baa)	N	3 (2018)	32 (2018)	5.012335	72.958938	PS
Medufinolhu (Baa)	N	1 (2013-2018)	25 (2017-18)	5.016184	72.966779	PS
Hanimaadhoo (Haa Dhaalu)	N	1 (2019)		6.7574889	73.17475	PS
Jehunuhura (Lhaviyani)	N	1 (2020)		5.5547972	73.4894583	PS
Olhuveli (Laamu)	N	1 (2011)		1.81504	73.40717	PS
Ufuligiri (Baa)	N	4 (2016-2017)		5.016839	72.97005	PS
Voavah (Baa)	N	1 (2013)		5.3166	73.07805	PS
LO-NWIO						
Hanimaadhoo (Haa Dhaalu)	N	1 (2018, 2020)		6.7431	73.1659	PS
Muravandhoo (Raa)	N	1 (2018)		5.6076	72.9521	PS
Emboodhoo (Kaafu)	N	1 (2020)		4.0841111	73.5122306	
Non species specific data						
Burehifasdhoo (Noonu)	N	6 (2010)		5.965803	73.368214	9
Faadhoo (Lhaviyani)	N	26 (2010)		5.431721	73.63064	9
Fainu (Raa)	N	27 (2010)		5.463993	73.034147	9
Goidhoo (Baa)	N	25 (2010)		4.873322	72.99762	9
Hulhudhuffaaru (Raa)	N	10 (2010)		5.764955	73.012015	9
Ifuru (Raa)	N	15 (2010)		5.707661	73.024438	9

Karimmavattaru (Noonu)	N	48 (2010)		5.670712	73.387782	9
Kunfunadhoo (Baa)	N	420 (1984)		5.1115555	73.078833	1
Kunfunadhoo (Baa)	N	5 (2010)		5.1115555	73.078833	9
Kuramaadhoo (Noonu)	N	10 (2010)		5.873508	73.143754	9
Kurendhoo (Lhaviyani)	N	1 (2010)		5.334024	73.463463	9
Maafilaafushi (Lhaviyani)	N	26 (2010)		5.362518	73.415696	9
Madhiriguraidhoo (Lhaviyani)	N	3 (2010)		5.469646	73.559641	9
Madhirivaadhoo (Baa)	N	16 (2010)		5.268994	73.161184	9
Maduvvari (Lhaviyani)	N	106 (2010)		5.285021	73.502144	9
Medhafushi (Noonu)	N	4 (2010)		5.744538	73.324161	9
Meedhupparu (Raa)	N	5 (2010)		5.45621	72.980186	9
Olhugiri (Baa)	N	58 (2010)		5.001348	72.906105	9
Vandhoo (Raa)	N	7 (2019)		5.5317944	73.0416028	PS
Undoodhoo (Baa)	N	13 (2010)		5.274509	73.042485	9

Table 3. Number of turtles caught as bycatch in long line fisheries 2014-2018 [5].

Year	Number of vessels	Reported annual bycatch
2014	71	24
2015	28	53
2016	42	n/a
2017	34	56
2018	28	4

Table 4. International conventions signed by Maldives in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Relevance to sea turtles
CITES	Y	Y	Y	ALL	Resolution Appendix 1
CBD	Y	Y	Y	ALL	Habitat protection
IOSEA-MOU	Y	Y	Y	ALL	
Northern Indian Ocean Marine Turtle Task Force	Y	Y	Y	ALL	
IOTC	Y	Y	Y	ALL	Resolution 12/04
CMS	Y	Y	Y	ALL	

Figure 1. Green sea turtle nesting sites in the Maldives.

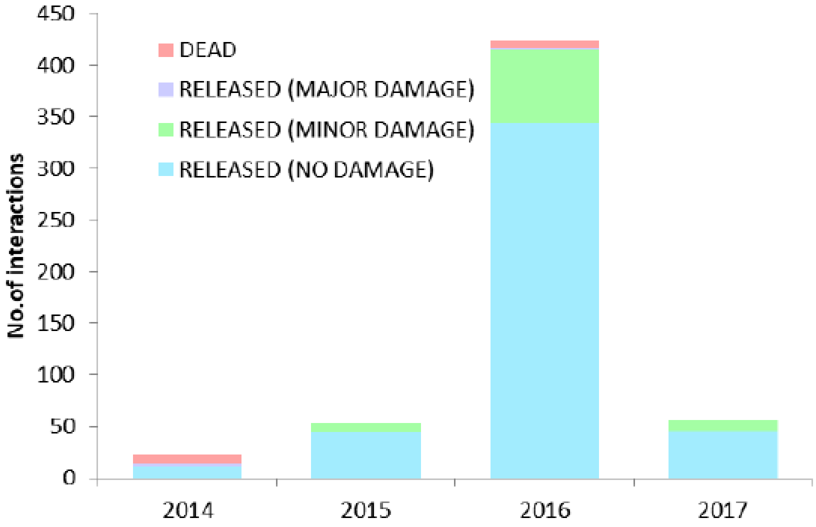

Figure 2. Fate of turtles caught in long line fisheries (2014-2017) [4].

Figure 3. Hawksbill turtle nesting sites in the Maldives.

Figure 4. Olive ridley turtle nesting sites in the Maldives.

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OMAN (SULTANATE OF)

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1. RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Oman has the largest number of nesting green turtles of any single Indian Ocean nation [23]. Although green turtles' nest on ~275 beaches along the entire coast of Oman [23], two beach areas have been identified as high value for green turtle activities: Ras al Hadd and Masirah Is. [19,20,22,37,38]. The majority of green turtles nesting in Oman occurs on a 45 km stretch of coast from Ras al Hadd to Ras al Khabbah [23], with approximately 6,000 nesting females recorded every year [19,20,22] (Table 1). Ras al Hadd, situated at the extreme eastern point of the Arabian Peninsula, contains ~90% of all abundance for the North Indian Ocean subpopulation of green turtles [20,23,34], the second being east of Mukulla in Yemen [34]. Acknowledging the importance of this area, the Government of Oman declared Ras al Hadd as a Nature Reserve in 1996; a map showing green turtle nesting sites at the reserve is given in Figure 1. Masirah Is. also harbours some important nesting sites of this endangered species [38]. A description of the nesting areas is given in Table 2.

1.1.2 Marine areas

Green turtles spend the majority of their adult lives feeding in shallow waters [20]. The feeding grounds of this NWIO sub-population are in the Arabian Gulf, on the coasts of Oman and Yemen and in the Red Sea [19,21]. Migration data of green turtles fitted with satellite tags off the east coast of Masirah Is. in 2012 (n=2) [15,17] and off the coast of Ras al Hadd between 2016-2019 (n=6) [34] showed a coastal route migration, with the capacity of long distance movement into the Red Sea and the Gulf of Kutch in India [15, 34]. Nesting migrations from Bu Tinah Is. in the United Arab Emirates to Ras al Hadd have been observed in 2018 [34]. Their post-nesting migration showed a "sudden reduction in travel rates and a shift from purposeful, rapid and unidirectional orientation to short distance movements with random heading changes" [34], however this is based on a small sample size (n=6) and should not be considered as a substantive conclusion [34]. Despite these studies, the complete relationship between the turtles that nest in Oman and those seen on the feeding grounds is not entirely clear [19] (Table 1).

1.2 Other biological data

Curved carapace length (CCL) differs between adult male and female green turtles, with males being on average around 6 cm smaller than females [34]. On Masirah Is., the CCL range is between 106-112 cm [38], the curved carapace width (CCW) range is between 96-101 cm [38], and the average track width is 102 cm [38]. The mean Straight Carapace Length (SCL) of green turtles in Ras al Hadd (n= 62, 97.1±1.2 SE) [19] is slightly bigger than the ones on Masirah Is. (n=90, 93.2±1.4 SE) [19]. The mean clutch size is 103.5±8.0 SE (n=58) for the Ras al Hadd population, and 97±5.6 SE (n=16) for the Masirah population [19]. Analysis of stomach content of sea turtles from Masirah Is. showed they feed on both seagrasses (*Halophila ovalis* and *Halodule uninervis*) and algae (*Sargassum illicifolium* and *Chaetomorpha aerea*) [20] (Table 1).

1.3 Threats

1.3.1 Nesting sites

Green turtles are consumed by people on Masirah Is. [19,20,37], Mhawt Is. and other small villages on the southern coast [19]. A minimum of 1,000 green turtles are captured each year from the feeding grounds and used as food [19,37]. Other threats on all unprotected nesting locations include disorientation from light pollution, recreational activities on nesting areas (such as camping and bonfires), driving on nesting beaches, harassing of nesting turtles and emerging hatchlings, coastal development and encroachment on nesting beaches [22,23,37,38]. Natural predators, such as feral cats, also impact turtle eggs and hatchlings [38] (Table 1).

1.3.2 Marine areas

Sea turtles in the waters of Oman face multiple threats including oil and gas industries, urban and industrial development, fishery pressure, and shipping. Major concerns exist regarding fisheries interactions with marine mega-fauna in the Northern Indian Ocean, including sea turtle populations [27]. These threats include bycatch in small scale and industrial fisheries [6,23,38], ghost fishing and entanglement and ingestion of marine debris. The entanglement of turtles in marine debris, particularly discarded fishing nets, is frequently observed among all four species of turtles on Masirah Is. by the field assistants of the Environment Society of Oman (Table 1).

In 1989, 586 individual turtles (unidentified species) were observed caught in demersal trawls [6], with 50% of turtles either dead or had no chance for survival upon return to sea [6]. A bycatch study was completed over three years on Masirah Is. (2014-2017), the results of which remain to be published. When published, these results should scale the bycatch problem in Oman and highlight practical conservation and management measures. Threats related to climate change are not studied nor understood.

1.4 Conservation

In Oman, marine turtles and their most commonly used habitats are protected by many national laws and decrees, but the most important one is the Law on nature reserves and wildlife conservation issued by Royal Decree No. (6/2003) where article [5] states that “The Environmental Assessment of any public and private development project shall include all data concerning measures that are to be followed to avoid damage to reserves and wildlifes, prior to obtaining approval for the project". Article (15) from same law states that "without prejudice to any severer penalty stipulated by the Omani penal Law or any other law: Any one who intentionally kills, hunts or smuggles any animal or birds in the attached appendix No. 2 (including sea turtles) or their genetic materials shall be subjected to imprisonment for a period not exceeding three months and a fine not less than R.O 100/= (one hundred Omani Rial) and not exceed R.O. 1000/= (one thousands Omani Rial) or one of two penalties".

The other important law is Royal Decree No. (20/19) on the promulgating the law on living aquatic wealth, the law consists of 64 articles aims at protecting, developing and strengthening controls on the live aquatic wealth in the Sultanate. The law prohibits for example (a) the use of fishing methods harmful to the marine environment, or in any way possible to affect the balance of vegetation and environment at sea, and (b) the actions that can cause pollution or destruction of marine environment. Article (11) of this law states "It is forbidden to hunt turtles, collect their eggs and hunt whales, dolphins, mammals and seabirds, except in accordance with the conditions specified by the regulations. It is also forbidden to tamper with the places and presence of turtles".

Royal Decree No. (114/2001) issuing the law on conservation of the environment and prevent of pollution article no. (9) "No establishment of any source or area of work shall be started before obtaining an environmental permit confirming its environmental soundness".

Ras al Hadd turtle reserve is monitored by the government through declaration of the nature reserve and regulating the nesting beaches by tourism and local communities by law as mentioned earlier and by Ministerial Decision No. (64/2017). As marine turtles are protected by law, Oman through Ministry of Environment and Climate Affairs working together with concerned authorities toward enforcing the existing law.

A list of international conventions signed by Oman in relation to marine turtle conservation is given in Table 4.

1.5 Research

Ras al Hadd Nature Reserve has been monitored almost annually from 1996 where the nesting beaches of green turtle were declared as Nature Reserves in 1996 for the conservation of the sea turtles [40,42,44]. The reserve is a 120 km area of beaches, coastal lands and marine habitats located along 45 km of the Ras al Hadd Penisula in Oman.

The Marine Turtle Conservation Project (MTCP) took place on Masirah Is. between 2004 and 2008 and aimed to establish a population assessment of the four species of turtle that nest on the Is., including green turtles [17]. The project involved the satellite tracking of two nesting green turtles in 2008. This project project was a collaboration between Ministry of Environment and Climate Affairs, Biodiversity East and the University of Exeter. A summary of past and current research and conservation projects on marine turtles in Oman is given in Table 4.

Six adult green turtles have been tracked in Ras al Hadd in 2016 under the Gulf Green Turtle Conservation Project 2016-2019 by Emirates Nature (formally EWS-WWF). This project was a collaboration between Emirates Nature, Ministry of Environment and Climate Affairs and Environment Society of Oman.

The Environment Society of Oman has been doing nesting surveys of green turtles since 2016 on Masirah Is. under its Marine Turtle Research & Conservation Project. This project is in collaboration with the Ministry of Environment and Climate Affairs.

However, more research on the genetic characterization of the turtles foraging in the Turtle Reserve and other nesting areas should be prioritised, together with hatchling rates and impacts of climate change.

2 RMU: *Caretta caretta*, North-West Indian Ocean (CC-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

One of the most important nesting aggregations for the loggerhead species in the world occurs in Oman on the Is. of Masirah [2,3,4,9,14,15,17,18,19,21,22,23,25,26,27,28,33,37,38]. This globally important nesting site used to record approximately 30,000 nesting females per year [19,22,23,37,38], mainly concentrated on 14 kilometers of beach on Masirah. A map showing loggerhead turtle nesting sites on Masirah Is. is given in Figure 2. Loggerhead turtles also nest in southern Oman on around 200 beaches along the mainland coast [22,23,37]. About 71% of these nests are on Al Hallaniyat Is. [23], where 3,137 nests were recorded in 1991 [23]. A description of the nesting areas is given in Table 2.

In recent years, a declining trend in nesting frequency of loggerhead sea turtles has been observed on Masirah Is. [4], with 659 tracks per day recorded on index beaches from 1985 to 1990, compared to 189.94 tracks per day from 2009 to 2013 [4]. A comparison of recent and historical surveys of nesting loggerhead turtles on beaches of Masirah in 2015 showed a reduced population estimate together with a downward trend in nesting effort [28]. Increased efforts are recommended at a regional level to investigate and respond to causal factors related to the declining trend in nesting [28]. These findings were of sufficient magnitude to revaluate the global population status of this species and its conservation needs [28]. This 2015 review led to the classification of the North West Indian Ocean loggerhead subpopulation as Critically Endangered on the IUCN Red List.

2.1.2 Marine areas

Satellite tracking systems have identified specific foraging and inter-nesting areas for loggerhead turtles by tracking a sample of female turtles from both main nesting sites [14,15,17,21,25,27,31]. Ten female loggerhead turtles fitted with satellite trackers on Masirah Is. in 2006 showed a dichotomy in behaviour during the internesting period, with six out of 10 remaining close to Masirah Is. and the others undertaking circuitous oceanic loops, hundreds of kilometres in length [14]. Some loggerheads headed southwest to Yemen, often far distant from the shallow coastal zone [15]. Post-nesting migrations revealed a propensity towards long-term utilisation of oceanic habitats in the region between Socotra Is. (Yemen) and the mainland of Yemen/Oman, with 76±15.4% of time spent in oceanic habitat [14,25]. Preliminary processing of data from 40 tags deployed in 2006 and between 2010 and 2012 on nesting females on Masirah revealed a predominance for tagged turtles to remain in a narrow corridor of approximately 100 km northwards from the north and eastern beaches of the island for up to 14 weeks after tagging [27]. Post-nesting migration routes are predominantly to the south of the island across continental shelf habitat, with most individuals circulating out to offshore waters of Oman and Yemen [27]. A study of the oceanic movement of juvenile loggerheads showed that 9 out of 18 loggerheads tracked from Reunion Is. between 2007 and 2011 swam towards the waters of Oman, with a mean traveling direction corresponding roughly to the direction of Masirah Is. [31].

2.2 Other biological data

Index Beaches (14 km high density nesting beaches) on Masirah Is. have an average of 189.9 tracks per day from 2009 to 2013, as opposed to 659 tracks per day from 1985 to 1990. On Masirah Is., the average CCL is 98 cm (n=14, range 89-107 cm) [38], the SCL is 91.2 cm ±1.0 SE (n=1378) [19], and the mean clutch size is 107 ± 3.0 SE (n=161). Mean Estimated Clutch Frequency (ECF) of loggerhead turtles on Masirah Is. are 5.4 nests ± (SD) 0.87 (range, 4-7 nests, n = 34) [26] (Table 1).

Genetic studies of loggerhead haplotypes on six of the nine globally significant RMUs for this species showed contemporary migratory connectivity between the Indian and Atlantic Oceans occurs on a broader scale than previously hypothesized [29]. Loggerhead genetics studies from Reunion Is. showed >83% of individuals have the haplotype signature of the Oman nesting population [32] (Table 1).

2.3 Threats

2.3.1 Nesting sites

Threats to nesting sites include disorientation from light pollution, recreational activities on nesting areas (such as camping and bonfires), driving on nesting beaches, harassing of nesting turtles and emerging hatchlings, coastal development and encroachment on nesting beaches [22,23,37,38] (Table 1).

Many potential natural predators of turtle eggs and hatchlings have been identified, although none was observed predating, and egg collection by humans may be less than 1% [21]. Hatchling predators on Masirah Is. include crabs, herons, egrets, cormorants, gulls, terns, kestrels, Egyptian vulture and feral cats [21] (Table 1).

2.3.2 Marine areas

See 1.3.2.

2.4 Conservation

See 1.4.

2.5 Research

Surveys of loggerhead turtle nesting on Masirah Is. were initiated in 1977 and 1978 by Dr. J. P. Ross of the World Wildlife Fund and personnel of the Ministry of Agriculture, Fisheries, Petroleum and Minerals in Oman [37].

The Marine Turtle Conservation Project (MTCP) took place on Masirah Is. between 2004 and 2008 and aimed to establish a population assessment of the four species of turtle that nest on the Is., including loggerhead turtles [17]. The project involved the satellite tracking of 10 nesting loggerheads in 2006. This project project was a collaboration between Ministry of Environment and Climate Affairs, Biodiversity East and the University of Exeter.

A standardised monitoring programme for the Masirah rookery was established in 2008 as a collaborative project between Oman's Ministry of Environment and Climate Affairs, US Fish and Wildlife Service, Archie Carr Center for Sea Turtle Research, Environment Society of Oman and Five Oceans Environmental Services [28]. This partnership resulted in data from 2008 to date that allows the evaluation of long-term nesting trends [28]. Through this partnership, around 40 loggerhead turtles were fitted with satellite tags on Masirah Is. and Hallaniyat Is. between 2006 and 2017. A summary of past and current research and conservation projects on marine turtles in Oman is given in Table 44.

Many of the data still needs to be analysed and published to build a more complete understanding of loggerhead migrations and distribution. More research on the presence of juvenile loggerhead turtles should be undertaken to determine residency and movement patterns and identify source populations through genetic analysis.

3. RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

There are currently 2 major nesting sites for hawksbill turtles in Oman: Daymaniat Islands which provide good feeding and nesting grounds for this species, and Masirah Is. [2,12,13,15,17,19,21,22,23, 33,36,37,38]. A minor site is reported from Muscat beaches [22]. Approximately 250 nest per year are recorded along 30 km long of beaches on Masirah Is. [13], and 109-350 nests per year along 2 km of beaches on Daymaniat Islands [19,22,23,36,37]. Daymaniyat Islands are considered one of the most important nesting aggregations for hawksbill turtles in the region and have been declared a Marine Protected Area in 1996. A description of the nesting areas is given in Table 2.

3.1.2 Marine areas

Satellite tagging of 25 hawksbill turtles from Oman between 2007-2012 from both Masriah Is. and Daymaniyat Islands, showed a steady migration pattern south towards Masirah Is. and to Quwayrah [12]. The turtles stayed close to the mainland and the continental shelf [12]. This same study showed that adult female hawksbill turtles in Oman spend 83% of their time foraging in small home ranges [12].

3.2 Other biological data

On Masirah, hawksbills have been observed to make a maximum of 3 nests/season [13,19,37], and have an average interesting interval of 14.5 days [13]. The SCL is 73.3 cm ±1.6 SE (n=48) [19] which is significantly larger than the ones in the Arabian Gulf by ~11 cm [12], and the mean clutch size is 97 ± 16.0 SE (n=9) [19] (Table 1).

3.3 Threats

3.3.1 Nesting sites

Threats to nesting sites include disorientation from light pollution, recreational activities on nesting areas (such as camping and bonfires), driving on nesting beaches, harassing of nesting turtles and emerging hatchlings, intentional poaching of turtle nests, coastal development and enchaorchment on nesting beaches [13,22,23,36,37,38]. Human predation of hawksbill nests has been reported in various publications [13,36]. The flesh is thought to be poisonous but the eggs are taken for food when they are found [13,36] (Table 1).

Many potential natural predators of turtle eggs and hatchlings have been identified, including the presence of numerous ghost crabs on the nesting beaches, and the possibility of nest flooding and destruction at high tides and beach erosion.

3.3.2 Marine areas

See 1.3.2.

3.4 Conservation

See 1.4.

3.5 Research

The Marine Turtle Conservation Project (MTCP) took place on Masirah Is. between 2004 and 2008 and aimed to establish a population assessment of the four species of turtle that nest on the island, including hawksbill turtles [17]. This project project was a collaboration between Ministry of Environment and Climate Affairs, Biodiversity East and the University of Exeter.

The Environment Society of Oman has been doing nesting surveys of hawksbill turtles since 2012 on Masirah Is. under its Marine Turtle Research & Conservation Project. This project is in collaboration with the Ministry of Environment and Climate Affairs. A summary of past and current research and conservation projects on marine turtles in Oman is given in Table 4Table 4.

Emirates Wildlife Society-WWF (now known as Emirates Nature) completed a Marine Turtle Conservation Project between 2010 and 2013, researching the foraging behaviour, migratory routes and conservation needs of hawksbill turtles in the Gulf, Gulf of Oman and Arabian Sea. 25 hawksbill turtles have been fitted with satellite trackers in Oman under this project, a collaboration effort between Emirates Nature, Oman's Ministry of Environment and Climate Affairs, Environment Society of Oman, and Five Oceans Environmental Services.

4 RMU: *Lepidochelys olivacea,* West Indian Ocean (LO-WIO)

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

Few olive ridley turtles nest in Oman, and the ones that do are known to nest only on Masirah Is. along 30 km of beach [2,13,15,16,17,19,21,22,23,33,37,38]. There is a record of around 150 nesting females every year on nesting beaches [19]. A description of the nesting areas is given in Table 2.

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4.1.2 Marine areas

A satellite telemetry project of nine adult female olive ridleys from Masirah Is. in 2008 revealed their preference for coastal neritic waters [15,16]. Olive ridleys remained localized around the island or migrated several hundred kilometers north of the island [15] and settled in coastal areas of water depth < 100 m. Their post-breeding migrations ranged from 85 to 796 km [16]. Some individuals travelled north to foraging grounds in Pakistan, Iran and United Arab Emirates [16], whereas others remained resident in the waters of Oman for extended period of times [16]. These locally resident turtles remained in very shallow water (<40 m depth) where they were capable of extended dive durations (>100 min) in water warmer than 21°C [16], this is a feature unique to olive ridleys amongst sea turtles [16] (Table 1).

4.2 Other biological data

On Masirah, olive ridleys have been observed to make a maximum of 3 nests/season [13,19,37]. Olive ridleys have an average internesting interval of 21 days [37]. The SCL is 71.5 cm ±0.6 SE (n=100) [19], and the mean clutch size is 118 ± 7.2 SE (n=22) [19]. There may be a correlation between body size and foraging grounds [16], a comparison between turtles migrating north towards Pakistan and the Arabian Gulf and those remaining south, near Masirah Is. found the southern ones to be larger [16] (Table 1).

4.3 Threats

4.3.1 Nesting sites

Threats to nesting sites include disorientation from light pollution, recreational activities on nesting areas (such as camping and bonfires), driving on nesting beaches, harassing of nesting turtles and emerging hatchlings, take of turtle eggs, coastal development and enchaorchment on nesting beaches [13,22,23,36,37,38] (Table 1).

Many potential natural predators of turtle eggs and hatchlings have been identified, including the presence of numerous ghost crabs on the nesting beaches, and the possibility of nest flooding and destruction at high tides and beach erosion [13].

4.3.2 Marine areas

See 1.3.2.

4.4 Conservation

See 1.4.

4.5 Research

The Marine Turtle Conservation Project (MTCP) took place on Masirah Is. between 2004 and 2008 and aimed to establish a population assessment of the four species of turtle that nest on the island, including olive ridley turtles [17]. The project involved the satellite tracking of nine nesting olive rildey turtles in 2008. This project project was a collaboration between Ministry of Environment and Climate Affairs, Biodiversity East and the University of Exeter.The Environment Society of Oman has been doing nesting surveys of olive ridley turtles since 2012 on Masirah Is. under its Marine Turtle Research & Conservation Project. This project is in collaboration with the Ministry of Environment and Climate Affairs. A summary of past and current research and conservation projects on marine turtles in Oman is given in Table 44.

Table 1a. Biological data, trends and threats relating to loggerhead and green turtles in Oman.

	Caretta caretta		*Chelonia mydas*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Occurrence				
Nesting sites	Y	2, 3, 4, 9, 14, 15, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 33, 37, 38	Y	1, 2, 8, 9, 10, 11, 15, 17, 19, 20, 21, 22, 23, 30, 33, 37, 38
Pelagic foraging grounds	Y	14	N	20, 23
Benthic foraging grounds	Y	14	N	20, 23
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)	2	9, 22, 23, 37	2	19, 20, 22
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	200	22, 23, 37	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)	88	PS	55	22, 37
Nesting females / yr	30000 (1979)	19, 22, 23, 37, 38	6000 (1979)	19, 20, 22, 23, 37
Nests / female season (N)	5.5 nests	28	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)	CCL 89 cm (n=14)	38 19	CCL 106 cm (n=3)	38 19
Age at maturity (yrs)	n/a		n/a	
Clutch size (n eggs) (N)	107 ± 3.0 (n=161)	19	103.5 ± 8.0 (n=58)	19
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)	Decreasing trend. Index Beach 1985-1990 = 659 tracks per day. 2009-2013 = 189.94 tracks per day.	4	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)	30000 (1979)	19, 22, 23, 37, 38	6000 (1979)	19, 20, 22, 23, 37
Published studies				
Growth rates	n/a		n/a	
Genetics	Y	29, 32	n/a	
Stocks defined by genetic markers	Y	29, 32	n/a	
Remote tracking (satellite or other)	Y	14, 15, 17, 21, 25, 27, 31	Y	15, 17, 21, 34

	Caretta caretta		*Chelonia mydas*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Survival rates	n/a		n/a	
Population dynamics	n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		Y	20
Capture-Mark-Recapture	n/a		n/a	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y SN DN	23, 38	Y SN DN	23, 38
Bycatch: presence of industrial fisheries?	YPT (nesting females), PLL (juveniles)	6, 31	Y	6
Bycatch: quantified?	Y	6	Y	6
Take. Intentional killing or exploitation of turtles	Y	23	Y	19, 20, 23, 37
Take. Eggs (illegal)	Y	2, 3	n/a	
Coastal Development. Nesting habitat degradation	Y	23, 38	Y	22, 23, 38
Coastal Development. Photopollution	Y	22, 23, 38	Y	22, 23, 38
Coastal Development. Boat strikes	n/a		n/a	
Egg predation	n/a		n/a	
Pollution (debris, chemical)	n/a		n/a	
Pathogens	n/a		n/a	
Climate change	n/a		n/a	
Foraging habitat degradation	n/a		n/a	
Other (natural threats)	Y	21	n/a	
Harassment of turtles (turtle riding etc.)	Y	22	Y	22
Long-term projects (>5yrs)	n/a		n/a	
Monitoring at nesting sites (period: range of years)	43 (1977-2020)	18, 19, 28	n/a	
Number of index nesting sites	1	4	2	PS
Monitoring at foraging sites (period: range of years)	n/a		n/a	
x				
Conservation				
Protection under national law	Y	39, 40	Y	39, 40
Number of protected nesting sites (habitat preservation) (% nests)	n/a		90%	42, 44
Number of Marine Areas with mitigation of threats	n/a		n/a	
N of long-term conservation projects (period: range of years)	1 (43)	18, 19, 28	1 (20) 1 (5) 1 (6)	PS 17 PS
In-situ nest protection (eg cages)	n/a		n/a	
Hatcheries	n/a		n/a	
Head-starting	n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a	
By-catch: onboard best practices	n/a		n/a	
By-catch: spatio-temporal closures/reduction	n/a		n/a	
Other	n/a		n/a	

Table 1b. Biological data, trends and threats relating to hawksbill and olive ridley turtles in Oman.

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Occurrence				
Nesting sites	Y	2, 12, 13, 15, 17, 19, 21, 22, 23, 33, 36, 37, 38	Y	2, 13, 15, 16, 17, 19, 21, 22, 23, 33, 37, 38
Pelagic foraging grounds	N	12	Y	16
Benthic foraging grounds	Y	36	Y	14, 16
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)	2	13, 22	1	13, 22
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	1	22	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)	30	13	30	13
Nesting females / yr	109-350 (1979-1991)	19, 22, 23, 36, 37	150 1982)	19
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)	SCL 73.3 cm (n=48)	19	SCL 71.5 cm (n=100)	19
Age at maturity (yrs)	n/a		n/a	
Clutch size (n eggs) (N)	97 ± 16.0 (n=9)	19	118 ± 7.2 (n=22)	19
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)	109-350 (1979-1991)	19, 22, 23, 36, 37	150 (1982)	19
Published studies				
Growth rates	n/a		n/a	
Genetics	n/a		n/a	
Stocks defined by genetic markers	n/a		n/a	
Remote tracking (satellite or other)	Y	12	Y	15, 16, 17
Survival rates	n/a		n/a	
Population dynamics	n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a	

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Capture-Mark-Recapture	n/a		n/a	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y SN DN	23, 37, 38	Y SN DN	23, 38
Bycatch: presence of industrial fisheries?	Y	6	Y PT	6, 37
Bycatch: quantified?	Y	6	Y	6
Take. Intentional killing or exploitation of turtles	Y	23	Y	23
Take. Eggs (illegal)	Y	36	n/a	
Coastal Development. Nesting habitat degradation	Y	23, 38	Y	23, 38
Coastal Development. Photopollution	Y	22, 23, 38	Y	22, 23, 38
Coastal Development. Boat strikes	n/a		n/a	
Egg predation	Y	13, 36, 37	n/a	
Pollution (debris, chemical)	n/a		n/a	
Pathogens	n/a		n/a	
Climate change	n/a		n/a	
Foraging habitat degradation	n/a		n/a	
Other (natural threats)	Y	23	n/a	
Harassment of turtles (turtle riding etc.)	Y	22	Y	22
Long-term projects (>5yrs)	n/a		n/a	
Monitoring at nesting sites (period: range of years)	5 (2004-2008)	17	5 (2004-2008)	17
Number of index nesting sites	1	PS	1	PS
Monitoring at foraging sites (period: range of years)	n/a		n/a	
x				
Conservation				
Protection under national law	Y	39, 40	Y	39, 40
Number of protected nesting sites (habitat preservation) (% nests)	80%	41, 43	n/a	
Number of Marine Areas with mitigation of threats	n/a		n/a	
N of long-term conservation projects (period: range of years)	1 (8)	PS	1 (8)	PS
In-situ nest protection (eg cages)	n/a		n/a	
Hatcheries	n/a		n/a	
Head-starting	n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a	
By-catch: onboard best practices	n/a		n/a	
By-catch: spatio-temporal closures/reduction	n/a		n/a	
Other	n/a		n/a	

Table 2. Turtle Nesting Beaches in Oman.

RMU/Nesting Beach	Index site	Nests/yr: recent average (range of years)	Crawls/yr: recent average (range of years)	Western limit		Eastern limit		Length (km)	% Monitored	Ref #	Monitoring Level (1-2)	Monitoring Protocol (A-F)
				Long	Lat	Long	Lat					
CC-NWIO												
Masirah Is.	A	30000 (1979)	n/a	58.898292	20.693993	58.638285	20.166245	83	100%	19, 22, 23, 37, 38	1	D, E
Al Hallaniyat Islands	B	3137 (1991)	n/a					5	0%	9, 23	n/a	n/a
Southern Oman		n/a	n/a	U	U	U	U	U	0%	22, 23, 37	n/a	n/a
CM-NWIO												
Masirah Is.	A	n/a	n/a	58.898292	20.693993	58.638285	20.166245	10	100%	19, 20, 22, 37, 38	1	D, E
Ras al Hadd/Ras al Jinz beaches	C	6000 (1979)	n/a	59.79298	22.538313	59.809517	22.226429	45	50%	19, 20, 22	2	A
EI-NWIO												
Muscat	D	n/a	n/a					0.5	0%	22/PS	n/a	n/a
Daymaniat Islands	E	109-350 (1979-1991)	n/a					2	0%	19, 22, 23, 36, 37	n/a	n/a
Masirah Is.	A	250	n/a	58.898292	20.693993	58.638285	20.166245	30	100%	13	1	D, E
LO-WIO												
Masirah Is.	A	250	n/a	58.898292	20.693993	58.638285	20.166245	30	100%	13	1	D, E

Table 3: International conventions signed by Oman in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA Marine Turtle MoU)	Y	N	Y	ALL		
Convention on Biological Diversity (CBD)	Y	N	Y	ALL		
The Convention on Wetlands - Ramsar	Y	N	Y	ALL		
CITES	Y	N	Y	ALL		

Table 4: List of past and current projects in relation to marine turtle research and conservation in Oman.

SI	RMU	Location	Project Name	Start date	End date	Leading organisation	Public/Private	Collaboration with
4.1	**CC-NWIO**	Masirah Is.	Oman 2006: Loggerhead Turtles of Masirah	2006	2006	Marine Turtle Research Group, University of Exeter	Public and Private	Ministry of Regional Municipalities, Environment and Water Resources, IPEDEX & CO LLC
4.2	**CC-NWIO**	Masirah Is.	2006 Post-nesting Migrations of Loggerhead Turtles from Masirah Is., Oman	2006	2006	Ministry of Regional Municipalities, Environment and Water Resources and Environment Society of Oman	Public and Private	Marine Research Foundation, the Florida Fish and Wildlife Conservation Commission, the U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.3	**CM-NWIO**	Ras al Hadd Turtle Reserve	Post-nesting migrations of Green Turtles from Ras al Hadd Turtle Reserve, Sultanate of Oman	2007	2007	Ministry of Regional Municipalities, Environment and Water Resources and Environment Society of Oman	Public and Private	U.S. Fish & Wildlife Service, and U.S. National Marine Fisheries Service, Five Oceans Environmental Services
4.4	**EI-NWIO**	Daymaniyat Islands	Post-nesting migrations of Hawksbill Turtles from Daymaniyat Islands, Oman	2007	2007	Ministry of Regional Municipalities, Environment and Water Resources and Environment Society of Oman	Public and Private	Marine Research Foundation (Sabah, Malaysia), the Florida Fish and Wildlife Conservation Commission, the U.S. NOAA/National Marine Fisheries Service, and the U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.5	**CC-NWIO**	Masirah Is.	Marine Turtle Research & Conservation (Phase 2)	2007	2008	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.6	**LO-WIO**	Masirah Is.	Oman 2008: Olive Ridley Turtles of Masirah	2008	2008	Marine Turtle Research Group, University of Exeter	Public and Private	Ministry of Environment and Climate Affairs

SI	RMU	Location	Project Name	Start date	End date	Leading organisation	Public/Private	Collaboration with
4.7	**CM-NWIO**	Masirah Is.	Oman 2008: Green Turtles of Masirah	2008	2009	Marine Turtle Research Group, University of Exeter	Public and Private	Ministry of Environment and Climate Affairs
4.8	**CC-NWIO**	Masirah Is.	Marine Turtle Research & Conservation (Phase 3)	2008	2009	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.9	**CC-NWIO**	Masirah Is.	Marine Turtle Research & Conservation (Phase 4)	2009	2010	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.10	**EI-NWIO**	Daymaniyat Islands	Gulf Turtle Conservation Project 2010	2010	2011	Emirates Wildlife Society (EWS-WWF)	Public and Private	Ministry of Environment and Climate Affairs, Environment Society of Oman, and Five Oceans Environmental Services
4.11	**CC-NWIO**	Masirah Is.	Marine Turtle Research & Conservation (Phase 5)	2010	2011	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.12	**EI-NWIO**	Daymaniyat Islands & Masirah Is.	Gulf Turtle Conservation Project 2011	2011	2012	Emirates Wildlife Society (EWS-WWF)	Public and Private	Ministry of Environment and Climate Affairs, Environment Society of Oman, and Five Oceans Environmental Services
4.13	**CC-NWIO**	Masirah Is.	2010 Inter-nesting and post-nesting movements of Loggerhead Turtles from Masirah Is., Oman	2010	2010	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	NOAA South West Fisheries Science Centre, Ocean Ecology Network and Five Oceans Environmental Services

SI	RMU	Location	Project Name	Start date	End date	Leading organisation	Public/Private	Collaboration with
4.14	**CC-NWIO**	Middle East, Masirah Is.	2011 Inter-nesting and post-nesting movements of Loggerhead Turtles from Masirah Is., Oman	2011	2011	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	NOAA South West Fisheries Science Centre, Ocean Ecology Network and Five Oceans Environmental Services
4.15	**CC-NWIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation (Phase 6)	2011	2012	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.16	**EI-NWIO**	Middle East, Daymaniyat Islands	Sea Turtle Tracking in Oman	2012	2012	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	Five Oceans Environmental Services
4.17	**CC-NWIO**	Middle East, Masirah Is.	2012 Inter-nesting and post-nesting movements of Loggerhead Turtles from Masirah Is., Oman	2012	2012	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	NOAA South West Fisheries Science Centre, Ocean Ecology Network and Five Oceans Environmental Services
4.18	**CC-NWIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation (Phase 7)	2012	2013	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.19	**CC-NWIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation (Phase 8)	2014	2016	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.20	**CC-NWIO**	Middle East, Masirah Is.	Masirah Is. Female Loggerhead Turtle Tracking 2016	2016	2016	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	NOAA South West Fisheries Science Centre, Ocean Ecology Network and Five Oceans Environmental Services

SI	RMU	Location	Project Name	Start date	End date	Leading organisation	Public/Private	Collaboration with
4.21	**CC-NWIO**	Middle East, Masirah Is. & Hallaniyat Islands	Oman Female Loggerhead Turtle Tracking 2017	2017	2017	Ministry of Environment and Climate Affairs and Environment Society of Oman	Public and Private	NOAA South West Fisheries Science Centre, Ocean Ecology Network and Five Oceans Environmental Services
4.22	**CC-NWIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation (Phase 10)	2018	2020	Environment Society of Oman	Public	Florida Fish and Wildlife Conservation Commission, U.S. NOAA/National Marine Fisheries Service, U.S. Fish and Wildlife Service, Five Oceans Environmental Services
4.23	**CM-NWIO**	Middle East, Ras al hadd	Gulf Green Turtle Project 2016-2019	2016	2019	Emirates Wildlife Society (EWS-WWF)	Public and Private	A project of Emirates Wildlife Society-WWF & MRF in conjunction with the partners and sponsors.
4.24	**EI-NWIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation	2012	2020	Environment Society of Oman	Public and Private	Ministry of Environment and Climate Affairs, Environment Society of Oman
4.25	**LO-WIO**	Middle East, Masirah Is.	Marine Turtle Research & Conservation	2012	2020	Environment Society of Oman	Public and Private	Ministry of Environment and Climate Affairs, Environment Society of Oman

SI	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
4.1	http://www.seaturtle.org/tracking/index.shtml?project_id=145	TOTAL Corporate Foundation for Biodiversity and the Sea, TOTAL S.A. Muscat Branch	Alan Rees (alanfrees@gmail.com)	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)

SI	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
4.2	http://www.seaturtle.org/tracking/index.shtml?project_id=171	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.3	http://www.seaturtle.org/tracking/index.shtml?project_id=255	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.4	http://www.seaturtle.org/tracking/index.shtml?project_id=214	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.5		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)
4.6	http://www.seaturtle.org/tracking/index.shtml?project_id=278	TOTAL Corporate Foundation for Biodiversity and the Sea, TOTAL S.A. Muscat Branch	Alan Rees (alanfrees@gmail.com)	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)
4.7	http://www.seaturtle.org/tracking/index.shtml?project_id=310	TOTAL Corporate Foundation for Biodiversity and the Sea, TOTAL S.A. Muscat Branch	Alan Rees (alanfrees@gmail.com)	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)
4.8		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)

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4.9		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)
4.10	http://www.seaturtle.org/tracking/index.shtml?project_id=658&dyn=1551331921	Emirates Wildlife Society (EWS-WWF)	Marina Antonopoulo (mantonopoulou@ewswwf.ae)	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om) Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.11		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)
4.12	http://www.seaturtle.org/tracking/index.shtml?project_id=737	Emirates Wildlife Society (EWS-WWF)	Marina Antonopoulo (mantonopoulou@ewswwf.ae)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.13	http://www.seaturtle.org/tracking/index.shtml?project_id=505	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.14	http://www.seaturtle.org/tracking/index.shtml?project_id=618	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.15		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)

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4.16	http://www.seaturtle.org/tracking/index.shtml?project_id=738	City Neon	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.17	http://www.seaturtle.org/tracking/index.shtml?project_id=733	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.18		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)
4.19		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)
4.20	http://www.seaturtle.org/tracking/index.shtml?project_id=733	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.21	http://www.seaturtle.org/tracking/index.shtml?project_id=1269	US Department of State, US Fish and Wildlife Service	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om)	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.22		US Department of State, US Fish and Wildlife Service	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Andrew Willson (andywillson@5oes.com)

SI	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
4.23	2016 Deployments http://www.seaturtle.org/tracking/index.shtml?project_id=1329 2017 Deployments http://www.seaturtle.org/tracking/index.shtml?project_id=1328 2018 Deployments http://www.seaturtle.org/tracking/index.shtml?project_id=1338	Emirates Wildlife Society (EWS-WWF)	Marina Antonopoulo (mantonopoulou@ewswwf.ae)	Dr. Thuraya al Sariri (thuraya.alsareeri@meca.gov.om) Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om) Andrew Willson (andywillson@5oes.com)
4.24		Environment Society of Oman	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Bashar Zeitoun (admin@eso.org.om)
4.25		Environment Society of Oman	Maia Sarrouf Willson (maia.sarroufwillson@eso.org.om)	Bashar Zeitoun (admin@eso.org.om)

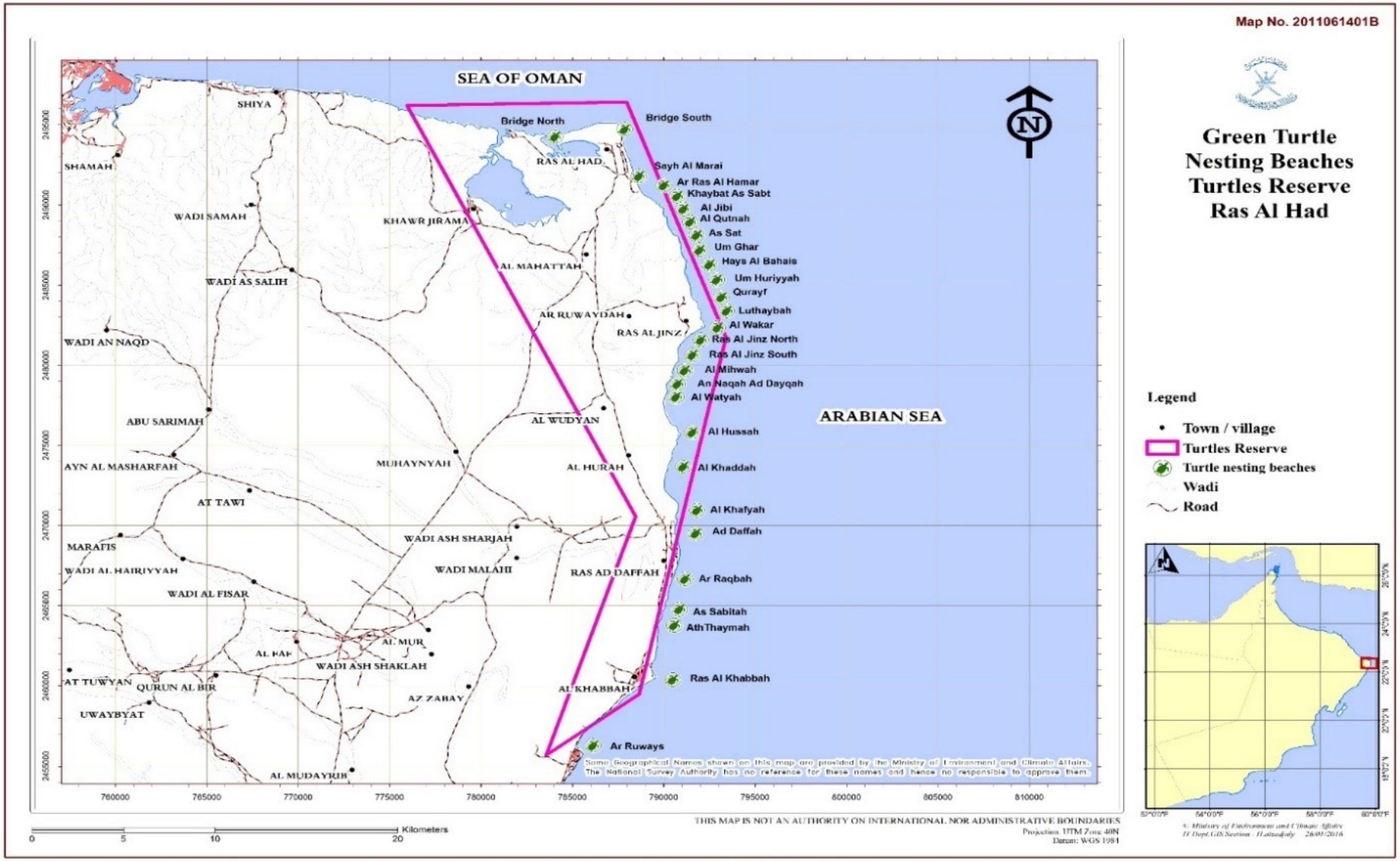

Figure 1. Green turtle habitats in Ras al Hadd Nature Reserve.

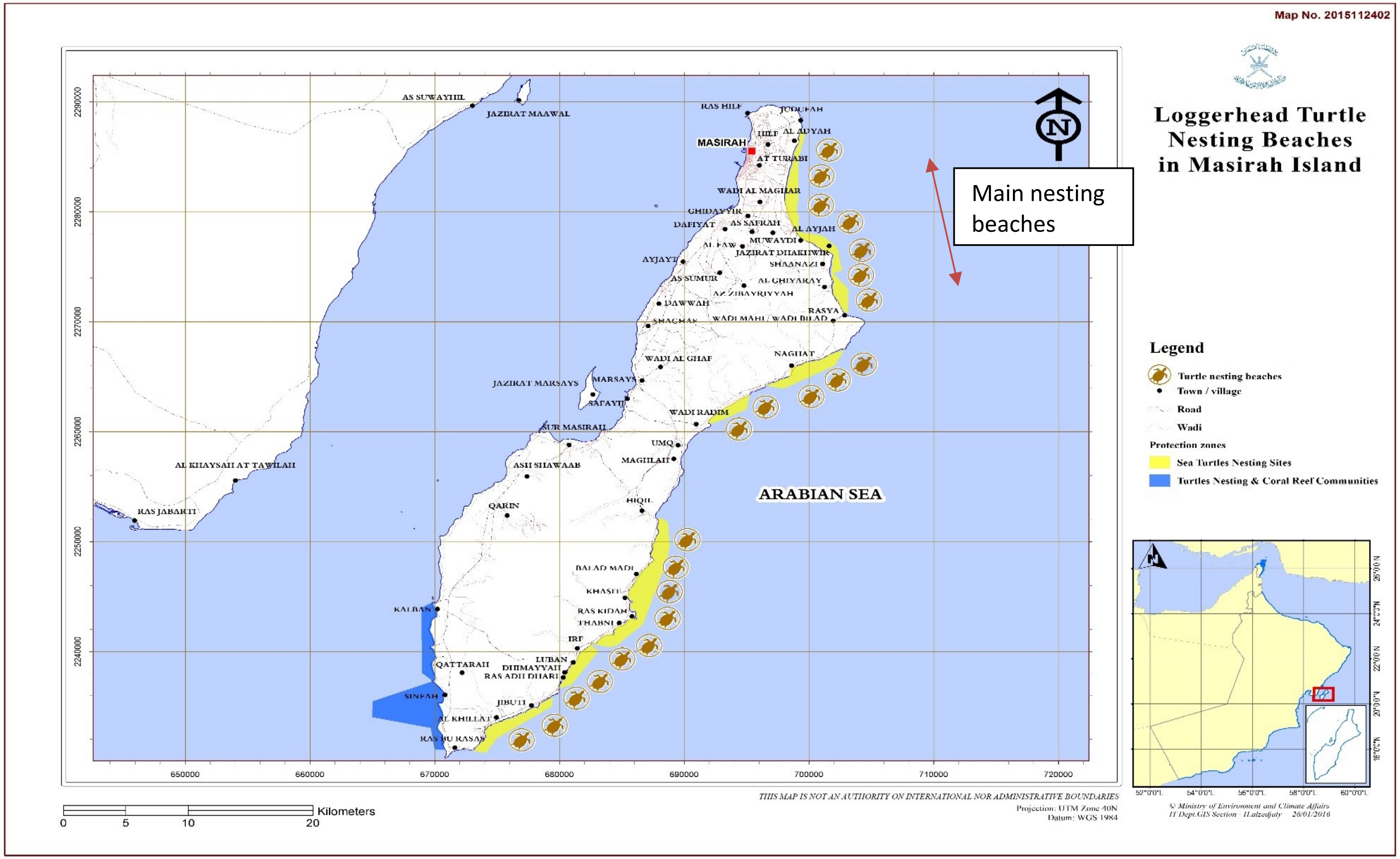

Figure 2. Loggerhead turtle habitats on Masirah Is..

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PAKISTAN

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Introduction

Five species of marine turtles occur in Pakistan. Green (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*) turtles have been recorded nesting in the country, although no nesting of the latter has been observed since 2001, and leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*) and hawksbill (*Eretmochelys imbricata*) turtles have been reported from individuals stranded on beaches or entangled in fishing gear.

Bycatch in commercial gillnet fishing gear is the greatest threat to marine turtles in Pakistan. An estimated 28,800 turtles are caught annually, with a mortality rate of 2.5% [78]. Bycatch mitigation techniques (mainly subsurface gillnetting) is now practiced and has greatly reduced turtle mortality in gillnet fisheries of Pakistan [53,76].

Habitat degradation, especially construction of huts for picnickers, debris from abandoned huts, solid waste, plastic pollution, and, to a lesser extent, illegal collection and sale of hatchlings to aquarists are also threats, especially to green turtles. Turtles are legally protected in Pakistan and there is no legal trade of turtle meat, eggs, or other products [49].

1 RMU: *Caretta caretta*, North-West Indian Ocean (CC-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

There is no record of loggerhead turtle nesting along the coast of Pakistan [48].

1.1.2 Marine areas

The species is widely distributed in waters along the Sindh and Balochistan coastlines, but no specific area of concentration has been observed. These waters are relatively close to the major loggerhead rookery is located on Masirah Is., Oman. Loggerhead turtles were observed by fishers throughout the year, except for June to August because of the tuna fisheries closure at this time [79]. During March to May more observations were recorded in comparison to other months of the years [48]. Further studies are required to ascertain the seasonality and preferred foraging habitats and potential migratory corridors of loggerhead turtles in Pakistan.

1.2 Other biological data

None available.

1.3 Threats

1.3.1 Nesting sites

There are no reported nesting sites for loggerhead turtles along the Pakistan coast. Even if nesting has gone unrecorded in some remote areas, the major threats would be feral dogs and other animals which may destroy the nest and depredate eggs. In addition, nesting may be hindered by the general public which has been reported to interact with nesting females mainly because of lack of awareness. Female turtles may abandon their nesting due to such disturbance.

1.3.2 Marine areas

Fishing operations, mainly gillnetting, is the major threat to loggerhead turtles in Pakistani waters. Entanglement of 11 loggerhead turtles in tuna gillnet operation along the coast of Pakistan was reported between December 2015 and April 2018 [48]. Two more loggerhead turtles were reported to be entangled in gillnets during 2019. Habitat degradation can be another threat, however, since no nesting or feeding grounds are known from Pakistan coast, the impact on loggerhead turtle populations cannot be assessed. Ghost fishing can be an important issue for sea turtles, however, no case of loggerhead turtle entangled in ghost gear is reported from Pakistan so far. Climate change is considered to be an important factor that effects distribution, abundance, feeding and breeding activities of turtles, but information about this for loggerhead turtles in Pakistan is not available.

1.4 Conservation

All marine turtles in Pakistan are protected under provincial wildlife and fisheries legislation. The legislation of Sindh Province, “Sindh Wildlife Protection Ordinance, 1972”, explicitly included all marine turtles in its Second Schedule (Protected Animals). In the fisheries legislation of Sindh all marine turtles are included in First Schedule of Sindh Fisheries Ordinance, 1970, Rule 2016 and their fishing (catching, marketing and trade) is prohibited [26]. In the legislation of Balochistan Province “Balochistan (Wildlife Protection, Preservation, Conservation and Management) Act, 2014”, marine turtles are included in Schedule III (Protected Animals). In the fisheries legislation of Balochistan catching, retention, marketing and trade of all marine turtles are prohibited under Balochistan Sea Fisheries Ordinance, 1971, Rule, 2016 [25]. In addition, export of all aquatic turtles is prohibited under Pakistan Fish Inspection and Quality Control Act, 1997, and Rules (1998) Clause 5 (3). Because of such legislation, marine turtles are protected and not commercially exploited; there is also no local consumption of these turtles.

1.5 Research

WWF-Pakistan has been conducting research on the bycatch of marine turtles in tuna fisheries of Pakistan since 2012 [41, 50,52,53,64,76-79]. In order to minimize entanglement of endangered, threatened and protected (ETP) species including turtles, WWF-Pakistan developed and advocated use of sub-surface operation of gillnets. The entire fleet immediately adopted subsurface gillnetting, which substantially reduced entanglement and mortality of marine turtles [76]. Loggerhead turtles are now only rarely reported to be entangled in gillnets and no mortality has been reported.

2 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

Green turtles nest on a large number of beaches between Manora in the East (Sindh Province) and Jiwani in the West (Balochistan Province) [4]. The most important green turtle nesting beaches along the Sindh coast are Sandspit, Hawks Bay, Kapaysee, and Cape Monz, whereas along Balochistan coast major nesting beaches for green turtles are Taq, Astola Is., Pasni (Ras Zarrien), Gwadar (Headland) and Daran (Jiwani) [1,2,3,6,10]. In addition to these sites, there are vast sandy beaches both in Sindh and Balochistan that green turtles have been observed to use in low density nesting. Between 1980 and 1997, a total of 17,008 nests of green turtles were observed along Hawksbay and Sandspit area [3]. From November 2011 to June 2012, a total of 1,208 nests of green turtles were counted from the same area [71]. Nesting of green turtles can be observed throughout the year; however, the main nesting season is from July to December with a peak in September [72].

2.1.2 Marine areas

Green turtles are found in coastal and offshore waters of Pakistan. Tagging experiments conducted by WWF-Pakistan under Pakistan Wetlands Programme revealed daily movements of adult green turtles between the Jiwani and Iranian Coast [35]. The most visited sites were Jiwani and Bandar Abbas, with turtles remaining for about 1.5 to 2 months in these areas. Two turtles, one tagged on Astola Is. and one at Daran, travelled as far as UAE and appeared near Um-al-Quain. Turtles were successfully tracked westwards to Iran, Qatar and UAE. The eastward movements of two tagged turtles ended on the west coast of India, where turtles travelled along the Makran Coast and reached the Sindh Coast in Karachi. Flipper tags placed by Sindh Wildlife Department also indicated that green turtle migrated to Bhaidar Is., Gulf of Kutch, India in September 1989, Beralsole village, south central Eritrea in December 1995, and between Lengeh and Dayyar, Iran (Persian Gulf) in August 1995 [72]. This indicates that green turtles nesting in Pakistan may migrate from the west coast of India, Persian Gulf, east coast of Africa.

There is no information about the feeding habitat of green turtles in coastal and offshore waters of Pakistan.

2.2 Other biological data

None available.

2.3 Threats

2.3.1 Nesting sites

The major threats to green turtles at nesting sites in Pakistan are feral dog and other animals which may destroy the nest and eat eggs. Crabs, seagulls, kites and crows are predators of green turtle hatchlings. Construction of huts and other structures along the highwater mark are also a serious threat for nesting females. In some areas, debris from construction, crumbling huts, and garbage from the huts are an obstruction for nesting females. In addition, nesting activity may be hindered by general public which has been reported to interact with nesting females mainly because of lack of awareness. Females of other turtle species have been reported to abandon their nest due to such disturbance. In some areas, solid waste pollution, including plastic waste, is also a challenge for nesting females. On a very small scale, the illegal take of emerging hatchlings is being reported from Hawks

Bay and Sandspit. These hatchlings are sold as freshwater turtles to aquarists and pet shops, and almost all die in few days to a few weeks. The Government of Sindh regularly takes actions against such collectors, but the trade continues.

2.3.2 Marine areas

Gillnetting is the major threat to green turtles in marine areas. Annual entanglement of green turtles in the tuna gillnet operation is ~4,200 out of a total of 28,800 turtles [78]. The highest number of bycatch green turtles was 900 during the month of November. No green turtles were caught by shrimp trawlers along the coast of Pakistan between 2010 and 2014 [78]. Habitat degradation is an important factor that may affect marine turtle populations. In addition, pollution especially solid waste pollution, is increasing in the coastal areas of Pakistan. However, there are no records of turtle mortality after ingestion of plastic or any other material from Pakistan. Green turtles have been entangled in ghost gear, resulting in unquantified mortality. Climate change is also predicted to effect distribution, abundance, feeding and breeding activities of green turtles but an assessment of this threat to Pakistani populations has not been conducted.

2.4 Conservation

The Sindh Wildlife Department relocated a total 2,305,257 green turtle eggs from their nests to hatcheries from October 1979 to December 2013 [75]. After an incubation period of 40-60 days hatchlings on emergence were collected, counted, and released safely to the sea to protect them from terrestrial predators. Through this process a total of 695,975 green turtle hatchlings were produced. Peak hatching of green turtles was observed during between September to December with the maximum in October [75].

Also see 1.4.

2.5 Research

See 1.5.

3 RMU: *Dermochelys coriacea*, Unknown (DC-U)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

Fishers have reported leatherback turtles nesting on islands near the mouth of the River Indus [47]. Extensive scientific surveys of the sandy islands at the mouth of the River Indus between Bundal Is. and Sir Creek have been made during last 30 years but no nesting has been detected [51]. Leatherback nesting was also reported from Mubarak Village during June and July (2004-2007), Pushukan in February, and Jiwani during January and February 2006. However, methods used to identify the nests as laid by leatherback turtles were not described and no hatchlings or adults were observed [39]. Nesting in these areas has not been independently verified.

3.1.2 Marine areas

Leatherback turtle have been reported in coastal and offshore waters of the Gwadar Jiwani area, including Surbundar, Malan, Sonmiani, Karachi and Great Khori Bank- Indus Canyon [7,51].

3.2 Other biological data

None available.

3.3 Threats

3.3.1 Nesting sites

There are no validated nesting sites for leatherback turtles along the Pakistan coast.

3.3.2 Marine areas

Fishing operations, mainly gillnetting, are the major threat to leatherback turtles. A total of 17 leatherback turtles were reported entangled in tuna gillnets along the coast of Pakistan between April 2012 and April 2017 [51]. Four records were of stranded leatherback turtles, and one dead turtle was found floating in the sea at Miani Hor, Sonmiani, after a possible boat strike. All other specimens were reported after becoming entangled in fishing gear operating in coastal and offshore water; all were safely released by fishers except one which died in the net. No leatherback turtles have been reported entangled in ghost gear in Pakistan waters.

3.4 Conservation

See 1.4

3.5 Research

See 1.5

4 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

Hawksbill turtles were reported nesting at Cape Monz and Mubarak Village in June and July (2004-2007) and at Astola Is. from July to December (2006). However, methods used to identify the nests as laid by hawksbill turtles were not described and no hatchlings of adults were observed [39]. Nesting in these areas has not been independently verified.

4.1.2 Marine areas

Hawksbill turtles have been widely observed along the Sindh and Balochistan coast, but no specific area of concentration has been identified [52,64]. Observations occurred mainly between October and March. Further studies are required to ascertaining seasonality of hawksbill turtles in Pakistani waters.

4.2 Other biological data

None available.

4.3 Threats

4.3.1 Nesting sites

See 1.3.1.

4.3.2 Marine areas

Nine hawksbill turtles were entangled in offshore fishing operations for tuna and tuna-like species between March 2013 and December 2018. All turtles were safely released except one, which died during disentanglement. Hawksbill turtles have also been observed entangled in ghost gear, resulting in their mortality. However, this has not been quantified.

4.4 Conservation

See 1.4

4.5 Research

See 1.5

5 RMU: *Lepidochelys olivacea*, West Indian Ocean (LO-WIO)

5.1 Distribution, abundance, trends

5.1.1 Nesting sites

Olive ridley turtles used to nest on beaches between Manora in the East (Sindh Province) and Jiwani in the West (Balochistan Province), the most important of which were Sandspit and Hawks Bay (Sindh coast). Taq and Astola Is. (Balochistan coast) supported smaller nesting numbers. Olive ridley nesting occurred from June to September, with a peak in August [72]. A total of 654 olive ridley turtle nests were recorded at Hawks Bay and Sandspit between 1980-1997 [3], with the highest nesting number of 113 during the 1987 season. However, there was a profound decline after this date, and only two olive ridley nests were recorded each year in 1996 and 1997 [3]. No observations were recorded about nesting of olive ridley turtles during 1998-2000, and no nesting of olive ridley has been reported in Pakistan since August 2001 [72].

5.1.2 Marine areas

Bycatch studies carried out by WWF-Pakistan between 2012 and 2019 revealed that olive ridley turtles are widely distributed in the northern Arabian Sea [59,77]. Numbers of entangled turtles (see section 5.3.2) suggests there is a large population of resident olive ridley turtles in the offshore waters of Pakistan The majority of these bycaught turtles are adults; juvenile and subadult olive ridley turtles are seldom caught in gillnet operations [77].

5.2 Other biological data

Flipper tags were placed on 46 nesting olive ridley turtles by Sindh Wildlife Department in 1982 and 2013. Of these, 12 olive ridley turtles were recovered locally (seven after 1 year, four after 2 years, and one after 5 years) [72]. Of nine nesting olive ridley turtles tagged with satellite transmitters in Oman, one travelled north to foraging grounds in Pakistan [73].

Sindh Wildlife Department moved 78,724 olive ridley eggs at Sandspit and Hawks Bay beaches to adjacent hatcheries from 1979 to 2001. After an incubation period of 40-60 days, 21,613 hatchlings were released to the sea. Most hatching occurred from August to December with a peak in September [72].

5.3 Threats

5.3.1 Nesting sites

There is no known reason for the disappearance of nesting of olive ridley in Pakistan, as no commercial harvesting is being done. There are no major related pollution issues because most of the coastline is uninhabited by any human settlements. It is speculated that the disappearance of nesting of olive ridley is because of climate change, although no concrete evidence is available.

5.3.2 Marine areas

About 24,600 olive ridley turtles (of 28,800 sea turtles in total) were entangled in commercial tuna gillnet operations in coastal and offshore waters of Pakistan [50,77]. The highest number of entanglements occurred in November (4,500) during a major peak in turtle bycatch from September to December, with a minor peak in captures during March and April [78]. An insignificant number of olive turtles are captured during shrimp trawling along the coast of Pakistan [50]. See also 1.3.2.

5.4 Conservation

See 1.4

5.5 Research

Pakistan waters support large populations of resident olive ridley turtles and the need to study their in-water biology and distribution in Pakistan cannot be over-emphasized. Potential reasons for the loss of Pakistan’s nesting population of olive ridley turtles since 2001 should also be examined. Also see 1.5.

Table 1a. Characteristics of nesting loggerhead, green and leatherback turtles in Pakistan.

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**
Occurrence						
Nesting sites	Y	29,38,39,41,42,47	Y	1-3,5,6,8-24,27-33,35-50,53-55, 59-61,66-69,71	Y	29,38,39,41,42,51
Pelagic foraging grounds	N		N		N	
Benthic foraging grounds	N		N		N	
Key biological data						
Nests/yr: recent average (range of years)	n/a		1,449 (2014-17)	23	n/a	
Nests/yr: recent order of magnitude	n/a		1,127-1,485	72	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		3	20, 23, 62	n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		10	29,35,40,41,64	n/a	
Nests/yr at "major" sites: recent average (range of years)	n/a		666 (2011-2014)	23	n/a	
Nests/yr at "minor" sites: recent average (range of years)	n/a		27 (2011-2014)	23	n/a	
Total length of nesting sites (km)	n/a		50.12	54,62,72	n/a	
Nesting females / yr	n/a		166	23	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: Immature (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)	60 CCL	47	103 CCL	22	120 CCL	51
Age at maturity (yrs)	n/a		n/a		n/a	
Clutch size (n eggs) (N)	n/a		78-120	62	n/a	
Emergence success (hatchlings/egg) (N)	n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**
Trends						
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		Stable	72	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	29,38,39,41,42	800 (1980)	72	n/a	
Published studies						
Growth rates	n/a		n/a		n/a	
Genetics	n/a		n/a		n/a	
Stocks defined by genetic markers	n/a		n/a		n/a	
Remote tracking (satellite or other)	Y	4,57	Y	37	n/a	
Survival rates	n/a		n/a		n/a	
Population dynamics	n/a		n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a		n/a	
Capture-Mark-Recapture	n/a		Y	24	n/a	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y(DN)	47	Y(DN)	52	Y(DN)	51
Bycatch: presence of industrial fisheries?	Y(DN)	47	Y(DN)	52	Y(DN)	51
Bycatch: quantified?	Y	47	Y	51	Y	51
Take. Intentional killing or exploitation of turtles	N		N		N	
Take. Eggs (illegal)	N		N		N	
Coastal Development. Nesting habitat degradation	N		Y	1,2,5,46,62	N	
Coastal Development. Photo pollution	N		N		N	
Coastal Development. Boat strikes	N		N		N	
Egg predation	N		Y	5	N	
Pollution (debris, chemical)	N		Y	1,2,5,46,62	N	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**
Pathogens	N		N		N	
Climate change	N		N		N	
Foraging habitat degradation	N		N		N	
Other	N		N		N	
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)						
Number of index nesting sites						
Monitoring at foraging sites (period: range of years)						
Conservation						
Protection under national law	N		Y (1980-Ongoing)	73	N	
Number of protected nesting sites (habitat preservation) (% nests)	N		1	73	N	
Number of Marine Areas with mitigation of threats	N		N		N	
N of long-term conservation projects (period: range of years)						
In-situ nest protection (eg cages)						
Hatcheries	Y	27,28	Y	27,28,42	Y	27,28
Head-starting	n/a		n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	1	10	1	10	1	10
By-catch: onboard best practices	n/a		1 (1980-ongoing)	10	n/a	
By-catch: spatio-temporal closures/reduction	n/a		3	62,64,71,72	n/a	
Other	n/a		n/a		n/a	

Table 1b. Characteristics of nesting hawksbill and olive ridley turtles in Pakistan.

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Occurrence				
Nesting sites	Y	30,39,40,42,43,52	Y	3,5,8-11,13-22,24, 27-33,36-43,46,47,49,50, 54,55,59-61,66-69
Pelagic foraging grounds	N		N	
Benthic foraging grounds	N		N	
Key biological data				
Nests/yr: recent average (range of years)	n/a		0 (2014-2017)	23
Nests/yr: recent order of magnitude	n/a		0	23
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		0	23
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		0	23
Nests/yr at "major" sites: recent average (range of years)	n/a		0	23
Nests/yr at "minor" sites: recent average (range of years)	n/a		0	23
Total length of nesting sites (km)	n/a		0	23
Nesting females / yr	n/a		0	23
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)	32 CCL	52	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	

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		Vanished; no nesting in past 14 years	14
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	n/a		n/a	
Genetics	n/a		n/a	
Stocks defined by genetic markers	n/a		n/a	
Remote tracking (satellite or other)	n/a		n/a	
Survival rates	n/a		n/a	
Population dynamics	n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a	
Capture-Mark-Recapture	n/a		n/a	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y(DN)	52	Y(DN)	52
Bycatch: presence of industrial fisheries?	Y(DN)	52	Y(DN)	52
Bycatch: quantified?	Y	52	Y	51
Take. Intentional killing or exploitation of turtles	N		N	
Take. Eggs (illegal)	N		N	
Coastal Development. Nesting habitat degradation	N		N	
Coastal Development. Photopollution	N		N	
Coastal Development. Boat strikes	N		N	
Egg predation	N		N	
Pollution (debris, chemical)	N		N	
Pathogens	N		N	
Climate change	N		N	

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Foraging habitat degradation	N		N	
Other	N		N	
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	N		Y (1980-Ongoing)	73
Number of index nesting sites	N		1	73
Monitoring at foraging sites (period: range of years)	N		N	
Conservation				
Protection under national law	Y	27,28	Y	27,28,42
Number of protected nesting sites (habitat preservation) (% nests)	n/a		n/a	
Number of Marine Areas with mitigation of threats	1	10	1	10
N of long-term conservation projects (period: range of years)	n/a			
In-situ nest protection (eg cages)	n/a		3	71,72
Hatcheries	n/a		n/a	
Head-starting	n/a		n/a	
By-catch: fishing gear modifications (eg, TED, circle hooks)	Y	50,52,72,76,78	Y	52,72,76,78
By-catch: onboard best practices	Y	77,79	Y	77,79
By-catch: spatio-temporal closures/reduction	Y	79	Y	79
Other	n/a		n/a	

Table 2. Index nesting sites for marine turtles in Pakistan.

RMU / 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)
				Long	Lat					
CM-NWIO										
Sandspit, Karachi	Y	927 (2014-2017)	n/a	24.842602	66.89794	24.860547	66.850817	24.851303	66.883837	6
Hawksbay, Karachi	Y	481 (2014-2017)	n/a	24.859596	66.864043	24.85881	66.834133	24.861363	66.846065	3.5
Kapaysee-1	N	n/a	n/a	24.831926	66.692004	24.8312	66.692682	24.831572	66.692368	0.1
Kapaysee-2	N	n/a	n/a	24.831386	66.687142	24.830203	66.688525	24.830873	66.687865	0.17
Cape Monz (Ras Mauri)	Y	27 (2014-2017)	n/a	24.836243	66.654521	24.8268	66.664109	24.831784	66.659563	1.51
Taq (Ormara)	N	n/a	n/a	25.274003	64.510731	25.270048	64.506681	25.272333	64.507113	0.66
Astola Is. (North)	N	n/a	n/a	25.126013	63.682819	25.126017	25.126017	63.850766	63.856504	1.29
Astola Is. (South)	N	n/a	n/a	25.119492	63.832003	25.120421	63.82903	25.119698	63.829875	0.39
Ras Zaarien (Pasni)	N	n/a	n/a	25.2043	63.49334	25.244142	63.206018	25.229384	63.316619	29.23
Gwadar (Headland)	N	n/a	n/a	25.096349	62.299959	25.098481	62.27542	25.097818	62.2861	2.53
Daran (Mazne daran) Jiwani	N	n/a	n/a	25.016495	61.778082	25.017198	61.754883	25.018854	61.767261	2.54
Daran (Shaheed Beach) Jiwani	N	n/a	n/a	25.021196	61.746648	25.021291	61.744112	25.021643	61.745461	0.26
Daran (Shambook) Jiwani	N	n/a	n/a	25.021181	61.740622	25.020483	61.736943	25.02116	61.738743	0.37
LO-WIO										
Sandspit, Karachi	Y	0	n/a	24.842602	66.89794	24.860547	66.850817	24.851303	66.883837	6

Table 3. International conventions signed by Pakistan in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention on International Trade in Endangered Species (CITES)1976	Y	Y	Y	Ei, Cc, Dc, Cm, Lo	International trade of marine turtles	All marine turtle species are listed in Appendix I of CITES, which prohibits commercial international trade of marine turtles and their parts and derivatives.
Convention on Migratory Species (CMS) 1987	Y	N	Y	Ei, Cc, Dc, Cm, Lo	All species of marine turtles are listed on both Appendices I and II	All marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention).
CMS Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA MoU).	Y	N	Y	Ei, Cc, Dc, Cm, Lo	The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitat	The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitat

Table 4. Current and past marine turtle projects in Pakistan.

#	RMU	Project Name or descriptive title	Key words	Start date	End date	Leading organization	Public /Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1	CM-NWIO	Pakistan Coast-Northern Arabian Sea	Cetacean mortality, tuna fisheries	2012	2014	WWF-Pakistan	Public	MFD-GOP	https://iotc.org/documents/assessment-cetacean-mortality-tuna-fisheries-pakistan	IPCRCF	Rab Nawaz (rnawz@wwf.org.pk)	Muhammad Moazzam Khan (mmoazzamkhan@gmail.com)
T4.2	CM-NWIO	Pakistan Coast-Northern Arabian Sea	Sustainable management, tuna fisheries, bycatch	2014	2020	WWF-Pakistan	Public	MFD-GOP, Provincial Governments Fisheries and Wildlife Departments		FAO/GEF/Common Oceans	Rab Nawaz (rnawz@wwf.org.pk)	Muhammad Moazzam Khan (mmoazzamkhan@gmail.com)
T4.3	CM-NWIO	Pakistan Coast-Northern Arabian Sea	Turtle conservation	1980	1984	WWF-Int, Sindh Wildlife Management Board	Public	Sindh Wildlife Management Board		Sindh Wildlife Department	Javed Mehar	

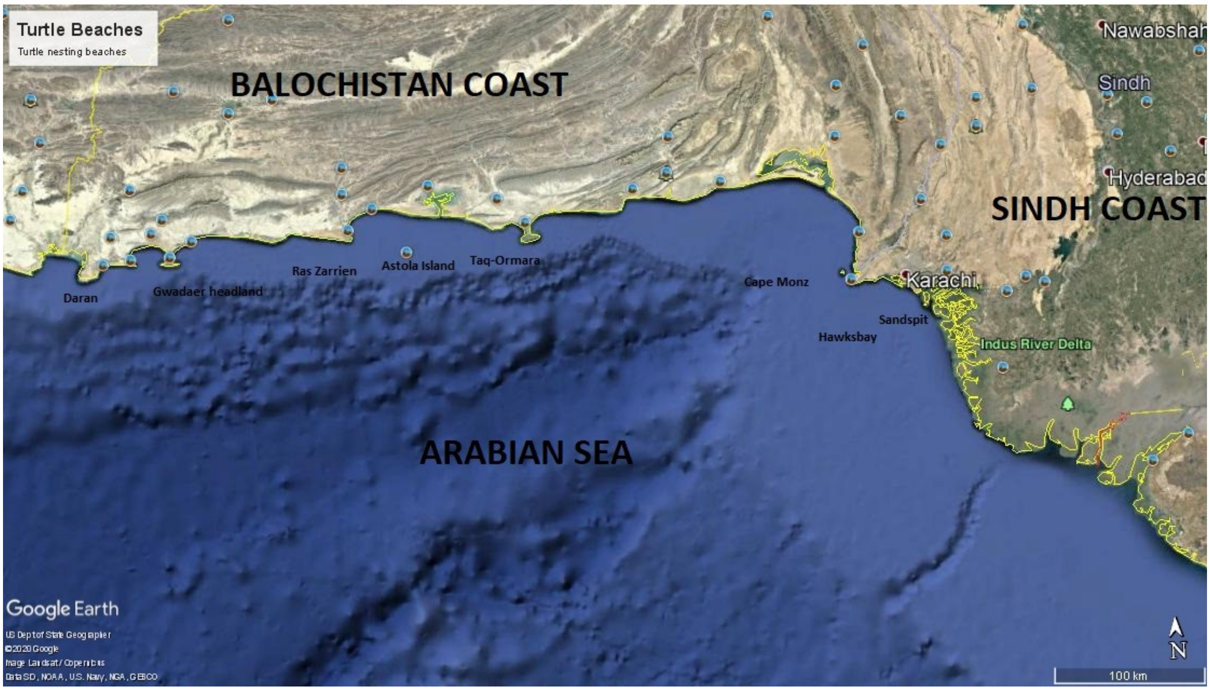

Figure 1a. Overview of Pakistan coast

Figure 1b. Nesting beaches of Karachi, Pakistan

Figure 1c. Nesting beaches of Pasni-Ormara, Pakistan

Figure 1d. Nesting beaches of Gwader-Jiwani, Pakistan

Figure 1e. Nesting beaches of Jiwani, Pakistan

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QATAR

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1 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Eleven nesting sites have been reported in the north-east of the country and offshore islands (Figure 1; Table 2). Two sites have received long-term monitoring efforts and can be considered index sites, Ras Laffan Industrial City (RLIC) and Fuwairit [3,7,11].

Further information on the number of nests etc. is provided in Table 1. There are no clear trends in nest numbers from the two published datasets [6,11]

1.1.2 Marine areas

Areas that can be considered marine habitat for hawksbills in Qatar are depicted in Figure 2. The locations were identified through in-water capture (juveniles and adults) and satellite tracking (adult females) projects [7,10].

1.2 Other biological data

Other biological data on hawksbills in Qatar are presented in Table 1.

1.3 Threats

1.3.1 Nesting sites

Threats to nesting sites include light pollution and traffic on the beaches. These are indicated in Table 1.

1.3.2 Marine areas

Threats to hawksbills in Qatar include becoming trapped in cooling water intakes at RLIC (Table 1).

1.4 Conservation

Nest protection and conservation measures take place at RLIC and Fuwairit (Table 1). There are no known meaningful conservation efforts taking place at other nesting locations in Qatar. Turtles are protected under CITES in Qatar (Table 3).

1.5 Research

Several older unpublished reports with additional data on turtles in Qatar exist but were not available for this reporting exercise. The data owners are encouraged to make these data available either through sharing the existing reports, by writing a comprehensive summary report and making it available online, or through publication in a peer reviewed journal.

Knowledge on the recent/current nesting numbers at the previously identified nesting beaches has improved since the previous report with the publication on turtle monitoring at Fuwairit [11], but information on the other nesting sites is lacking.

2 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

There is no known green turtle nesting in Qatar,

2.1.2 Marine areas

Figure 2 and Table 1 indicate the locations where green turtles were captured during a study of turtles in coastal waters [7].

2.2 Other biological data

All biological data on green turtles in Qatar are presented in Table 1 and published by Pilcher et al. [7]

2.3 Threats

2.3.1 Nesting sites

Not applicable as no nesting.

2.3.2 Marine areas

See Section 1.3.2

2.4 Conservation

To the author's knowledge, no marine protection measures exist for sea turtles in Qatar. However green turtles are covered under CITES (Table 3).

2.5 Research

More research on the presence of juvenile green turtles should be undertaken to determine residency and movement patterns and identify source populations through genetic analysis.

Table 1. Characteristics of nesting marine turtles in Qatar.

	Eretmochelys imbricata		*Chelonia mydas*	
RMU	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Occurrence				
Nesting sites	Y	1,2,3,4,6	N	1
Pelagic foraging grounds	N/A		N/A	
Benthic foraging grounds	JA	7,10	J	7
Key biological data				
Nests/yr: recent average (range of years)	179 (2001-2016)	4,11	N/A	
Nests/yr: recent order of magnitude	100-300	4,11	N/A	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	2	3,4,8	N/A	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	10	4	N/A	
Nests/yr at "major" sites: recent average (range of years)	152 (2001-2009 - excl 2008) Ras Laffan, 27 (2010-2016) Fuwairit	6,11	N/A	
Nests/yr at "minor" sites: recent average (range of years)	154 (2003)	4	N/A	
Total length of nesting sites (km)	N/A		N/A	
Nesting females / yr	N/A		N/A	
Nests / female season (N)	1.5 (27)	11	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)	20% (74)	7	70% (30)	7
Sex ratio: Adults (F / Tot) (N)	N/A		N/A	
Min adult size, CCL or SCL (cm)	65.0 CCL	3,11	N/A	
Age at maturity (yrs)	N/A		N/A	
Clutch size (n eggs) (N)	82 (40) 78.9 SD=17.1 (?)	3,11	N/A	
Emergence success (hatchlings/egg) (N)	HS 73% (22)	3	N/A	
Nesting success (Nests/ Tot emergence tracks) (N)	N/A		N/A	

	Eretmochelys imbricata		*Chelonia mydas*	
RMU	**EI-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	Stable (2001-2009 and 2010-2016)	6,11	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)	154 (2003)	4	N/A	
Published studies				
Growth rates	N		N	
Genetics	N		N	
Stocks defined by genetic markers	N		N	
Remote tracking (satellite or other)	Y	8,9,10	N	
Survival rates	N		N	
Population dynamics	N		N	
Foraging ecology (diet or isotopes)	N		N	
Capture-Mark-Recapture	Y	11	N	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y (not stipulated)	7	Y (not stipulated)	7
Bycatch: presence of industrial fisheries?	N/A		N/A	
Bycatch: quantified?	N		N	
Take. Intentional killing or exploitation of turtles	N		N	
Take. Eggs (illegal)	N		N/A	
Coastal Development. Nesting habitat degradation	Y	5	N/A	
Coastal Development. Photopollution	Y	5	N/A	
Coastal Development. Boat strikes	N/A		N/A	
Egg predation	Y	5	N/A	
Pollution (debris, chemical)	N/A		N/A	
Pathogens	N/A		N/A	
Climate change	Y	7	Y	7
Foraging habitat degradation	Y	7	Y	7

	Eretmochelys imbricata		*Chelonia mydas*	
RMU	**EI-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Other	Y	7	Y	7
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	14 (2001-2015) & 7 (2010-2016)	6,7,11	N/A	
Number of index nesting sites	2	6,11	N/A	
Monitoring at foraging sites (period: range of years)	N/A		N/A	
Conservation				
Protection under national law	Y	7	Y	7
Number of protected nesting sites (habitat preservation) (% nests)	2 (72%)	6,7,11	N/A	
Number of Marine Areas with mitigation of threats	N/A		N/A	
N of long-term conservation projects (period: range of years)	2 (2001-present (except 2008))	6,7,11	N/A	
In-situ nest protection (eg cages)	N		N/A	
Hatcheries	1	11	N/A	
Head-starting	N		N/A	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	N		N	
Bycatch: onboard best practices	N		N	
Bycatch: spatio-temporal closures/reduction	N		N	
Other	N		N	

Table 2. Marine turtle nesting beaches in Qatar.

RMU / 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)
				Long	Lat					
EI-NWIO										
Ras Laffan	Y	152 (2001-2009, EXCL 2008)	SEE NESTS!	51.5397	25.9262	<14km	100	2,4,6	2	B
Fuwairit	Y	29.4 (2010-2016)		51.3757	26.0312	2.4	100	3,4,11	1	B
Ras Rakan	N	25 (2003)		51.2312	26.1798	2.5	N/A	4	N/A	N/A
Al Ghariya	N	13 (2003)		51.3603	26.1001	N/A	N/A	4	N/A	N/A
SharaAwh Is.	**N**	9 (2002-2003)		52.2321	25.0303	0.5	N/A	4	N/A	N/A
Ras Marbakh	N	9 (2003)		N/A	N/A	N/A	N/A	4	N/A	N/A
Al Mafjar	N	5 (2003)		51.3125	26.1317	N/A	N/A	4	N/A	N/A
Umm Tays	N	4 (2003)		51.2827	26.1499	5.2	N/A	4	N/A	N/A
Al Maronah	N	2 (2003)		51.4002	25.9842	N/A	N/A	4	N/A	N/A
Uraydah	N	2 (2003)		N/A	N/A	N/A	N/A	4	N/A	N/A
Al Jassasiyah	N	1 (2003)		N/A	N/A	N/A	N/A	4	N/A	N/A
Al Huwaylah	N	1 (2003)		51.5108	25.9615	N/A	N/A	4	N/A	N/A
Al Dakerah	N	0 (2003)		51.5962	25.7852	N/A	N/A	4	N/A	N/A
Al Khor	N	0 (2003)		51.5874	25.7047	N/A	N/A	4	N/A	N/A
Halul	N	0 (2003)		52.4165	25.6765	N/A	N/A	4	N/A	N/A
Dayinah	N	'few' historic		N/A	N/A	N/A	N/A	1	2	?

Table 3. International conventions signed by Qatar in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	Y	Y		CM, EI		

Table 4. Marine turtle projects and databases in Qatar.

#	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
T4.1	EI-NWIO	Qatar	Ras Laffan Industrial City, Fuwairit	Tracking nesting hawksbills	Nesting, tracking, migration	2010	2012	WWF-EWS	Private	MRF / Qatar Uni	8	* (see below)

Ctd.

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 #
Marina Antonopoulou <mantonopoulou@enwwf.ae>	Nicolas J. Pilcher <npilcher@mrf-asia.org>	N	-	Fuwairit Ras Laffan	2010	2016	N	N	N	N	N	Y	9,10

*7Days, Abu Dhabi Urban Planning Council, Bridgestone, CASP, College of the North Atlantic - Qatar, Deutsche Bank, Dubai Electricity & Water Authority, Dubai Festival City, Emirates Palace, Environment & Protected Areas Authority - Sharjah, Environment Agency – Abu Dhabi, Fairmont, Géant, Gulftainer, HSBC, Intercontinental - Dubai Festival City, Jebel Ali Golf Resort & Spa, Jumeirah at Etihad Towers, Linklaters, Momentum Logistics, Mubadala, Murjan Marinas, Nokia, Sheikha Salama bint Hamdan Al Nahyan Foundation, The Club, TimeOut Dubai, and the Young Presidents Organisation

Figure 1. Marine turtle nesting areas of Qatar. [4]

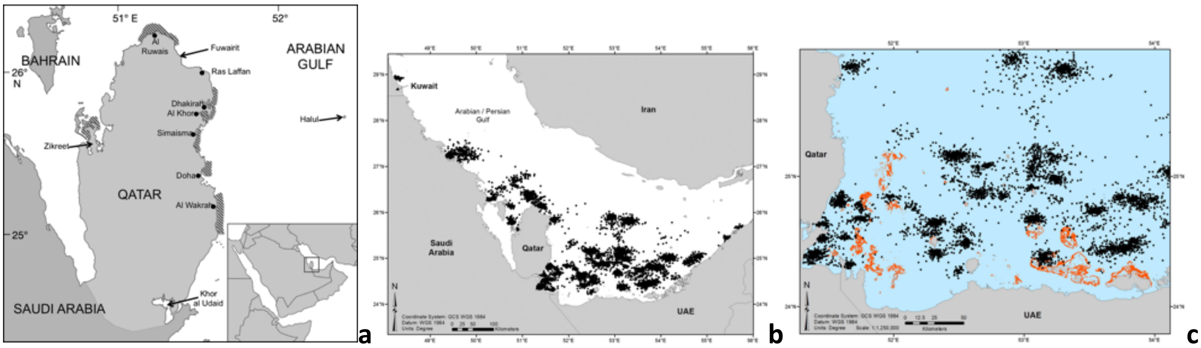

Figure 2. Marine areas in Qatar.

a) reproduced from reference 7. Hatched coastal areas are locations where turtles were caught. b&c) reproduced from reference 10. Black dots represent repeated locations of adult female hawksbills tracked from several nesting areas in the Gulf.

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SAUDI ARABIA (KINGDOM OF)

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1 *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

1.1 Distribution, abundance, trends

In Saudi Arabia, hawksbill turtles nest on islands in both the Red Sea and Arabian (Persian) Gulf [13,14,21]. There is only minor nesting on the mainland.

1.1.1 Nesting sites

Red Sea: Nesting by hawksbill turtles in the Red Sea region [5,6,8,13,35] is clustered in the northern section [9,12,21,34] and the southern section [9,21] with a very low-density nesting occurring in the middle portion [21] (Figure 1, Table 1). During an aerial survey in 1984, Ormond *et al*. [9] identified 42 locations (mostly on islands) where nesting occurred (Table 2). The highest density nesting (>50 tracks) occurred at Maghabiya, Bargan and Shusha Islands with >25 tracks recorded at an additional 10 sites (Table 2.). In 1987, Miller [21] surveyed the same area of the coast and near-shore islands. The surveys agreed that diffuse low-density nesting hawksbill turtles occurred along the length of the Saudi portion of the Red Sea. Pilcher and Al Merghani [34] did not report the same level of nesting observed during their aerial survey but the general pattern was confirmed. In interpreting the numbers of turtles and the distribution of nesting, it must be remembered that surveys were not conducted on exactly the same flight paths or at exactly the same time of year.

Arabian (Persian) Gulf: In the Arabian (Persian) Gulf [23,25,26], nesting occurs mainly on the offshore islands, with recently found low-density nesting on the adjacent mainland. Aerial and beach surveys along the Gulf coast and offshore islands revealed that nesting occurred only on the offshore islands in 1986 [21,30,32] (Figure 2). Coastal surveys to the north of Al Khobar yielded no tracks or other signs that indicated nesting with the exception of one hawksbill track and one green turtle track at Ras Tannurah beach on 5 May 1987 and 13 May 1987, respectively [21]. This site had been reported to host very low-density nesting by Gasperitti (pers. comm.) [21] and Basson *et al*. [4]. However, no further reports of nesting were made until 2010 when tracks were found on the beach again. No nesting sites were found along the coast or on any of the islands in the Gulf of Salwa [21].

Since the initial intensive field work between 1986 and 1997 [2], few new data have been published concerning the numbers of nesting turtles on the coast of the Red Sea and offshore islands of the Arabian (Persian) Gulf. The Saudi Wildlife Authority has been conducting census studies on Karan and Jana Islands for more than a decade, but the information has not been published. This situation precludes making any comment concerning changes or trends in the numbers of nesting turtles or more general comment about their populations.

1.1.2 Marine areas

Red Sea: In Saudi Arabia hawksbill turtles utilise the shallow ribbon-fringing reef complexes along the entire length of the Red Sea from the Gulf of Aqaba to the boarder with Yemen. Aerial surveys along the Red Sea coast and islands show several areas are important resident areas for turtles (Figure 3); the major areas are (1) in the far northern section (28° 30' N to 27° 30' N), (2) in the Al Wejh to Yanbu area (25° 30' N to 23° 30' N), and (3) from Al Lith to south of Gizan (20° 30' N to 19° 30' N). At least small numbers of hawksbill turtles reside along the length of the Red Sea reef complex and coast, but aggregations may be limited by the foraging habitat.

Arabian (Persian) Gulf: The western Arabian (Persian) Gulf hosts reef complexes around the offshore islands and scattered patches of reefs [20]. Because no systematic survey has been conducted to determine the distribution of the patch reefs nor the turtles associated with them, it is presumed that hawksbill turtles utilize available, appropriate habitat in the region.

1.2 Other biological data

Al Merghani *et al*. [2] summarized the available data on the morphometrics and other biological data of hawksbill turtles nesting on the offshore islands of the western Arabian (Persian) Gulf (Table 1,5)**.** Most of the existing (published) data are greater than 20 years old.

Recent records of marine turtle carcasses stranded in Bahrain included juvenile and adult sized hawksbill turtles [1]. The proximity of Bahrain and Saudi Arabia, the presence of these species and their sizes, together with the season of their stranding, suggest that resident populations probably occur in Saudi Arabia and are widespread in the Gulf.

Genetic sampling of nesting and foraging populations in the north-west Indian Ocean is not complete [3,11]. Hawksbill turtles are resident in the Arabian (Persian) Gulf and the Red Sea which fall into the RMU of the North West Indian Ocean [3,11].

1.3 Threats

Before 1989 coastal use, landfilling, dredging, water and air pollution, solid waste production, fishing practices, impact of agricultural practices, and recreation and tourism were identified as issues impacting the Red Sea and the Arabian (Persian) Gulf coastal and marine areas [23,24]. Unfortunately, the impact of most of the threats remains unquantified. Al Merghani *et al*. [2] commented that "effective management must address both the causes of the pollution and the impacts, including monitoring the situation through time". PERSGA [10] reviewed the state of the marine environment in the Red Sea and Gulf of Aden. A recent review by Mancini *et al*. [18] presented synoptic information on marine based threats to the populations in the Red Sea and Gulf of Aden (Table 1).

1.3.1 Nesting sites

Red Sea: In their review of the status of marine turtles in the Red Sea, Mancini *et al*. [18] identified general threats to the nesting populations. There is a need for quantification of threats so the appropriate conservation management action can be initiated. It should be noted that marine turtle nesting on the islands and along the coast of the Red Sea is wide-spread and occurs in low density. These are remote areas that are not monitored routinely.

Arabian (Persian) Gulf: There is a continuing risk from oil spills (even though the response capability has improved and current practices have reduced the risk) ending with oil washing onto the offshore island beaches that are used for nesting [21]. Even though the beaches of the islands were cleaned following the 1991 Gulf war, they continue to accumulate flotsam and jetsam. Plastic and wood debris litter the island beaches to the extent that turtle nesting can be disrupted and that hatchlings may be blocked from reaching the water. The layering of tar on the beach rock has the potential to impede hatchlings leaving the beach [32]. Pilcher [32] noted that Saudi Arabian fishermen typically do not collect turtle eggs for consumption but that fishermen of other nationalities sometimes do. Because access to the islands by fishermen has been restricted by the Saudi Coast Guard in recent years the practice of taking turtle eggs has likely been reduced but should be quantified. The impact of human activities (e.g., accumulation of debris on the islands, oil spills) is likely to disrupt nesting success and, thereby, reduce hatchling production. In contrast, because of the large number of turtles nesting on the offshore islands, the loss of individual turtles from the population is likely to go unnoticed for a long time unless monitoring of the population is done rigorously.

1.3.2 Marine areas

Red Sea: Although the potential for an oil spill through an accident has been reduced and ballast discharge is not allowed, some, albeit unquantified, risk remains from oil spills [18]. The potential risk and impact should be quantified. An unquantified number of turtles were caught in trawler operations in the Farasan archipelago in the late 1980s [21]. The impact of fisheries operations on marine turtles needs to be assessed. In addition, there is a potential risk to turtles and their habitat by the transhipment of oil through the Res Sea and from ocean borne debris washing onto nesting sites [18].

Arabian (Persian) Gulf: As in the Red Sea, the potential for an oil spill has been reduced in the Gulf. However, there is a continuing need to monitor the impact of oil on near-shore foraging habitat and the animals that utilize these areas. Degradation of the seagrass beds and other shallow habitats can disrupt the interlinked coastal ecosystems, including marine turtles and fisheries. In 1989, Miller [21] commented that the use of trawler efficiency devises (TEDs) would reduce the bycatch of turtles and other non-target marine animals. Recently, Abdulqader *et al*. [22] estimated that 4,726 turtles (mixed species) were captured per year in nine directed artisanal fisheries (excluding the seven steel hulled shrimp trawlers used in the industrial fishery), among which the artisanal shrimp trawl fishery was responsible for 86.3% of the captures.

1.4 Conservation

Saudi Arabia has developed an action plan for the protection for marine turtles and their habitats [19]. In addition, it participates in several international conventions, regional agreements and has national laws that provide for protection of marine turtles and their habitat, at least indirectly (Table 3). A recent review by Mancini *et al*. [18] presented synoptic information on International Conventions, Regional Organizations, and the National legal framework for management and conservation of marine resources for countries of the Red Sea region, including marine turtles in Saudi Arabia.

1.4.1 International Conventions

Saudi Arabia is a party to several international agreements which deal mostly with protection of the marine environment, such UNCLOS (United Nations Convention on the Law of the Sea (Table 3) and treaties that that deal with wildlife (i.e., CITES, CBD, CMS) [18,33,38].

1.4.2 Regional Organizations

The Kingdom of Saudi Arabia is participant in two regional organizations that focus on the conservation of the marine environment and marine species: PERSGA and ROPME [7,18].

In the Red Sea region, PERSGA (Jeddah 1982) focuses on the conservation of marine species and the marine environment, including the Gulf of Aden (Table 3). The signatories of the Jeddah Convention (1982) agreed to contribute to conservation in the region by promoting a rational use of living and non-living resources in the Red Sea. PERSGA has produced several documents to guide the national efforts of the signatory states, including a regional action plan that identifies the priorities for the research and conservation management in the region [28]. In addition, PERSGA has published a manual of research techniques [16] and many other documents to assist the regional countries with the assessment and management of their marine and coastal resources.

In the Arabian (Persian) Gulf, ROPME [7] conducts and facilitates projects that deal with environmental assessment and management. ROPME sponsors and coordinates regional management efforts and provides technical assistance in the implementation of the Convention. ROPME has developed protocols addressing the critical areas of environmental management, and outreach materials to help its member countries (Table 3).

1.4.3 National legal framework

A number of national decrees and laws regulate marine conservation measures in the Kingdom of Saudi Arabia [18] (Table 3) including:

- the Environmental protection Standards Document No. 1401-01 (1402 H);
- the Council of Ministers Decision no. 271 (23.11.1404 that requires the use of best available technology to reduce pollutant emissions (such as cement dust);
- the Rules and Regulations for Saudi Arabian Seaports.

The National Commission for Wildlife Conservation and Development (NCWCD [now Saudi Wildlife Authority]) was established by Royal Decree No. M/22, dated 12/9/1406 to manage protected areas. Saudi Wildlife Authority's main role is to preserve, protect and develop the wildlife within the Kingdom. [17] The Saudi Wildlife Authority is responsible for coordination of different ministries, authorities, and national and international institutions to accomplish these objectives.

The Saudi Wildlife Authority uses ecological and socio-economic criteria for the selection protected areas [17]. These include:

- Representative coverage of all the Kingdom's biotopes.
- Protection of existing populations of key wildlife species.
- Protection of habitats of key biological importance.
- The potential of the site to provide tangible economic benefits to the local people.
- Sites which are of greatest value for environmental education and awareness.
- Recognition of traditional protection by local people.
- An equitable geopolitical spread of protected areas.

Using these criteria, the Saudi Wildlife Authority has identified 47 marine and coastal sites as suitable for proclamation as protected areas. However, few have been declared. Existing marine protected areas along the Red Sea coast include: The Farasan Islands protected area (5,408 km^2) that was proclaimed in 1989 and includes marine, coastal, and terrestrial habitats in the reserve. In addition, two relatively small areas: the Yanbu Royal Commission Protected Area (ca. 5 km^2) and Umm al Qamar (ca. 2 km^2) have been established [33]. In the Arabian (Persian) Gulf the marine protected area is the Jubail Wildlife Sanctuary (ca. 2,410 km^2) that was established in 1994 but has not been declared by the Council of Ministers. The Sanctuary encompasses the important nesting areas for sea turtles.

1.5 Research

Although a basic understanding of marine turtle species composition, breeding biology, distribution of nesting habitat, and distribution of foraging habitat has been developed in the Kingdom of Saudi Arabia over the years, most of the published information is old and should be updated with specific studies. Monitoring of the populations on the Gulf islands was initiated in 1989 and continued (albeit with gaps) until 1997 [2,21,30,32,34]. Simply put, essential data are missing from the literature that would aid present-day management decisions concerning marine turtles and their habitat in the Red Sea and the Arabian (Persian) Gulf. For example, the distribution and use of foraging habitat, the quality of food supply in the foraging area(s), and the determination of the activities that degrade and enhance the quality of the habitat, as well as the genetic composition of foraging area residents and genetic composition of nesting populations should be determined. In addition, some biological characteristics can only be determined through long term studies, including remigration intervals, individual growth rates, hatching success, and the survival of different size classes as they grow toward maturity. The SWA [17] has tracked the movements of hawksbill turtles using satellite transmitters and conducted done basic monitoring of the nesting populations.

1.5.1 Recommendations

Data on the size of nesting turtles, the number of eggs produced per clutch, the number of clutches produced per year and the hatching success of clutches should be reassessed. Long-term studies are needed to estimate growth rates and renesting intervals to detect any changes in the characteristics of the population.

Multiple authors have identified threatening processes and made recommendations for the conservation management of marine turtles and their habitats over the years [2,12,13,18,20,21,29,30,32,34]. These need to be assessed for their current impact potential and to facilitate remediation. In addition, the declaration of the proposed marine protected areas (Table 6) on both sides of the Kingdom of Saudi Arabia should be encouraged and their design should include important habitat for marine turtles and other marine species, such as has been done in the Farasan Archipelago. The regulations imposed in protected areas should allow multiple-use while minimizing impact on turtles and other at-risk species (e.g., requiring the use of TEDs), whereas other areas should be under more strict protective management to preserve the marine resources (e.g., restrictions on the type of gear used and/or restriction of the season/location of fishing effort). This can only be achieved based on current data.

2 *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

In Saudi Arabia, green turtles nest [2,13,14,21] on islands in both the Red Sea [5,6,8] and Arabian (Persian) Gulf [15,25,26]. There is only minor nesting on the mainland. Since the initial intensive field work between 1986 and 1997 [2], few new data have been published concerning the numbers of nesting turtles on the coast of the Red Sea and offshore islands of the Arabian (Persian) Gulf. The Saudi Wildlife Authority has been conducting census studies on Karan and Jana Islands for more than a decade, but the information has not been published. This situation precludes making any comment concerning changes or trends in the numbers of nesting turtles or more general comment about their populations.

2.1.1 Nesting sites

Red Sea: The aerial survey of turtle nesting by Ormond *et al.* [9] in 1982/83 identified green turtle nesting at 29 locations (mostly on islands) from the Gulf of Aqaba to the border with Yemen. In 1987, the same general area of the coast and near-shore islands was surveyed [21]. The largest nesting aggregation for green turtles occurred on the coast at Ras Baridi, just north of Yanbu, where between 50 to 100 green turtles nest between May and September [2,9]. Other important nesting (n= 25-49 nests/tracks) was reported on Walih, Al Hasani, and Dorish Islands [9]. The two surveys provide a general over-view of the distribution of the diffuse low-density nesting by green turtles along the Saudi portion of the Red Sea (Figure 1).

Arabian (Persian) Gulf: Aerial and beach surveys along the entire Gulf coast (including the Gulf of Salwa) and offshore islands revealed that nesting occurred only on the offshore islands [21] (Figure 2). The coastal site at Ras Tannurah was reported by Gasperitti [21] and Basson *et al*. [4] to host very low-density nesting but none had been found until recently. In 2010 tracks were reported again.

2.1.2 Marine areas

Red Sea: Green turtles forage in the shallow reef complexes that support sea grass and algae along the length of the Saudi Arabian Red Sea coast from the Gulf of Aqaba to the border with Yemen [18]. The major foraging areas are (1) in the far northern section (28° 30' N to 27° 30' N), (2) in the Al Wejh to Yanbu area (25° 30' N to 23° 30' N), and (3) from Al Lith to south of Gizan (20° 30' N to 19° 30' N) (Figure 3). Pilcher and Al Merghani [34] reported that only Sharm Al Khaur (near Ras Baridi) and the Farasan Archipelago hosted numerous resident turtles. It is likely that at least small numbers of green turtles reside along the length of the Red Sea reef complex and coastal shelf, but numbers may be limited by the distribution of diffuse or poor-quality habitat.

Arabian (Persian) Gulf: Three areas in the western Gulf have been identified as foraging areas for resident green turtles (Figure 4). First, the reef systems around the each of the offshore islands, second the Dawhat Abu Ali inside the Berri oil field just north of Jubail and south of Abu Ali, and third, the shallow area north of Abu Ali and south of Safaniyah [21]. Aerial surveys over these areas determined that some turtles were present in these areas year-round. Miller [21] reported seeing 3.3, 2.78 and 0.01 green turtles per minute of survey time in the coastal and offshore areas from the border with Kuwait southward to Khobar, with the least number of turtles being seen closest to the industrialized area. Aerial surveys in the Gulf of Salwa recorded turtles in very low numbers, although sea grasses and algae appeared abundant [21]. Because shallow seagrass and algal habitat occurs along the western Gulf coast it is probable that turtles are distributed throughout the area.

2.2 Other biological data

The available data on the morphometrics and other biological data of green turtles nesting on the offshore islands of the western Arabian (Persian) Gulf and in the vicinity of Ras Baridi has been summarized (Table 1, 5) [2,21,30,31,34]. Because most of the published data are greater than 20 years old [2], current data are needed to assess the status of the populations. Data on the size of nesting turtles, the number of eggs produced per clutch, the number of clutches produced per year and hatching success should be reassessed. In addition, long-term studies are needed to estimate growth rates and renesting intervals to detect any changes in the populations

Recently, marine turtle carcasses of juvenile and adult sized green turtles were stranded in Bahrain [1]. Based on the proximity of Bahrain and Saudi Arabia, the sizes of these specimens, and the season of their stranding, resident populations occur in Saudi Arabian territory and, possibly, throughout the northern Gulf.

Genetic sampling of nesting and foraging populations in the north-west Indian Ocean is not complete [3,11]. Green turtles are resident in the Arabian (Persian) Gulf and the Red Sea [18] but their populations have not been adequately defined. Based on samples collected in the 1993, Jensen *et al*. [37] demonstrated that the green turtles nesting in the Jana/Karan Islands complex are separated from other nesting aggregations in the Arabian Gulf and provided a genetic definition of green turtles nesting at Ras Baridi. However, more sampling and genetic analysis of these populations are needed to define the stocks [3,11].

2.3 Threats

Beginning before 1989, coastal use, landfilling, dredging, water and air pollution, solid waste production, fishing practices, impact of agricultural practices, and recreation and tourism were identified as issues impacting the Red Sea and the Arabian (Persian) Gulf coastal and marine areas [18,21,23,24,31]. Unfortunately, the impact of most of the threats remains unquantified [18]. The recent review by Mancini *et al*. [18] summarized information on marine based threats to the populations in the Red Sea and Gulf of Aden (Table 1) [10]. Although there is some information available [21] about the Arabian (Persian) Gulf, a current assessment is needed.

2.3.1 Nesting sites

Red Sea: In their review of the biology, distribution and general status of marine turtles in the Red Sea, Mancini *et al*. [18] reiterated threats to the populations identified by previous authors. For example, Pilcher and Al Merghani [34] reported that light pollution emanating from the cement factory and the local coastal development was bright enough to disorient hatchlings at some of the beaches they studied. In addition, because he monitored hatching success, Pilcher [31] determined that cement dust was impacting hatchling emergence at Ras Baridi. Clearly there is a need for threats to be identified and quantitated, so the appropriate conservation management action can be initiated.

Arabian (Persian) Gulf: Although the response capability has improved and current practices have reduced the risk, there is a continuing risk from oil spills in the Arabian (Persian) Gulf [21]. Flotsam and jetsam, including plastic and wood debris accumulate on the island beaches to the extent that turtle nesting can be disrupted and that hatchlings may be blocked from reaching the water. The layering of tar on the beach rock has the potential to impede hatchlings leaving the beach [31, 32]. Saudi Arabian fishermen typically do not collect turtle eggs for consumption but that fishermen of other nationalities sometimes do [32]. Because access to the islands by fishermen has been restricted by the Saudi Coast Guard in recent years the practice of taking turtle eggs has likely been reduced but the extent of egg collection should be quantified.

2.3.2 Marine areas

Red Sea: Although the potential for an oil spill through an accident has been reduced and ballast discharge is not allowed, some unquantified risk remains from oil spills. The potential risk and impact should be quantified. Miller [21] reported that an unquantified number of turtles were caught in trawler operations in the Farasan archipelago in the late 1980s. He also noted that there was a potential risk to turtles and their habitat by the transhipment of oil through the Red Sea and from debris in the ocean and along the coast [21]. The impact of fisheries on marine turtle populations should be quantified [18].

Arabian (Persian) Gulf: As in the Red Sea, the potential for an oil spill has been reduced in the Gulf. However, the impact of oil on near-shore foraging habitat and the animals utilize these areas needs to be determined. Degradation of the seagrass beds and other shallow habitats can disrupt the interlinked coastal ecosystems, including marine turtles and fisheries. In 1989, Miller [21] commented that the use of trawler efficiency devises (TEDs) would reduce the bycatch of turtles and other non-target marine animals. Recently, Abdulqader *et al*. [22] estimated that 4726 turtles (of mixed species) were captured per year in nine directed artisanal fisheries (excluding the seven steel hulled shrimp trawlers used in the industrial fishery), among which the artisanal shrimp trawl fishery was responsible for 86.3% of the captures. Further quantification and working with the industry to reduce the bycatch is warranted.

2.4 Conservation

Saudi Arabia has developed an action plan for the protection for marine turtles and their habitats [19]. In addition, it participates in several international conventions, regional agreements and has national laws that provide for protection of marine turtles and their habitat, at least indirectly (Table 3). A recent review [18] summarized International Conventions, Regional Organizations, and the National legal framework for management and conservation of marine resources, including marine turtles, for countries of the Red Sea region to which Saudi Arabia belongs.

2.4.1 International Conventions

Saudi Arabian is a party to UNCLOS (United Nations Convention on the Law of the Sea) and others which deal mostly with protection of the marine environment and to treaties that that deal with wildlife (i.e., CITES, CBD, CMS) (Table 3) [18,33].

2.4.2 Regional Organizations

The Kingdom of Saudi Arabia is an active supporter of two regional organizations that focus on the conservation of the marine environment and marine species: PERSGA and ROPME [7,18,33].

In the Red Sea region PERSGA (Jeddah 1982) focuses on the conservation of marine species and the marine environment, including the Gulf of Aden (Table 3). The signatories of the Jeddah Convention (1982) agreed to promote conservation in the region by encouraging rational use of living and non-living resources in the Red Sea [27]. PERSGA has produced several documents for the signatory states to guide their national efforts, including a regional action plan that identifies issues and prioritizes actions for research and conservation management in the region [28]. In addition, PERSGA has published a manual of research techniques [16] and other documents with a goal of assisting the signatory countries in the assessment and management of their marine and coastal resources.

In the Arabian (Persian) Gulf, ROPME [7] facilitates projects that deal with environmental assessment and management. ROPME sponsors and coordinates regional management efforts and provides technical assistance in the implementation of the Convention [7]. ROPME has developed protocols addressing the critical areas of environmental management, and outreach materials to help its member countries (Table 3) [7].

2.4.3 National legal framework

The Kingdom of Saudi Arabia has made a number of national decrees and laws to regulate marine conservation measures (Table 3) including: [18]

- the Environmental protection Standards Document No. 1401-01 (1402 H);
- the Council of Ministers Decision no. 271 (23.11.1404 that requires the use of best available technology to reduce pollutant emissions (such as cement dust);
- the Rules and Regulations for Saudi Arabian Seaports.

The Saudi Wildlife Authority [previously National Commission for Wildlife Conservation and Development (NCWCD)] mandated by Royal Decree No. M/22, dated 12/9/1406 to manage protected areas. Saudi Wildlife Authority's main role is to preserve, protect and develop the wildlife within the Kingdom. The Saudi Wildlife Authority is responsible for coordination of different ministries, authorities and national and international institutions to accomplish these objectives.

The Saudi Wildlife Authority uses ecological and socio-economic criteria for the selection protected areas [17]. These include:

- Representative coverage of all the Kingdom's biotopes.
- Protection of existing populations of key wildlife species.
- Protection of habitats of key biological importance.
- The potential of the site to provide tangible economic benefits to the local people.
- Sites which are of greatest value for environmental education and awareness.
- Recognition of traditional protection by local people.
- An equitable geopolitical spread of protected areas.

The marine protected areas along the Red Sea coast include: The Farasan Islands protected area (5408 km^2) includes marine, coastal and terrestrial habitats [33]. In addition, two relatively small areas: the Yanbu Royal Commission Protected Area (ca. 5 km^2) and Umm al Qamar (ca. 2 km^2) have been proclaimed [33]. In the Arabian (Persian) Gulf, marine protected areas include: the Jubail Wildlife Sanctuary (ca. 2410 km^2) that was established in 1994 and encompasses the important nesting areas for sea turtles [33]. Unfortunately, it has not been adopted by the Council of Ministers.

2.5 Research

Data on the marine turtle species composition, breeding biology, distribution of nesting habitat, and distribution of foraging habitat, as well as some threats, have been developed in the Kingdom of Saudi Arabia over the years [2,14,21,22,30,32,34]. Unfortunately, most of the published information is old and should be updated with specific studies. For example, monitoring of the populations on the Gulf islands was initiated in 1989 and continued (albeit with gaps) until 1997 [2]. Essential data required for management decisions concerning marine turtles and their habitat in the Red Sea and the Arabian (Persian) Gulf are missing from the literature. For example, the distribution and use of foraging habitat, the quality of food supply in the foraging area(s), and the determination of the activities that degrade and enhance the quality, as well as the genetic composition of foraging area residents and genetic composition of nesting populations should be determined. In addition, some biological characteristics can only be determined through long term studies, including remigration intervals, individual growth rates, hatching success, and survival of different size classes as they grow toward maturity. Collection and analysis of the necessary data requires a long-term commitment to funding and resources by government agencies and international organizations.

The SWA [17] has done basic monitoring of the nesting populations. In addition, SWA has tracked the movements of green turtles using satellite transmitters. Recently, the Research Institute of King Fahd University of Petroleum and Minerals (KFUPM-RI) began a series of studies on both species nesting on the Gulf Islands (Table 4). The information being collected involves movements using satellite tracking, stable isotope analysis, and genetic identification of the nesting populations, as well as an assessment of the island habitat in which the eggs incubate.

2.5.1 Recommendations

Multiple authors have identified threatening processes and made recommendations for the conservation management of marine turtles and their habitats over the years [2,13,18,20,21,29,30,32,34]. Although recent initiated studies are designed to collect missing information, there is a need to collect and analyse data on the populations. In addition, the declaration of the proposed marine protected areas (Table 6) on both the Red Sea and the Arabian (Persian) Gulf should be encouraged. The boundaries of marine and coastal protected areas should include important habitat for marine turtles and other marine species, such as has been done in the Farasan Archipelago. The regulations imposed in protected areas should allow multiple use while minimising the impact on turtles and other at-risk species; whereas, other areas should be under more strict protective management to preserve the marine resources. This can only be achieved based on current data.

A mosaic of marine parks and protected areas should include both foraging habitat and areas essential for reproduction of multiple species. In addition, baseline environmental conditions and quality need to be established and monitored in seagrass areas and on coral reefs. The results of these research efforts should be integrated into management and conservation efforts. Essential to successful conservation are public education and public involvement in all phases of development so that stakeholders realize the benefits of conservation management in the area. Equally important are enforcement of the regulations and the availability of resources and personnel to conduct surveillance and enforcement activities.

3 Other

Records from the British Museum (Natural History) list three skulls of loggerhead turtles (*Caretta caretta*, collected from Ras Gasra, Ras al Qarain, and Gau village (east coast of Bahrain by M.D. Gallagher in 1970) [13]. These records indicate that loggerhead turtles occur in the Arabian (Persian) Gulf although they have not been recorded to nest in the region. Loggerhead turtles nest in large numbers on Masirah Is. in Oman [29].

Table 1. Representation and biological characteristics of nesting marine turtle species in the Kingdom of Saudi Arabia.

	Eretmochelys imbricata Arabian (Persian) Gulf		*Chelonia mydas* Arabian (Persian) Gulf		*Eretmochelys imbricata* Red Sea		*Chelonia mydas* Red Sea	
RMU	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Occurrence								
Nesting sites	Y	2, 32	Y	2, 30	Y	18, 21, 25	Y	2, 18, 34
Pelagic foraging grounds	n/a		n/a		n/a		n/a	
Benthic foraging grounds	Y	21	Y	21	Y	18, 21	Y	21, 18
Key biological data								
Nests/yr: recent average (range of years)	≈300 (1985-1997)	2, 21, 32	≈800 (1985-1997)	2, 21, 30	n/a		50-75 (1989-1992)	34
Nests/yr: recent order of magnitude	≈300	2, 21, 32	≈800 (1985-1997)	2, 21, 30	n/a		50-75	34
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	2	2, 21, 32	4	2, 21, 30	13	21, 9	4	9
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	2	21, 32	1	21	36	9	30	9
Nests/yr at "major" sites: recent average (range of years)	≈200 (1985-1997)	2, 21, 32	≈800 (1985-1997)	2, 21	n/a		150-200 (1989-1992)	34
Nests/yr at "minor" sites: recent average (range of years)	≈100 (1985-1997)	2, 21, 32	≈200 (1985-1997)	2, 21	0-25 (1975)	9, 18, 21	0-25 (1975 + 1986)	9, 21
Total length of nesting sites (km)	≈ 8	21, 30, 32	≈ 8	21, 30, 32	n/a		≈ 6	21, 34
Nesting females / yr	≈200	2, 32	800	2, 30	n/a		40+	2
Nests / female season (Range) (N)	2.2 (1-3) (42)	32	1.9 => 4 (1-7)	21, 30	n/a		1.9 (1-5)	34

	Eretmochelys imbricata Arabian (Persian) Gulf		*Chelonia mydas* Arabian (Persian) Gulf		*Eretmochelys imbricata* Red Sea		*Chelonia mydas* Red Sea	
RMU	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Female remigration interval (yrs) (N)	n/a		2 -5	30	n/a		2.7 (1-4)	34
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) CCL (cm)	59 (499)	2	73 (2844)	2	n/a		89 (n= 303)	2
Mean adult size, CCL or SCL (cm) CCL (cm)	71.5 ± 3.82	2	98.2 ± 4.56	2	n/a		104.7 ± 5.3	2
Age at maturity (yrs)	n/a		n/a		n/a		n/a	
Clutch size (n eggs) (N clutches)	75.2 ± 16.7 (134)	2	88.5 ± 16.62 (91)	2	n/a		103 ± 23.6 (81)	2
Emergence success (hatchlings/egg) (N)	≈63 (30)	2	84.7 (21)	30	n/a		80 (30-90)	2
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	Y	3	Y	37	n/a		Y	37

	Eretmochelys imbricata Arabian (Persian) Gulf		*Chelonia mydas* Arabian (Persian) Gulf		*Eretmochelys imbricata* Red Sea		*Chelonia mydas* Red Sea	
RMU	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**
Stocks defined by genetic markers	Y	3	Y	3	n/a		n/a	
Remote tracking (satellite or other)	Y	unpublished	Y	unpublished	Y	unpublished	Y	unpublished
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		Y	PS	n/a		n/a	
Capture-Mark-Recapture	n/a		n/a		n/a		n/a	
Threats								
Bycatch: presence of small scale / artisanal fisheries?	Y (ST, SN, FP)	22, 36	Y (ST, SN, FP)	22, 36	n/a		Y (ST, SN, FP)	36
Bycatch: presence of industrial fisheries?	Y (ST, DN, PLL)	36	Y (ST, DN, PLL)	36	n/a		Y (ST, DN, PLL)	36
Bycatch: quantified?	Y	22	Y	22	n/a		N	36
Take. Intentional killing or exploitation of turtles	No	2, 21, 32	No	36	n/a		N	36
Take. Eggs (illegal)	Y	36	Y	36	n/a		Y	36
Coastal Development. Nesting habitat degradation	No	30, 23	No	30, 23	Y	36	Y	31, 34
Coastal Development. Photo-pollution	Y	PS	Y	PS	Y	36	Y	31, 34
Coastal Development. Boat strikes	Y	36	Y	36	Y	36	Y	36
Egg predation	No	21, 32	No	21	n/a		Y	34
Pollution (debris, chemical)	Y	Per Obs	Y	Per Obs	Y	36	Y	36
Pathogens	n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a	

	Eretmochelys imbricata **Arabian (Persian) Gulf**		*Chelonia mydas* **Arabian (Persian) Gulf**		*Eretmochelys imbricata* **Red Sea**		*Chelonia mydas* **Red Sea**	
RMU	EI-NWIO	Ref #	CM-NWIO	Ref #	EI-NWIO	Ref #	CM-NWIO	Ref #
Foraging habitat degradation	Y	36	Y	36	n/a		Y	36
Other	n/a		n/a		n/a		n/a	
Long-term projects (>5yrs)								
Monitoring at nesting sites (period: range of years)	1986-2013*	36	1986-2013	36	n/a		(variable: 1986-2013)	36
Number of index nesting sites	2, Jana I, Karan	36	2, Karan, Jana	36	0		1, Ras Baridi	36
Monitoring at foraging sites (period: range of years)	n/a		n/a		n/a		n/a	
Conservation								
Protection under national law	Yes	36	Yes	36	Yes	36	Yes	36
Number of protected nesting sites (habitat preservation) (% nests)	100% of known	36	100% of known	36	n/a		10% of known	36
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)	1 (1986-2013)	36	1 (1986-2013)	36	n/a		1 (1986-2013)	36
In-situ nest protection (eg cages)	N	36	N	36	n/a		N	36
Hatcheries	N	36	N	36	N	36	N	36
Head-starting	N	36	N	36	N	36	N	36
Bycatch: fishing gear modifications (eg, TED, circle hooks)	Y	36	Y	36	Y	36	Y	36
Bycatch: onboard best practices	Y	36	Y	36	Y	36	Y	36
Bycatch: spatio-temporal closures/reduction	Y	36	Y	36	Y	36	Y	36
Other	Y	36	Y	36	Y	36	Y	36

Table 2. Nesting beaches in the green and hawksbill turtle RMUs of Saudi Arabia.

RMU / 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)
				Lat	Long					
CM-NWIO Arabian (Persian) Gulf										
Karan Is. (=Jazirat Karan)	Y	n/a	n/a	27.71250	49.82500	2.03	Variable	2, 21, 30	2	C
Jana Is. (= Jazirat Jana)	Y	n/a	n/a	27.36389	49.90000	1.1	Variable	2, 21, 30	2	C
Kurayn Is. (= Jazirat Kurayn)	N	n/a	n/a	27.64583	49.82083	>1	Variable	21	2	A
Jurayd Is. (= Jazirat Jurayd)	N	n/a	n/a	27.19167	49.99028	1.8	Variable	21	2	A
Harqus Is. (= Jazirat Harqus)	N	n/a	n/a	27.93750	49.68333	>0.6	Variable	21	2	A
Ras Tannurah	N	n/a	n/a	27.44300	49.32300	>0.6	Variable	20	2	A
CM-NWIO Red Sea										
Al Lith to Jizan	N	n/a	n/a	18.25000	41.25000			21	2	A
Al Wajh Banks	N	n/a	n/a	25.75000	36.75000			21	2	A
Al Hala Is.	N	n/a	n/a	18.21808	40.72467	< >1		9	2	A
Al Hasani Is.	N	n/a	n/a	24.97770	37.08360	< >1		9	2	A
Al Umm Is.	N	n/a	n/a	18.27353	40.73385	< >1		9	2	A
Barton	N	n/a	n/a	18.41798	41.21807	< >1		21	2	A
Birema Is. (Mashabih)	N	n/a	n/a	25.61561	36.52741	< >1		9	2	A
Birema Is. (Mashabih)	N	n/a	n/a	25.61706	36.50349	< >1		9	2	A
Danak Is.	N	n/a	n/a	19.51666	40.03333	< >1		9	2	A

RMU / 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)
				Lat	Long					
Disan Is.	N	n/a	n/a	16.94747	41.70651	< >1		21	2	A
Dohar Is.	N	n/a	n/a	19.82607	39.89924	< >1		9	2	A
Dorish Is.	N	n/a	n/a	18.50696	40.66418	< >1		9	2	A
Farasan Islands Area	N	n/a	n/a	16.88869	41.56289	< >1		21	2	A
Islands of the outer Farasan banks	N	n/a	n/a	16.50000	42.00000	< >1		21	2	A
Khawr Abhur	N	n/a	n/a	21.81670	39.03333	< >1		13	2	A
Libana Is.	N	n/a	n/a	24.97720	37.04880	< >1		9	2	A
Mafsubber/Sabiya Is.	N	n/a	n/a	18.26409	40.75501	< >1		9	2	A
Maghabiya Is.	N	n/a	n/a	18.25194	40.73250	< >1		9	2	A
Malathu Is.	N	n/a	n/a	19.74928	39.90855	< >1		9	2	A
Maliha Is.	N	n/a	n/a	25.03330	37.11660	< >1		9	2	A
Pelican	N	n/a	n/a	19.27313	40.90285	< >1		21	2	A
Qadd Humais Is.	N	n/a	n/a	20.28556	39.48472	< >1		9	2	A
Qalib Is. chain	N	n/a	n/a	25.21296	37.17057	< >1		9	2	A
Qishran Islet (1)	N	n/a	n/a	20.27024	39.92209	< >1		9	2	A
Qishran Islet (2)	N	n/a	n/a	20.26646	39.96119	< >1		9	2	A
Qishran Islet (3)	N	n/a	n/a	20.26564	39.98740	< >1		9	2	A
Ras Baridi-A	Y	n/a	n/a	24.26670	37.53333	> 2		2, 21, 34, 9	2	B, D
Ras Baridi-B	Y	n/a	n/a	24.28330	37.51660	> 2		2, 21, 34, 9	2	B, D

RMU / 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)
				Lat	Long					
Ras Baridi -C	Y	n/a	n/a	24.26674	37.53337	> 2		2, 21, 34, 9	2	B, D
S. cement factory	N	n/a	n/a	24.27378	37.51851	< >1		2, 21, 34, 9	2	A
Sharbain Is. (Sharbayn)	N	n/a	n/a	18.71861	40.48889	< >1		9	2	A
Sharm Al Khaur Is.	N	n/a	n/a	24.26660	37.65000	< >1		9	2	A
Sharm Mujawwan	N	n/a	n/a	28.16660	34.65000	< >1		9	2	A
Shoreline opposite Rayman Is.	N	n/a	n/a	28.05904	35.03275	< >1		9	2	A
Sila Is.	N	n/a	n/a	27.65000	35.28330	< >1		9	2	A
Sirrain (Sirrayn) Is.	N	n/a	n/a	19.62545	40.67169	< >1		21, 9	2	A
Tidhkar Is.	N	n/a	n/a	18.94662	40.61646	< >1		9	2	A
Tiran	N	n/a	n/a	27.93330	34.55000	< >1		21, 39, 35	2	A
Tiran Is.	N	n/a	n/a	27.93835	34.54176	< >1		21, 9	2	A
Walih Is.	N	n/a	n/a	27.78330	35.16660	< >1		9	2	A
Waqada Is.	N	n/a	n/a	25.34020	36.95830	< >1		9	2	A
Wasaliyat Is. (S)	N	n/a	n/a	17.78439	41.43237	< >1		21, 9	2	A
EI-NWIO Arabian (Persian) Gulf										
Karan Is. (=Jazirat Karan)	Yes	n/a	n/a	27.71250	49.82500	2.03	Variable	2, 21, 30	2	C
Jana Is. (= Jazirat Jana)	Yes	n/a	n/a	27.36389	49.90000	1.1	Variable	2, 21, 30	2	C
Kurayn Is. (= Jazirat Kurayn)	No	n/a	n/a	27.64583	49.82083	>1	Variable	21	2	A

RMU / 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)
				Lat	Long					
Jurayd Is. (= Jazirat Jurayd)	No	n/a	n/a	27.19167	49.99028	1.8	Variable	21	2	A
Harqus Is. (= Jazirat Harqus)	No	n/a	n/a	27.93750	49.68333	>0.6	Variable	21	2	A
Ras Tannurah	No	n/a	n/a	27.44300	49.32300	>0.6	Variable	20	2	A
EI-NWIO Red Sea										
E. Tiran Is.	N	n/a	n/a	27.93835	34.54176			9	2	A
N. Tiran Is.	N	n/a	n/a	27.93835	34.54176			9	2	A
W. Sinafir Is.	N	n/a	n/a	27.93453	34.69686			9	2	A
E. Shusha Is.	N	n/a	n/a	27.91660	34.70000			9	2	A
E. Sinafir Is.	N	n/a	n/a	27.91660	34.71000			9	2	A
E. Barqan Is.	N	n/a	n/a	27.90000	35.06660			9	2	A
S. Barqan Is.	N	n/a	n/a	27.90000	35.06660			9	2	A
Sila Is.	N	n/a	n/a	27.65000	35.28330			9	2	A
Sharm Antar	N	n/a	n/a	26.60000	36.25000			9	2	A
Central Is.	N	n/a	n/a	25.55467	36.86708			9	2	A
Waqada Is.	N	n/a	n/a	25.34020	36.95830			9	2	A
Al Hasani Is. (S)	N	n/a	n/a	24.97770	37.08360			9	2	A
Maliha Is.	N	n/a	n/a	25.03330	37.11660			9	2	A
Qalib Island chain A	N	n/a	n/a	25.16038	37.16071			9	2	A

RMU / 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)
				Lat	Long					
Qalib Island chain-B	N	n/a	n/a	25.19085	37.17197			9	2	A
Djedda (= Jeddah)	N	n/a	n/a	21.50000	39.20000			13	2	A
Qadd Humais Is. (S)	N	n/a	n/a	20.28556	39.48472			9	2	A
Dohar Is.	N	n/a	n/a	19.82607	39.89924			9	2	A
Malathu Is.	N	n/a	n/a	19.74928	39.90855			9	2	A
Qishran Islet (1)	N	n/a	n/a	20.27024	39.92209			9	2	A
Qishran Islet (2)	N	n/a	n/a	20.26646	39.96119			9	2	A
Qishran Islet (3)	N	n/a	n/a	20.26564	39.98740			9	2	A
Danak Is.	N	n/a	n/a	19.51666	40.03333			9	2	A
Sharbain Is. (Sharbayn)	N	n/a	n/a	18.71861	40.48889			9	2	A
Tidhkar Is.	N	n/a	n/a	18.94662	40.61646			9	2	A
Muska Is.	N	n/a	n/a	18.81759	40.63626			9	2	A
Dorish Is.	N	n/a	n/a	18.50696	40.66418			9	2	A
Sirrain Is.	N	n/a	n/a	19.62545	40.67169			9	2	A
Al Hala Is.	N	n/a	n/a	18.21808	40.72467			9	2	A
Maghabiya Is.	N	n/a	n/a	18.25194	40.73250			9	2	A
Al Umm Is.	N	n/a	n/a	18.27353	40.73385			9	2	A
Mafsubber/Sabiya Is.	N	n/a	n/a	18.26409	40.75501			9	2	A
Zuqaq Is. (Zukak)	N	n/a	n/a	18.04180	40.80290			9	2	A

RMU / 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)
				Lat	Long					
Abu Rukaba Is.	N	n/a	n/a	19.49732	40.89333			9	2	A
Pelican Is.	N	n/a	n/a	19.24312	40.93769			9	2	A
Wasaliyat Is. (S)	N	n/a	n/a	17.68450	41.02490			9	2	A
Jebel Sabaya Is.	N	n/a	n/a	18.59140	41.06440			9	2	A
Qutu Is.	N	n/a	n/a	18.48778	41.06694			9	2	A
Dhahrat Simer Is.	N	n/a	n/a	17.83330	41.16670			9	2	A
Hadara Is.	N	n/a	n/a	18.42278	41.22583			9	2	A
Barton Island	N	n/a	n/a	18.38211	41.27481			9	2	A
Wasaliyat Is. (S)	N	n/a	n/a	17.78439	41.43237			9	2	A
Dhi Dhayaha Is.	N	n/a	n/a	16.88950	41.46310			9	2	A
Disan Is.	N	n/a	n/a	16.92048	41.69518			9	2	A
Towasela Is.	N	n/a	n/a	16.46887	41.87841			9	2	A
Marrak Is.	N	n/a	n/a	16.42306	41.90556			9	2	A
Dohrab Is.	N	n/a	n/a	16.30458	41.96911			9	2	A
Firan Is.	N	n/a	n/a	17.17733	42.20503			9	2	A
Dahert Simer Is.	N	n/a	n/a	16.48896	42.29981			21, 9	2	A
Simer Is. (Zamhar)	N	n/a	n/a	16.29450	42.32441			9	2	A
Fara fir Is.	N	n/a	n/a	16.99164	42.41513			9	2	A

Table 3. International conventions signed by Saudi Arabia in relation to marine turtle conservation. [18, 33, 36]

Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles	Contact
International							
Convention on International Trade in Endangered Species of wild animals (CITES, Washington, 1973)	1996	Country must adopt national legislation under the framework established by the CITES.		all marine turtles.	regulating international trade of different species of threatened animals. forbids trade of these species in all signatory countries except in exceptional circumstances.		
Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn 1979)	1991	This convention is an intergovernmental treaty that becomes legally binding when agreements are signed and included into national legislation.		all marine turtles.	aims to conserve terrestrial, aquatic and avian migratory species throughout their range.		
Indian Ocean South East Asian Memoranda of Understanding (MoU)on Marine turtles	2005		Latest report 2014	all marine turtles.	Some countries bordering the Red Sea are part of the MoU on Marine Turtles and their Habitats of the Indian Ocean and South-East Asia.		
Convention on Biological Diversity (CBD, Rio 1992)	2002	internationally binding treaty	Implemented in signatory countries by national committees that have to prepare national action plans and ensure their implementation.	all marine turtles.	aiming at conserving biodiversity in signatory countries, promoting sustainable use of resources and fair sharing of benefits from genetic resources.		Mr. Abdallah R. Al-Tlasat Director Department of Protected Areas Planning Saudi Wildlife Authority Riyadh, Saudi Arabia E-Mail: a_altlassy [at] hotmail.com
United Nations Convention on the Law of the Sea (UNCLOS, Montego Bay 1972)	1984				aiming at establishing guidelines for the use of marine resources.		

Regional							
ROPME (Arabian Gulf) [Kuwait Regional Convention on the Protection and Development of the Marine Environment from Pollution, 1978] Including 5 Protocols:	1979	Yes	Self Reporting as requested	de facto: All Marine turtles	help sponsor and coordinate regional management efforts; objective: to ensure that development projects and other human activities do not in any way cause damage to the marine environment, jeopardize its living resources or create hazards to human health. Objective: the development of an integrated management approach to the use of the marine environment and the coastal areas in a sustainable way which will allow the achievement of environmental and developmental goals in a harmonious manner.	Protects habitat; reduce threats	Dr. Abdul Basit Sairafi, Assistant to the President, General Authority of Meteorology and Environment Protection, Ministry of Defense and Civil Aviation, P.O.Box 1358, Jeddah 21431
1. Protocol concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency (1978)	1978	Yes					
2. Protocol concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf (1989)	1989	Yes					
3. Protocol for the Protection of the Marine Environment against Pollution from Land-Based Sources (1990)	1990	Yes					
4. Protocol on the Control of Marine Trans-boundary Movements and Disposal of Hazardous Wastes and Other Wastes (1998)	1998	Yes					
5. Protocol concerning the conservation of biological diversity and the establishment of protected areas.		Yes					

PERSGA (Red Sea) [the Regional Convention for the Conservation of the Red Sea and Gulf of Aden] [Jeddah Convention, 1982]	1982	Yes	Self Reporting as requested	de facto: All Marine turtles	help sponsor and coordinate regional management efforts; Objectives: To improve the sustainable management and use of the RSGA's coastal and marine resources. To conserve the current excellent state of our shared marine environment.	Protects habitat; reduce threats	Dr. Abdel Basset Salem Alsarafi, Deputy for Environment Affairs and Sustainable Development, Presidency of Meteorology & Environment PME. P.O. Box 1352 Jeddah 21431 Kingdom of Saudi Arabia
Protocol Concerning the Conservation of Biological Diversity and the Establishment of Network of Protected Areas in the Red Sea and Gulf of Aden (2005).	2005	Yes					
Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden (2005).	2005	Yes					
Protocol Concerning Technical Cooperation to Borrow and Transfer Experts, Technicians, Equipment and Materials in Cases of Emergency (2009).	2009	Yes					
National							
Royal Decree No. 33, 27/7/137 established the Saudi Arabian Coast Guard					enforces rules, regulations and laws from 12 miles offshore to 10 km inland.		
Environmental Protection Standards Document No. 1401-01 (1402 H);					created the Meteorology and Environmental Protection Administration (MEPA) MEPA also has jurisdiction and is responsible for		
The Council of Ministers Decision No. 271, 23/11/1404:					"the use of best available technology to reduce pollutant		

					emissions (such as cement dust)".		
By Royal Decree No. 7/505M, dated 28/3/1406, the Ministry of Agriculture					responsibility for fishery activities and for permitting filling of submerged lands in the Eastern Province.		
The Royal Decree No. M/22, dated 12/9/1406, [NCWCD has been renamed the Saudi Wildlife Authority.]					established the National Commission for Wildlife Conservation and Development (NCWCD) as being responsible for the management of protected areas.		
The Council of Ministers decision No. 157, Dated 20/11/1411 and *Royal Decree No. 7/505M, dated 28/3/1406*, created the Meteorology and Environmental Protection Administration (MEPA)					that is charged with preventing pollution in the territorial seas.		
· established under Royal Decree 7/B/13307, dated 22/7/1411),					oil spill response (coordination mechanism		
· (Royal Decree No. 7/505M, dated 28/3/1406).					prevention of pollution including effluent from land fill ports		
· (Royal Decree No. 7/M/8903					setting standards for the environment and for carrying out a programme of environmental impact assessment and coastal zone management.		
· Royal Decree No.71 M/8903. The Presidency of Meteorology and Environment (PME)					responsible for setting standards for the environmental protection and for carrying out a programme of environmental impact assessment.		

Minister of Agriculture defining the Executive Bill Ministerial Decision number 21911 dated on 27/3/1409H equivalent to 6/11/1988G and Royal Decree number M/9 dated 27/3/1408 H equivalent to 18/11/1987 G				All marine turtles	Hunting, exploitation, and protection of the marine living natural resources in the territorial waters of the Kingdom of Saudi Arabia is regulated by law.	In Addition to regulating all fishing and maritime commercial exploitation, this law prohibits the taking of marine mammals, marine turtle and seabird eggs.	Authorities involved in implementation of this law in Saudi Arabia are: The Ministry of Agriculture and Water; The Ministry of Interior; Saudi Wildlife Authority (SWA)
Ministerial Decision number 103 dated on 10/8/1413H equivalent to 1/2/1993G, approved by the Royal Decree number M/12 dated 11/8/1413H equivalent to 2/2/1993G.					Regulates all research in Territorial waters of the Kingdom of Saudi Arabia, which includes all technical and scientific activities conducted in marine areas including recording, aquatic studies and research as well as marine treasures in the territorial waters of the Kingdom of Saudi Arabia.	Requires permit to conduct research	Authority empowered with the implementation of this law in Saudi Arabia is: Department of Military Survey, The Ministry of Defense and Aviation.

Table 4. Current and past marine turtle projects in Saudi Arabia.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Name of Database	Names of sites included	Beginning of the time series	End of the time series	Track information	Nest information	Flipper tagging	Tags in STTI-ACCSTR
T4.1	North West Indian Ocean	Saudi Arabia	western Arabian Gulf and eastern Red Sea	SWA Turtle Data		1989	Present*	SWA Turtle Data	Ras Baridi, Gulf islands	1989	Present	Yes	Yes	Yes	No
T4.2	North West Indian Ocean	Saudi Arabia	western Arabian Gulf	KFUPM Turtle Data		2015	2018	KFUPM Turtle Data	Gulf Islands	2015	2018	No	Minor	Yes	No

Leading organization	Public/Private	Collab-oration with	Reports / Information material	Current Sponsors	Contact (name and Email)	Database available	PIT tagging	Remote tracking	Ref #
Saudi Wildlife Authority	Private		Available on publication		Mr. Anas Z. Sambas, Saudi Wildlife Authority (SWA), P.O. Box 61681, RIYADH 11575, Saudi Arabia. E-mail: sambas@ncwcd.gov.sa	No	No	Yes	
KFUPM	Private		Available on publication		Dr. M. Qurban, KFUPM Research Institute, King Fahd University of Petroleum and Minerals, Dammam, Saudi Arabia.	No	No	Yes	

Table 5. Synopsis of hawksbill turtles nesting in the Arabian (Persian) Gulf and synopsis of green turtles nesting in the Arabian (Persian) Gulf and at Ras Baridi in the Red Sea. [2]

	Hawksbill Turtles			Green Turtles			Green Turtles		
	Arabian Gulf			Arabian Gulf			Ras Baridi		
CHARACTER	MEAN	RANGE	Sample	MEAN	RANGE	Sample	MEAN	RANGE	Sample
NESTING ADULTS									
Curved Carapace Length (cm)	71.5	59 - 93	499	98.2	73- 114	2844	104.7	89 - 118	303
Weight (g)	38.2	26 - 64	245	107.8	72 - 168	662	125.7	85 – 171	108
EGGS									
Diameter (cm)	3.99	2.36- 4.93	879	4.28	3.38 - 4.38	730	4.4	3.6 - 5.5	597
Weight (g)	31.2	19.4 - 46	863	44.6	33.2 - 60	719	51.9	38 – 72	597
Number in Clutch	75.2	59-124	134	88.5	51 - 138	91	103	63 – 158	81
Yolkless Eggs per Clutch	16.9	0-35		9.9	0 - 28		7.7	0 – 20	81
Incubation Period (weeks)		7-11			7-11			7-12	
HATCHLINGS									
Carapace Length (cm)	3.82	2.88 - 4.26	634	4.75	4.14 - 5.21	205	4.87	3.4 - 5.7	847
Weight (g)	12.7	9-18	292	21.98	18.2 - 25.0	120	24.6	16 - 58	847
NESTING CYCLE									
Renesting Interval (days)	18.2	12 - 22		14.3	9 - 15		12.3	9 - 15	n/a

BREEDING SEASON			
Mating	In the northern Gulf of Arabia mating commences in the spring and reaches a peak in late April.	In the northern Arabian Gulf mating commences in late May and reaches a peak in early June.	In the Red Sea, the time of mating is not known.
Nesting	Nesting commences in May, reaches a peak in late May and ends by July.	Nesting commences in early June, reaches a peak in late July and ends in Mid-September.	Nesting commences in August, reaches a peak in late October and ends in December.
Hatchling Emergence	Hatchlings emerge from early July through mid-August with a peak of hatching in late June	Hatchlings emerge from late July through mid-October with a peak of hatching in late August to Mid- September.	Hatchlings emerge from late October with a peak of emergence in December.

Table 6. Protected marine areas in Saudi Arabia.

FROM	Summary
[17, 38]	"The Kingdom of Saudi Arabia has established a number of extensive terrestrial protected areas, but lags behind in the development and implementation of marine protected areas. Many areas have been proposed and suggested, dating back to the mid- and late 1980s, and remain that way to date. With the exception of the Farasan Is.s, protected in 1996, and the Jubail Wildlife Sanctuary, which was developed shortly after the Gulf war, there have been no other recent marine protected areas established. With the resurgence of PERSGA and its Strategic Action Plan this is expected to change, with up to 32 proposals for protected areas being put forward for the Red Sea alone."
MPAs Declared	
Yanbu Royal Commission Protected Area:	This area is protected by the Royal Commission through an agreement with the Meteorological and Environmental Protection Administration. It covers an area of ca. 5 km² and encompasses fringing reefs, mangroves, and seabird nesting sites.
Umm al Qamari:	Established in 1977 and covering an area of only 2 km², this small protected area in the southern Red Sea has two small islands with surrounding fringing reefs and is an important habitat for thousands of seabirds.
Farasan Islands:	Established in 1996 and covering an area of 3310 km², this Terrestrial and Coastal Reserve is an archipelago of small islands at the southern extreme of Saudi Arabia's Red Sea shores. It is an important habitat for mangroves, seagrass, coral reefs, marine mammals, marine turtles, seabirds and endemic gazelle, and is threatened by fishing, development and recreation activities.
***de facto* and Planned MPAs**	
Jubail Wildlife Sanctuary:	This is a *de facto* protected area awaiting Royal declaration. Established in 1994 and covering an area of 2300 km², research and baseline surveys to identify the main ecosystems were carried out after the Gulf wear. The Sanctuary encompasses important wetlands for seabird migration and nesting areas for birds and sea turtles. The most extensive coral reefs in the Saudi Arabian Gulf are also found within the Sanctuary borders.
Straits of Tiran:	Straddling the Saudi Arabia / Egypt border, it encompasses islands and extensive coral reefs with diverse reef associated fauna in the transition area between the gulf of Aqaba ad the Red Sea. Is an important marine turtle and dugong habitat. There is tourist activity on the Egyptian side.
Ras Suwayhil:	Proposed to cover an area of 267 km², the site encompasses pristine and diverse coral reefs and reef associated fauna and is a prime example of the Gulf of Aqaba reefs and high cliffs. Habitat for seabirds and dugong.
Sharm Zubayr:	Proposed to cover 80 km², the area encloses open coastline and a sharm with fossil reef cliffs, narrow fringing reefs and the northernmost mangroves in the Red Sea. A causeway has been proposed to cut through the area.

Ghubbat Bal'aksh:	Covering 33 km², this is a sharm and open coastline with coral reefs with a particularly high species diversity, seagrass beds, and seabirds, subject to unregulated recreation activities.
Sharm Dumagyh and Sharm Antar:	Covering an area of 70 km², these two inlets contain fringing reefs, seagrass beds, mangrove areas and are habitats for green and hawksbill turtles and seabirds. The area is subject to fishing and recreation pressures.
Al-Wedj Bank:	Including Sharm habban and Sharm Munaybirah, this protected area will cover 2840 km², and is home to the most extensive coral reef system of the entire red Sea, diverse reef-associated fauna, seagrass beds and mangroves. It is inhabited by marine turtles and seabirds and is a key area for dugong.
Qalib Islands:	Actually included in the Al-Wedj bank, these islands are surrounded by fringing reefs and are important nesting sites for seabirds and marine turtles.
Al-Hasani and Libanah Islands:	These are high-aspect islands with extensive fringing reefs and are important nesting sites for seabirds and marine turtles.
Ras Abu Madd and Sharm Hasi:	Scenic sharms and high-quality fringing coral reefs, fossil reef terraces and important seabird area. To be combined with the Al-hasani and Libanah Islands protected area. Threatened by fishing activities.
Ras Baridi and Sharm al-Khawr:	The area encompasses sand beaches, small islands, high quality coral reefs and seagrass beds. It is the most important marine turtle nesting site in the Red Sea. It is threatened by unchecked fallout from a nearby cement factory.
Sharm Yanbu:	Enclosing 50 km², the sharm is a deep, bi-lobed lagoon that contains mangrove and seagrass beds and fringing reefs and is an important seabird area.
Shi'b al-Qirin:	Extending over 30 km², this a high-quality inshore reef complex that is also an important seabird area.
Marsa as-Sarraj:	Proposed to cover 200 km², this is the largest land-locked lagoon on the Saudi Arabian Red sea coast. Seasonally inundated, it contains mangroves, halophytes, seagrass beds and high-quality coral reefs. It is threatened by agricultural development and fishing activities.
Ras Hatiba:	covering ca. 450 km², this is a large lagoon with sandy and coraline spits, small mangrove stands, extensive offshore reefs and is a prime site for environmental and extension education programmes. Currently threatened by recreation and unregulated development.
Jaddah Salt Marsh:	Proposed to cover 100 km², this is a marshland area with extensive offhsore reefs, threatened by oil pollution and other waste disposal.
Ash-Shu'aybah and Mastaba:	Proposed to cover ca. 100 km², this is a large lagoon with extensive mangroves, fossil reef terraces and good quality offshore reefs. It is a key site for seabirds, and is threatened by unregulated development and mangrove felling, and a possible major highway project.

Qishran:	This is a complex of coral reefs, coral spits, seagrass beds and extensive mangroves. It is an important seabird and dugong habitat.
Outer Farasan Bank:	This is a major reef and island system contiguous with the Farasan Islands. It has diverse mangrove, seagrass and coral reef habitats, and is an important turtle and seabird nesting area.
Khawr Nahoud:	Proposed to cover ca. 33 km², this is a lagoon with fringing corals, seagrass beds and mangroves. It is an important dugong and seabird habitat.
Khawr Itwad:	Proposed to cover ca. 70 km², this is a lagoon with fringing corals, seagrass beds and mangroves.
Shi'b Abu al-Liqa and Shi'b al-Kabir:	Proposed to cover ca. 140 km², these are two lagoons with abundant fringing corals and mangroves.

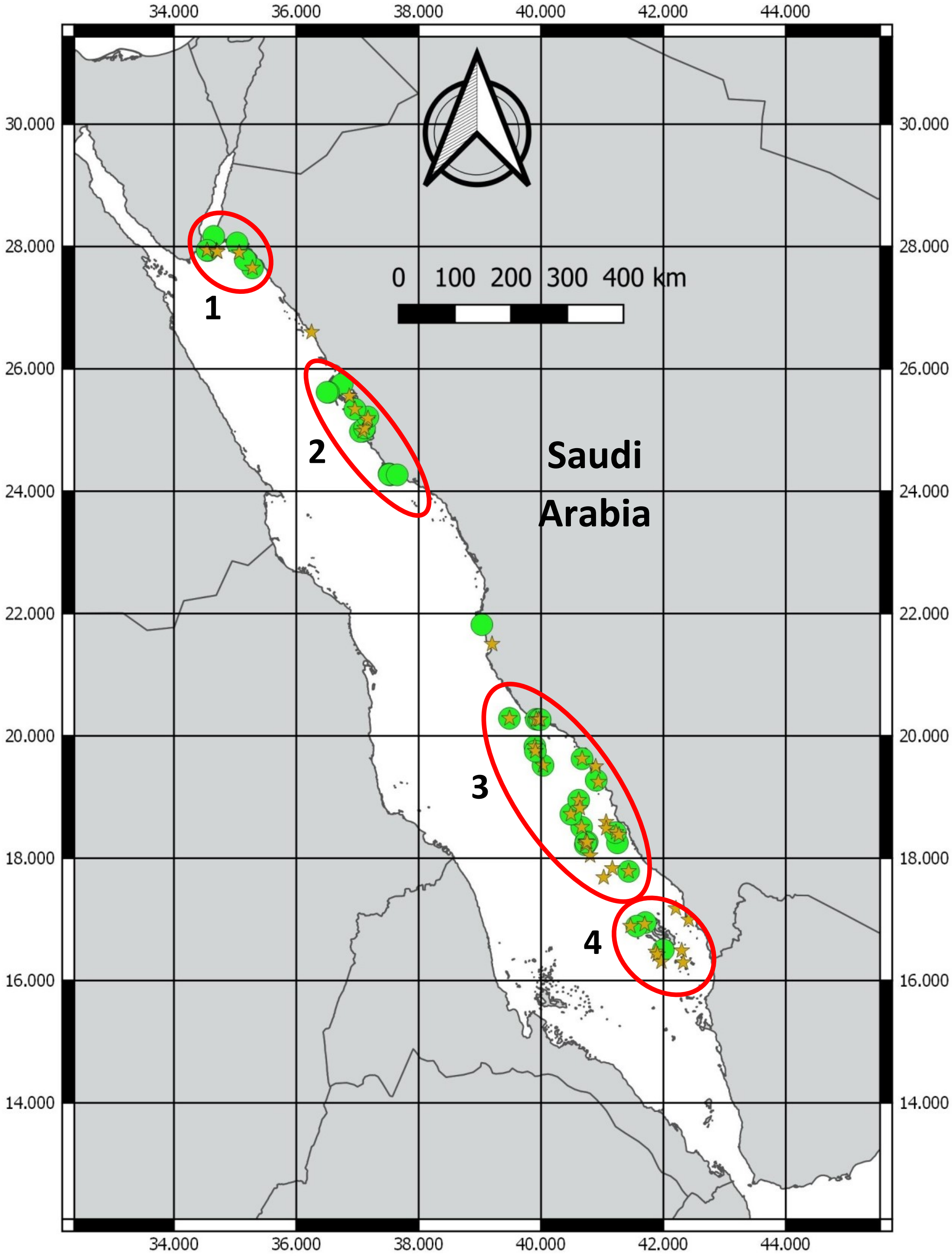

Figure 1. Red Sea region showing know nesting sites in the Kingdom Saudi Arabia.

The general pattern of nesting can be divided into four areas: (1) the area in the vicinity of Tiran Is. and Sanifar Islands, (2) the area between Wejh and Yanbu, including the Wejh Bank and several mainland sites (Ras Al Lakk and Ras Baridi, (3) the area south of Al Lith to just north of Gizan, and (4) the Farasan Archipelago. Circles: Green turtles; Stars: Hawksbill turtle. Symbols indicate location, not density.

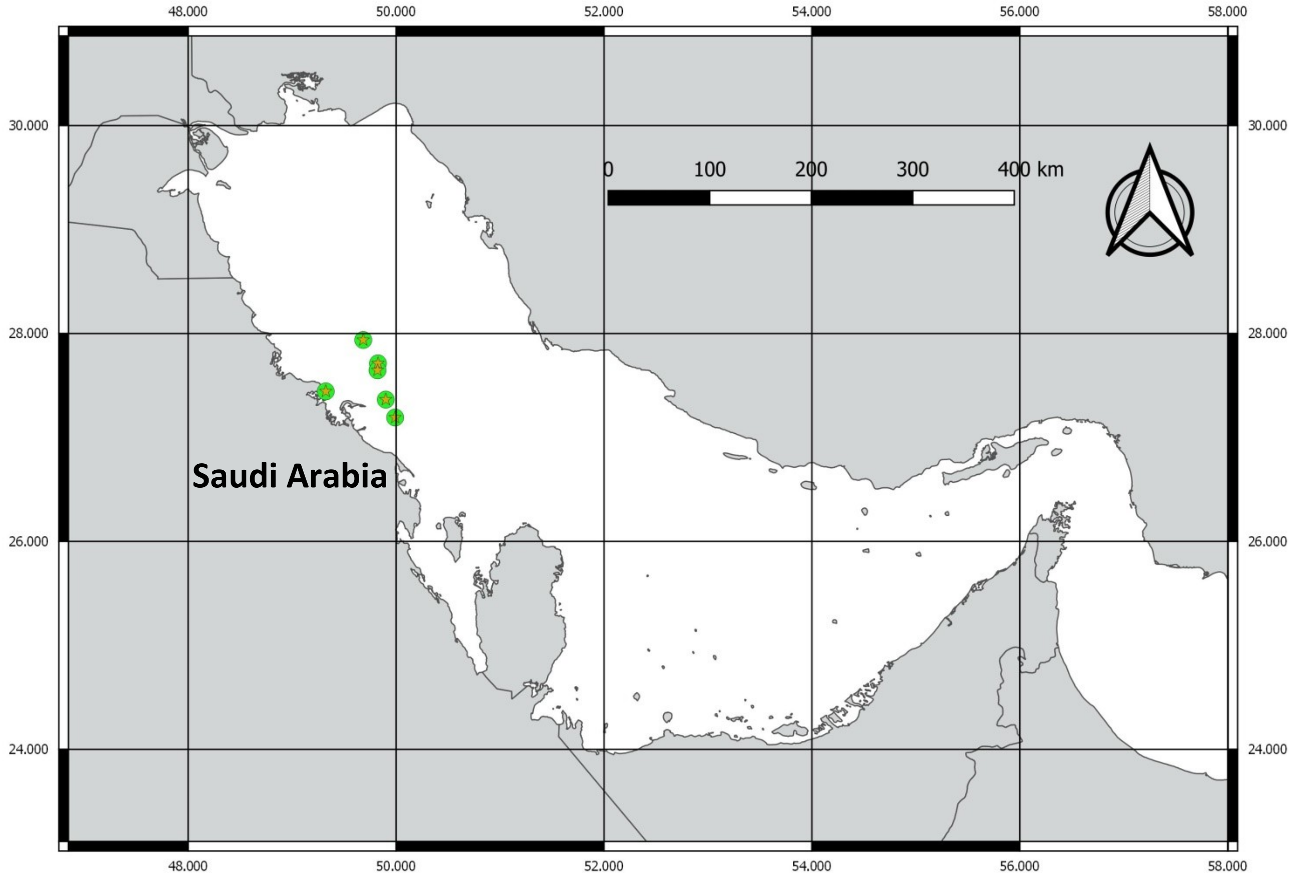

Figure 2. Arabian (Persian) Gulf region showing marine turtle nesting sites in the Kingdom Saudi Arabia.

Symbols: Circles: Green turtles; Stars: Hawksbill turtles. Symbols indicate location, not density.

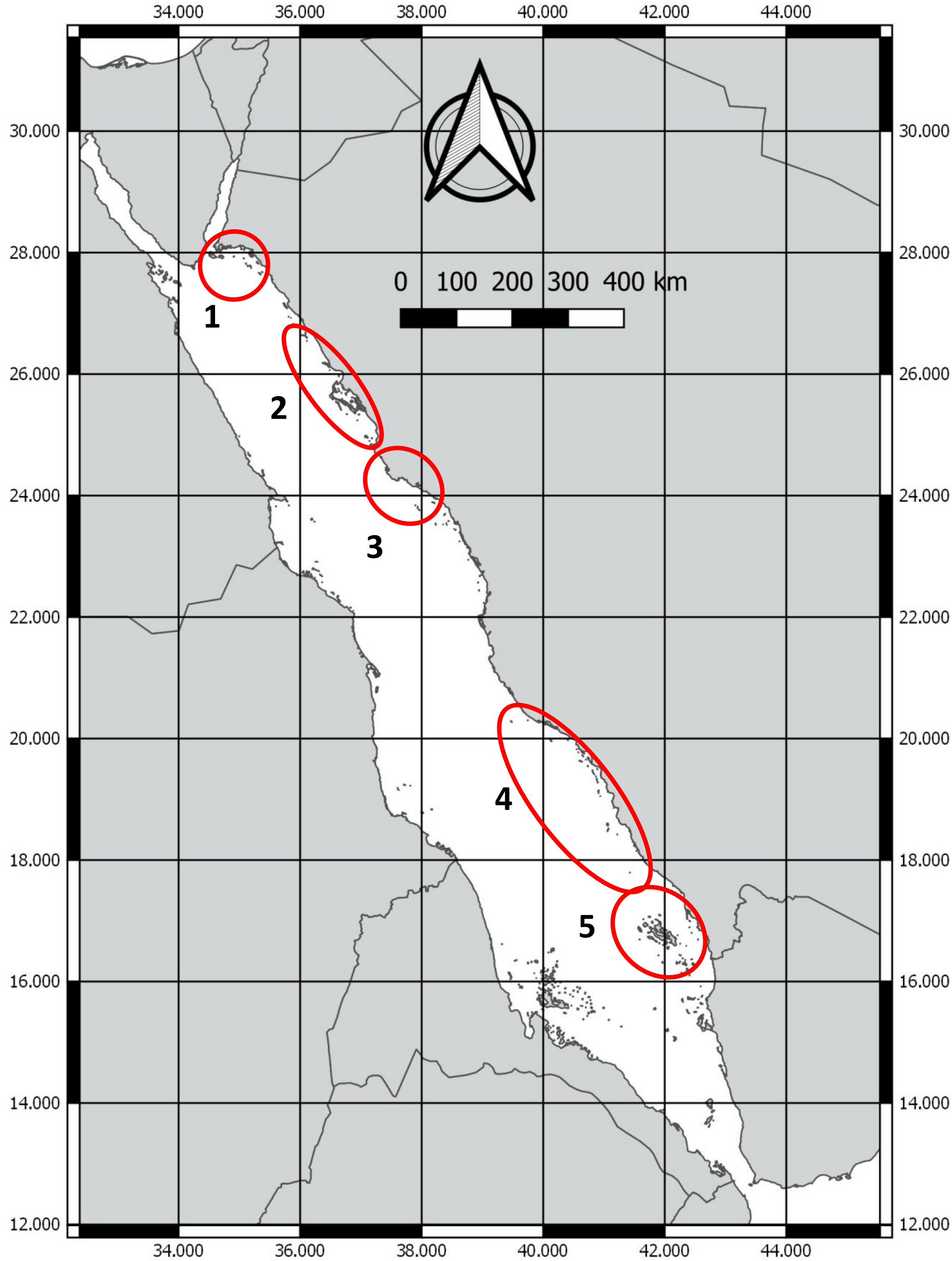

Figure 3. Marine turtle foraging areas in the Saudi Arabian portion of the Red Sea.

(1) the area in the vicinity of Tiran Is. and Sanifar Islands
(2) the Wejh Banks
(3) near Yanbu, including several near-shore sites (Ras Al Lakk and Ras Baridi,
(4) the area south of Al Lith to just north of Gizan, and
(5) the Farasan Archipelago

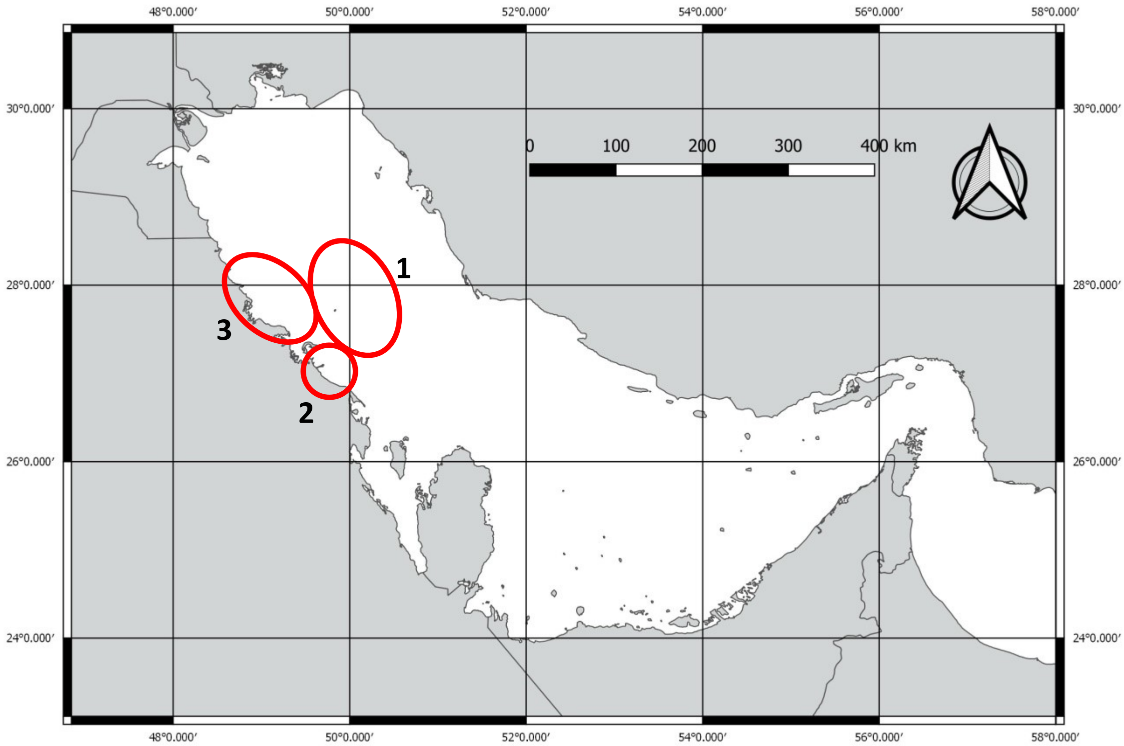

Figure 4. Arabian (Persian) Gulf region showing an important foraging area used by marine turtles in the Kingdom Saudi Arabia

1. the reef systems around the each of the offshore islands,

2. the Dawhat Abu Ali inside the Berri oil field just north of Jubail south of Abu Ali,

3. and the shallow area north of Abu Ali and south of Safaniyah.

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SRI LANKA

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Five species of marine turtle nest in Sri Lanka: green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta*), hawksbill turtle (*Eretmochelys imbricata*) and olive ridley turtle (*Lepidochelys olivacea*) [1,2,4,5,8,9,10,13,18,47].

1 RMU: *Caretta caretta*, North-East Indian Ocean (CC-NEIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

Only a small number of nests of loggerheads are reported annually in Sri Lanka [11], probably less than 25 nests per year along the southern and southwestern coasts (T. Kapurusinghe, pers.comm.).

1.1.2 Marine areas

No data available.

1.2 Other biological data

It is unknown if the population forms a separate genetic stock [72].

1.3 Threats

1.3.1 Nesting sites

Threats at nesting beaches include illegal take of eggs by villagers, increasing artificial light from coastal development [74], and egg depredation by Indian gerbi and Indian bush rat [77] (Table 1).

1.3.2 Marine areas

Consumption of meat from bycatch is a threat for sea turtles in marine areas and is known to be high along the western and north-western coasts of Sri Lanka [28,38,39,46,48,50,66,73,81,83] (Table 1).

1.4 Conservation

Sea turtles have been protected in Sri Lanka under government legislation since 1972 by Fauna and Flora Protection Ordinance (FFPO, 1972; amendment 1993 and 2009). All five species of sea turtles are protected by the amendments to the FFPO in 1972 and the punishments were increased by the amendments in 1993. Under section 30 of the FFPO it is an offence to kill, wound, harm or take a turtle using a net, trap, explosive or any other device, to keep in possession, sell or expose for sale a turtle or any part of a turtle, or destroy or take turtle eggs. A person found guilty for any of these offences is liable to a fine of LKR 10,000 to 30,000 and/or to imprisonment for two to five years. The amendment to the FFPO in 2009 increased the maximum fine up to LKR 100,000 [62].

In 1995, the Department of Wildlife Conservation (DWC) initiated an *in situ* nest protection programme in collaboration with the Heritage Foundation along 4 km stretch of beach in Bundala National Park. At present DWC is continuing the project with the support of the local communities and the project area has been extended to 8 km. In 1996, the Turtle Conservation Project (TCP), a nongovernmental organization (NGO), initiated its pioneering community-based *in situ* sea turtle nest protection and research programme at Rekawa with the aim of protecting sea turtles and also supporting local people who depend on the coastal resources for their livelihood [15]. This project was implemented in collaboration with the DWC, the University of Peradeniya, the National Aquatic Resources Agency (NARA) and the University of Ruhuna. Local community members, who may have been previously involved in illegal take of eggs, were trained in turtle biology and research and had been employed by TCP as turtle nest protectors. TCP also recruited research officers to carry out research activities such as flipper tagging, collecting biometric and nesting frequency data etc. A similar project was established in Kosgoda in August 2003 by the TCP. Many awareness and community-based conservation activities along the coast, especially southern and south-western areas, have been conducted by various NGOs which may have led to the reduction in illegal take of eggs and killing of turtles for meat especially in Kosgoda and Rekawa areas [31]. An *in situ* turtle nest protection programme has been initiated recently on the east coast of Sri Lanka [61], an area previously inaccessible due to the civil war.

Selling of eggs and meat in the open market gradually decreased after the strict law enforcement but turtle eggs and meat are still eaten or sold by the local community in some areas [31].

The first two sea turtle sanctuaries in Sri Lanka were declared in 2006 at Rekawa (4.5 km stretch) and at Godawaya (3.8 km stretch) [82]. The area is bound 500 meters towards the sea and 100 meters towards the land from the high tide level in both sites. Although the Ordinance protects the sea turtles throughout Sri Lanka, their nesting areas are not protected and hence, local communities can disturb nesting beaches and foraging areas through activities such as removing sand, installing lighting adjacent to beaches, cutting the beach vegetation etc. Some of these activities are prohibited under the Coast Conservation Act but, not under the FFPO. However, once declared as a sanctuary all these activities affecting the sea turtles are prohibited. Currently, “The Rekawa Turtle Watch” is a turtle conservation project run by an NGO.

Hatcheries are used as an *ex situ* conservation tool of sea turtles in Sri Lanka but their contribution towards conservation of sea turtles is highly debated [34,35,40,41,42,43]. All the hatcheries are operated by private owners and their prime motive is profit, relying on tourists for their viability [32,75]. However, unlike in the past, the existing hatcheries operate throughout the year, not only during tourist season. The common practice is to buy turtle eggs from suppliers and bury them in an incubation enclosure within the hatchery and release hatchlings after keeping in tanks for 5 days to 2 weeks [34]. Hatcheries are illegal and attempts to issue licences to hatcheries was not successful so far [29].

Community education and awareness programmes on plastic pollution in coastal regions [80] and turtle bycatch [78,79] have been conducted in areas where there had been turtle bycatch especially in Kalpitiya.

1.5 Research

The research on sea turtles in Sri Lanka dates back to as early as 1930 when Deraniyagala described the five nesting species and the beaches in Sri Lanka [2], then known as Ceylon. His first herpetological book, and perhaps one of the important herpetological milestones in the country, is "*Tetrapod reptiles* *of Ceylon vol. 1. Testudinates and Crocodilians*" [2]. Deraniyagala published his three volumes of his books on reptiles including sea turtle in 1939, 1943, and 1952 and many papers later [4,8,9,69,70].

Turtle bycatch is high along the western and north western coasts of Sri Lanka [31,39,48]. Many studies have been conducted in the commercial sea turtle hatcheries which are well established in Sri Lanka [32,34,35,40,41,42,43].

2 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

The southern and south-western coasts of Sri Lanka are the main turtle nesting sites, but nesting occurs from Mount Lavinia on the west coast to Arugambay on the east coast (Figure 1) [1,2,4,6,8,9,18,61]. The green turtle is the most frequent nesting turtle in Sri Lanka, contributing about 96% nests at Rekawa [15] and 90% at Kosgoda [16]. High nesting abundance of nesting green turtles occurs in Rekawa, Kosgoda, Kahandamodara and Bundala, while scattered nesting is observed in the other beaches [1,3,15,16]. Green turtle nesting takes place throughout the year but March to May can be considered the main nesting season with a peak in April [15,16]. In recent years, a declining trend in nesting frequency of sea turtles has been observed in Rekawa [14].

2.1.2 Marine areas

Satellite tracking suggest that the nesting green turtles tagged in Rekawa sanctuary migrated to foraging grounds in Gulf of Mannar Biosphere Reserve off the coast of Tamil Nadu, India, the Lakshadweep islands, and west coast of India near Karnataka [25].

2.2 Other biological data

Five years of data on the reproductive output of female green turtles collected from Kosgoda beach with a total of 1,492 nests comprising 166,358 eggs laid by 575 nesting females show that larger females have a higher reproductive output, laying larger eggs, bigger clutches, and producing a greater number of eggs in total for a season. There is no relationship between clutch size and egg size, and hatchling size does not depend on the egg size or female size. The mean hatching success is 77.3% with a mean incubation duration of 50.6 days. Clutch size, egg size, female body size, and nest depth have no effect on hatching success of the green turtle nests laid at Kosgoda rookery [16].

2.3 Threats

2.3.1 Nesting sites

See 1.3.1.

2.3.2 Marine areas

Before the civil war started in 1983, fishers of the south and, particularly, the east coast sent bycatch sea turtles to the collecting centres and from those places the turtles were periodically transported to Jaffna in large lorry consignments in a most cruel manner [58]. This practice gradually decreased after the amendment of the FFPO in 1972 (personnel communications with the local community in the nesting areas). Kalpitiya on the north-western coast has been the main location for the deliberate take of turtles since the civil war began in Jaffna in 1983 [38].

In more recent times, many turtles are accidentally caught and drowned in fishing gear [39]. During 1999 and 2000, a turtle rescue programme was initiated at Kandakkuliya in Kalpitiya; bycatch turtles trapped in gill nets were released by fishers [39]. Bycatch was thought to be the leading cause of sea turtle mortality population [50]. However, some reports show that people in the north are accomplished turtle-catchers and use a variety of nets to capture sea turtles, and there is a high demand for turtle meat from the northern areas [45]. There are reports of the butchering and selling of live turtles openly in Kandakuliya and north-western parts of the country [39,48]. In 2008, a survey reported that 45% of the villagers at Kandakkuliya consumed turtle meat mostly from bycatch [31]. But a 2014 study found that incidental capture of sea turtles in the fishing sites Negambo and Beruwala was not very significant; olive ridley followed by green turtles were the most abundant species caught in fishing gear [68]. Some fishers are willing to rescue the entangled turtles while others are not [38] but a more recent survey shows that the percentage of fishers who release bycatch had increased from 63% in the past to 90% [66].

See also 1.3.2.

2.4 Conservation

See Section 1.4.

2.5 Research

The nesting behaviour of female green turtles was studied at the Rekawa and Kosgoda rookeries and found similar patterns with a peak in warmer months from February to May (see 2.2; [15,16]). The same population was studied for genetics using six microsatellite loci. High genetic diversity was observed within the population and the study also showed that, although the green turtle population nesting at Kosgoda is small compared to other nesting rookeries in the world, high genetic diversity among and within individuals suggests that the population may not be currently undergoing a bottleneck [26]. This study further reported the paternity in the offspring and showed that clutches of 47% of the females were sired by two (62.5%) or three (37.5%) fathers. The successive clutch analysis showed that the dominant father sired 50% of the total offspring followed by 33.3% by the second male [26].

Satellite tagging has shown that after completing nesting in the south and south-western coast, green sea turtles migrate back to their foraging grounds in the Gulf of Mannar Biosphere Reserve off the coast of Tamil Nadu and Lakshadweep Islands in southern India [25].

See also Section 1.5.

3 RMU: *Dermochelys coriacea*, North-East Indian Ocean (DC-NEIO)

3.1 Distribution, abundance, trends

3.1.1 Nesting sites

Overall, only a small number of leatherbacks nest in Sri Lanka [9], with most leatherback nesting occurring at Godawaya beach in southern Sri Lanka [10].

3.1.2 Marine areas

No data available.

3.2 Other biological data

No data available.

3.3 Threats

3.3.1 Nesting sites

See 1.3.1.

3.3.2 Marine areas

There are no bycatch records of leatherbacks in Sri Lanka.

3.4 Conservation

See Section 1.4.

3.5 Research

See Section 1.5.

4 RMU: *Eretmochelys imbricata*, North-East Indian Ocean (EI-NEIO)

4.1 Distribution, abundance, trends

4.1.1 Nesting sites

Southern and south-western coasts of Sri Lanka are where the main nesting takes place but nesting spans from Mount Lavinia in the western coast to Arugambay in the eastern coast (Figure 1) [1,2,4,6,8,9,18,61].

4.1.2 Marine areas

No data available.

4.2 Other biological data

No data available.

4.3 Threats

4.3.1 Nesting sites

See 1.3.1.

4.3.2 Marine areas

See 1.3.2.

4.4 Conservation

The hawksbill turtle has been hunted for its carapace to provide raw materials for the tortoiseshell trade [41]. A 1994 survey of illegal tortoiseshell trade in Sri Lanka recorded 112 retailers openly selling tortoiseshell products in six towns and a subsequent survey in 1996 recorded 83 shops selling tortoiseshells in 14 towns [41]. However, the tortoiseshell trade has been greatly reduced due to strict legislation and public awareness and education programmes conducted by the government and non-government organizations [67]. The tortoiseshell trade cannot be considered an ongoing and pervasive threat to hawksbill recovery. See also Section 1.4.

4.5 Research

Data not available.

5 RMU: *Lepidochelys olivacea*, North-East Indian Ocean (LO-NEIO)

5.1 Distribution, abundance, trends

5.1.1 Nesting sites

The southern and south-western coasts of Sri Lanka are the main turtle nesting sites but nesting occurs from Mount Lavinia on the west coast to Arugambay on the east coast (Figure 1) [1,2,4,6,8,9,18,61]. The highest abundance of nesting olive ridley turtles occurs at Rekawa, Kosgoda, Kahandamodara and Bundala, while scattered nesting is observed at the other beaches [1,3,15,16]. The olive ridley turtle is the second-most common nesting species in Sri Lanka. A declining trend in nesting frequency of sea turtles has been observed at Rekawa in 2012 [14].

5.1.2 Marine areas

Nesting olive ridley turtles tagged in Orissa, India, have been recorded in the coastal waters of eastern Sri Lanka [11]. Observations on inter- and post-nesting olive ridleys tagged at Kosgoda and Rekawa beaches show high fidelity to nesting beaches [12,16,17,19,69].

5.2 Other biological data

Data not available.

5.3 Threats

5.3.1 Nesting sites

See 1.3.1.

5.3.2 Marine areas

See 1.3.2.

5.4 Conservation

See Section 1.4.

5.5 Research

Data not available

Table 1a. Characteristics of nesting loggerhead, green and leatherback turtles in Sri Lanka.

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**
Occurrence						
Nesting sites	Y	1-7,8,14,15	Y	1-7,12,14,15	n/a	1-7,9,10,14,15
Pelagic foraging grounds	n/a		J & A	25	n/a	
Benthic foraging grounds	n/a		n/a		n/a	
Key biological data						
Nests/yr: recent average (range of years)	17 (2014-2017)	1,10,15,16,17,18,61	2884 (2014-2017)	1,10,15,16,17,18,61	14 (2014-2017)	1,10,15,16,17,18,61
Nests/yr: recent order of magnitude	n/a		n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	1,10,15,16,17,18,61,82	12	1,10,15,16,17,18,61,82	1	1,10,15,16,17,18,61,82
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	14	1,10,15,16,17,18,61	32	1,10,15,16,17,18,61	37	1,10,15,16,17,18,61
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)	35	1,10,15,16,17,18,61	104	1,10,15,16,17,18,61	96	1,10,15,16,17,18,61
Nesting females / yr	n/a		n/a		170	10
Nests / female season (N)	n/a		4/598	20	n/a	
Female remigration interval (yrs) (N)	n/a		2.5-3.5 (1,506)	16,19, 20	n/a	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		0.70	21	n/a	
Sex ratio: Immature (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)	n/a		85.9 CCL	71	n/a	
Age at maturity (yrs)	n/a		n/a		n/a	
Clutch size (n eggs) (N)	105.2 (5)	15	112.1 (1,985)	15	100.5 (30)	15
Emergence success (hatchlings/egg) (N)	n/a		74.3(526)	71	n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		51.9 (5,281)	26	n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**
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/a		n/a		n/a	
Genetics	n/a		Y	23,24	n/a	
Stocks defined by genetic markers	n/a		n/a		n/a	
Remote tracking (satellite or other)	n/a		Y	25	n/a	
Survival rates	n/a		n/a		n/a	
Population dynamics	n/a		n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a		n/a	
Capture-Mark-Recapture	n/a		Y	19	Y	53
Threats						
Bycatch: presence of small scale / artisanal fisheries?	PLL, SN	27,28,38,46,48,73,8183	PLL, SN	27,28,38,46,48,73,81,83	PLL	27,28,38,46,48,73,8183
Bycatch: presence of industrial fisheries?	n/a		n/a		n/a	
Bycatch: quantified?	Y	46,48,51	Y	46,48,52	Y	49,51,54
Take. Intentional killing or exploitation of turtles	Y	45,55,56	Y	45,55.56	Y	45,55.56
Take. Eggs (illegal)	Y	45,57,58,59,34	Y	45,57,58,59,34	Y	45,57,58,59,34
Coastal Development. Nesting habitat degradation	n/a	49,60	n/a	49,60	n/a	49,60
Coastal Development. Photo pollution	Y	74	Y	74	Y	74
Coastal Development. Boat strikes	n/a		n/a		n/a	
Egg predation	Y	15, 61	Y	15,16, 61,77	Y	15,61
Pollution (debris, chemical)	Y	80	Y	80	Y	80

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*	
RMU	**CC-NEIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-NEIO**	**Ref #**
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						
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	1 (12: 2005-2017)	14	1 (12: 2005-2017)	14	1 (12: 2005-2017)	14
Number of index nesting sites	n/a		n/a		n/a	
Monitoring at foraging sites (period: range of years)	n/a		n/a		n/a	
Conservation						
Protection under national law	Y	62	Y	62	Y	62
Number of protected nesting sites (habitat preservation) (% nests)	2 (U %)	1,10,15,16,17,18,61	7 (U %)	1,10,15,16,17,18,61	7 (U %)	1,10,15,16,17,18,61
Number of Marine Areas with mitigation of threats	16	62,63,64,65,81	16	62,63,64,65,81	16	62,63,64,65,81
N of long-term conservation projects (period: range of years)	2 (1996 to 2000, 2005 to 2012)	14,15	2	14,15	2	14,15
In-situ nest protection (eg cages)	Y	15,16,61	Y	15,16,61	Y	15,16,61
Hatcheries	Y	29,35,37,44,75	Y	29,35,36,37,38,43,44,45,46,75	N	
Head-starting	Y	35,37,44	Y	35,37,44	N	
Bycatch: fishing gear modifications (eg TED, circle hooks)	n/a		n/a		n/a	
Bycatch: onboard best practices	n/a		n/a		n/a	
Bycatch: spatio-temporal closures/reduction	n/a		n/a		n/a	
Other	y		y	76,78,79	y	76,78,79

Table 1b. Characteristics of nesting hawksbill and olive ridley turtles in Sri Lanka.

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NEIO**	**Ref #**	**LO-NEIO**	**Ref #**
Occurrence				
Nesting sites	y	1-7,13,14,15	Y	1-7,11,14,15
Pelagic foraging grounds	n/a		n/a	
Benthic foraging grounds	n/a		n/a	
Key biological data				
Nests/yr: recent average (range of years)	54 (2014-2017)	1,10,15,16,17,18,61	772 (2014-2017)	1,10,15,16,17,18,61
Nests/yr: recent order of magnitude	n/a		n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	0	1,10,15,16,17,18,61,82	12	1,10,15,16,17,18,61,82
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	17	1,10,15,16,17,18,61	28	1,10,15,16,17,18,61
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)	40	1,10,15,16,17,18,61	95	1,10,15,16,17,18,61
Nesting females / yr	n/a		n/a	
Nests / female season (N)	n/a		1-3	17
Female remigration interval (yrs) (N)	n/a		1-4 (76)	17
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)	115.2 (6)	15	105.1 (30)	15
Emergence success (hatchlings/egg) (N)	n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a	

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NEIO**	**Ref #**	**LO- NEIO**	**Ref #**
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		n/a	
Published studies				
Growth rates	n/a		n/a	
Genetics	n/a		n/a	
Stocks defined by genetic markers	n/a		n/a	
Remote tracking (satellite or other)	n/a		n/a	
Survival rates	n/a		n/a	
Population dynamics	n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a	
Capture-Mark-Recapture	n/a		Y	22
Threats				
Bycatch: presence of small scale / artisanal fisheries?	PLL,SN	27,28,38,46,48,73,81,83	PLL	27,28,38,46,48,73,81,83
Bycatch: presence of industrial fisheries?	n/a		n/a	
Bycatch: quantified?	Y	49,51,54,	Y	47,49,51,54
Take. Intentional killing or exploitation of turtles	Y	45,55.56	Y	45,55.56
Take. Eggs (illegal)	Y	45,57,58,59,34	Y	45,57,58,59,34
Coastal Development. Nesting habitat degradation	n/a	49,60	n/a	49,60
Coastal Development. Photopollution	Y	74	Y	74
Coastal Development. Boat strikes	n/a		n/a	
Egg predation	Y	15, 61	Y	15, 61,77
Pollution (debris, chemical)	Y	80	Y	80
Pathogens	n/a		n/a	
Climate change	n/a		n/a	

	Eretmochelys imbricata		*Lepidochelys olivacea*	
RMU	**EI- NEIO**	**Ref #**	**LO- NEIO**	**Ref #**
Foraging habitat degradation	n/a		n/a	
Other	PLL,SN	27,28,38,46,48,73,81,83	PLL	27,28,38,46,48,73,81,83
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	1 (12: 2005-2017)	14	1 (12: 2005-2017)	14
Number of index nesting sites	n/a		n/a	
Monitoring at foraging sites (period: range of years)	n/a		n/a	
Conservation				
Protection under national law	Y	62	Y	62
Number of protected nesting sites (habitat preservation) (% nests)	3 (U %)	1,10,15,16,17,18,61	7 (U %)	1,10,15,16,17,18,61
Number of Marine Areas with mitigation of threats	16	62,63,64,65,81	16	62,63,64,65,81
N of long-term conservation projects (period: range of years)	2	14,15	2	14,15
In-situ nest protection (eg cages)	Y	15,16,61	Y	15,16,61
Hatcheries	Y	29,	Y	29,35,37,44,71
Head-starting	N		Y	35,37,44
Bycatch: fishing gear modifications (eg TED, circle hooks)	n/a		n/a	
Bycatch: onboard best practices	n/a		n/a	
Bycatch: spatio-temporal closures/reduction	n/a		n/a	
Other	y	76,78,79	y	76,78,79

Table 2. Index nesting sites for marine turtles in Sri Lanka.

RMU / 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)
				Long	Lat					
CC-NEIO										
Rekawa		1.8 (1996-2000)		80.843356	6.043539	2	100	15	1	B
Rekawa		1 (2012-2017)		80.843356	6.043539	4	100	DWC Unpublished data	1	B
Bundala		1.3 (2012-2017)		81.212725	6.164184	4		DWC Unpublished data	1	B
CM-NWIO										
Rekawa	Y	804 (1996-2000)		80.843356	6.043539	2	100	15	1	B
Rekawa	Y	482 (2005-2011)		80.843356	6.043539	2	100	14	1	B
Kosgoda		298 (2003-2008)		80.024083	6.341413	1	100	16	1	B
Rekawa	Y	1,142 (2012-2017)		80.843356	6.043539	4		DWC Unpublished data	1	B
Kalamatiya		10 (2014-2016)		80.962725	6.084554	2		DWC Unpublished data		
Bundala		103.5 (2014-2017)		81.212725	6.164184	4		DWC Unpublished data	1	B
Mount Lavinea		9 (2014)		79.862994	6.825496	1.44		18		
Induruwa		280 (2014)		80.013807	6.362792	4		18		
Mahapalana		60 (2014)		80.018299	6.353629	1.3		18		
Duwemodara		85 (2014)		80.020556	6.348359	1.2		18		
Kosgoda		570 (2014)		80.024083	6.341413	2.3		18		
Ahungalla		90 (2014)		80.034526	6.303652	1.5		18		
Balapitiya		30 (2014)		80.034998	6.278739	2		18		
Kahawa		48 (2014)		80.072185	6.183077	5.2		18		
Habaraduwa		14 (2014)		80.306969	5.992858	0.8		18		
Panama		28 (2014)		81.809299	6.746488	4		62		

RMU / 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)
				Long	Lat					
DC-NEIO										
Rekawa		14 (1996-2000)		80.843356	6.043539	2	100	15	1	B
Godawaya		333 (2002)	495 (2002)	81.034422	6.106125	4	100	10	1	
Bundala		4 (2017)		81.212725	6.164184	4		DWC Unpublished data	1	B
EI-NEIO										
Kumana		16 (2015)		81.717518	6.527416	7		DWC Unpublished data	1	B
LO-NEIO										
Rekawa		11 (1996-2000)		80.843356	6.043539	2	100	15	1	B
Kosgoda		34 (2003-2008)		80.024083	6.341413	2	100	17	1	B
Rekawa		30.5 (2012-2017)		80.843356	6.043539	4		DWC Unpublished data	1	B
Kumana		68 (2013-2017)		81.717518	6.527416	7		DWC Unpublished data	1	B
Bundala		162 (2014-2017)		81.212725	6.164184	4		DWC Unpublished data	1	B
Kalamatiya		22 (2014-2015)		80.962725	6.084554	2		DWC Unpublished data		
Mount Lavinea		20 (2014)		79.862994	6.825496	1.44		18		
Benthota		40 (2014)		79.995358	6.422218	2.3		18		
Warahena		20 (2014)		80.001604	6.405475	0.9		18		
Induruwa		10 (2014)		80.013807	6.362792	4		18		
Mahapalana		10 (2014)		80.018299	6.353629	1.3		18		
Duwemodara		14 (2014)		80.020556	6.348359	1.2		18		
Kosgoda		10 (2014)		80.024083	6.341413	2.3		18		
Ahungalla		65 (2014)		80.034526	6.303652	1.5		18		
Ambalangoda		30 (2014)		80.045115	6.246312	1.2		18		
Kahawa		45 (2014)		80.072185	6.183077	5.2		18		
Habaraduwa		30 (2014)		80.306969	5.992858	0.8		18		
Koggala		30 (2014)		80.322247	5.988579	1.6		18		
Panama		128(2014)		81.809299	6.746488	4		62		

Table 3. International conventions signed by Sri Lanka in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
CITES	1979	y	y	CC, CM, DC, EI, LO	n/a	y
CMS	1990	y	y	CC, CM, DC, EI, LO	n/a	y
IOSEA Marine Turtle MoU	2001	y	y	CC, CM, DC, EI, LO	n/a	y

Table 4. Current and past marine turtle projects in Sri Lanka.

#	RMU	Region / Location	Project Name or descriptive title	Key words	Start date	End date	Leading organization	Public /Private	Collaboration with	Primary Contact (name and Email)	Other Contacts (name and Email)
T4.1		Rekawa beach, Tangalle	In-situ nest protection programme	Flipper tag, satellite tag, nesting female	1996	2000	Turtle Conservation Project (TCP)	Public	University of Peradeniya	T. Kapurusinghe, kjthushan@yahoo.com	L. Ekanayake lalitheml@yahoo.com
T4.2		Rekawa beach, Tangalle	In-situ nest protection programme	Flipper tag, satellite tag, nesting female	2005	2012	Turtle Conservation Project (TCP)	Public	University of Peradeniya	T. Kapurusinghe, kjthushan@yahoo.com	L.Ekanayake lalitheml@yahoo.com
T4.3		Kosgoda beach, Kosgoda	In-situ nest protection programme	Flipper tag, satellite tag, nesting female	2003	2012	Turtle Conservation Project (TCP)	Public	University of Peradeniya	T. Kapurusinghe, kjthushan@yahoo.com	L.Ekanayake lalitheml@yahoo.com
T4.4		Rekawa beach, Tangalle	Nest protection programme	Nest protection	2012	ongoi ng	Department of Wildlife Conservation	Public		DG, DWC	P.A.C.N.B. Suraweera channasuraweera@yahoo.com
T4.5		Bundala	Nest protection programme	Nest protection	2014	ongoi ng	Department of Wildlife Conservation	Public		DG, DWC	P.A.C.N.B. Suraweera channasuraweera@yahoo.com
T4.6		Kumana	Nest protection programme	Nest protection	2013	ongoi ng	Department of Wildlife Conservation	Public		DG, DWC	P.A.C.N.B. Suraweera channasuraweera@yahoo.com

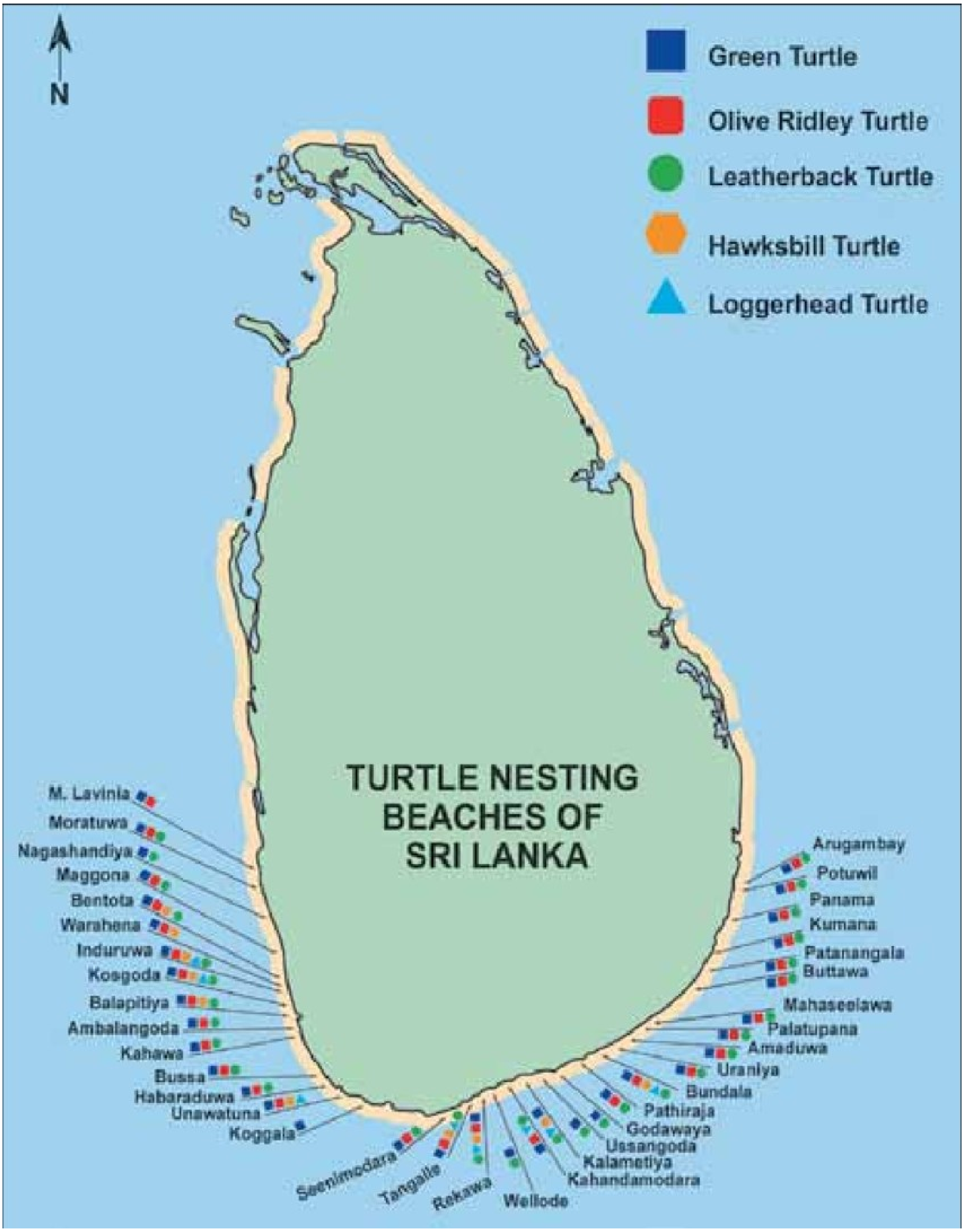

Figure 1 The nesting beaches of five sea turtle species in Sri Lanka

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SUDAN

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Introduction

Five species of sea turtle have been recorded in Sudan [11,12]. Hawksbill turtles (*Eretmochelys imbricata*) are the most common, followed by green turtles (*Chelonia mydas*), with both confirmed as nesting in the country; these two species are reported on below. Loggerhead turtles (*Caretta caretta*), leatherback turtles (*Dermochelys coriacea*) and olive ridley turtles (*Lepidochelys olivacea*) are identified from very infrequent records [1,12] and are not further discussed.

1 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

1.1 Distribution, abundance and trends

1.1.1 Nesting sites

The distribution and levels of hawksbill nesting in Sudan have not been reported for over 15 years ([12] Table 1) and require updating. Mukkawar (Mesgarsam) Is. appears to be the most important nesting location in the country [12,15] within the Mohammad Gol Dungonab Bay region; however, other important areas include several islands, most notably Seil Ada Kebir [2] and Suakin ([12], Table 2).

Nesting on Mukkawar Is. was estimated to be "several thousand nesting pits on an 8-10km stretch of shore" in 2002 [15], while 42 individual turtles were recorded to have nested on Seil Ada Kebir between 11–18 March in 1978 [2].

No nesting trends are available for the country and a comprehensive assessment of nesting sites is lacking (Table 1).

1.1.2 Marine areas

The greater area of Dungonab Bay has been identified as a sea turtle marine habitat, with hawksbills being particularly noticeable at the extreme northern end of the bay [15]. However, hawksbills are thought to forage at all fringing and barrier reefs [10].

1.2 Other biological data

The clutch size for hawksbills in Sudan averages upwards of 70 eggs ([2,12]; Table 1) with numerous additional yolkless "eggs" also deposited with the viable clutch. The straight carapace length (SCL) for nesting females in Sudan is at least 53.3 cm [2] but is more commonly at least 10 cm longer in other locations [2,12]. No other useful biological data for hawksbills in Sudan has been reported (Table 1).

1.3 Threats

1.3.1 Nesting sites

Threats to turtle nesting sites have not been quantified, but egg harvesting and consumptive exploitation of turtles have been reported (Table 1).

1.3.2 Marine areas

Bycatch is a documented threat to turtles in their marine habitats [10,12,13] as well as targeted take and habitat degradation (Table 1).

1.4 Conservation

Turtles are afforded nominal legal protection in Sudan under several international and national regulations (Table 3).

A marine park that encompasses the important known nesting and foraging sites for hawksbill turtles has been established [15]; however, no documented or known conservation programmes are currently running (Table 1).

1.5 Research

No current research is reported or known to be in progress (Table 1). Therefore, there is an urgent need for an update on the status of sea turtle populations and all aspects of turtle demography in Sudan.

2 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

There is very limited information on green turtle nesting in Sudan [11,12]. However, Mukkawar, Payer and Seil Ada Kebir Islands (Table 2) are known nesting grounds, with an estimate of no more than 50 nests annually ([11], Table 1).

2.1.2 Marine areas

The greater area of Dungonab Bay has been identified as a sea turtle marine habitat, with green turtles being widespread and seen across the region. However, particularly large numbers of green turtles were observed in the very extensive areas of the shallow reef flat and sand at the northern end of Kukkawar Is., at the extreme northern end of the bay [15].

2.2 Other biological data

No biological data on green turtles in Sudan has been reported (Table 1).

2.3 Threats

2.3.1 Nesting sites

See Section 1.3.1 and Table 1.

2.3.2 Marine areas

See Section 1.3.2 and Table 1.

2.4 Conservation

See Section 1.4.

2.5 Research

No current research is reported or known to be in progress (Table 1). There is an urgent need for an update on the status of sea turtle populations and all aspects of turtle demography in Sudan.

Table 1. Characteristics of nesting marine turtles in Sudan.

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Occurrence										
Nesting sites	U	11,12	Y	11,12	N	11,12	Y	2,3,11,12	N	11,12
Pelagic foraging grounds	n/a		n/a		Y	12	n/a		Y	1
Benthic foraging grounds	Y	12	Y	10,15	n/a		Y	4,5,10,15	n/a	
Key biological data										
Nests/yr: recent average (range of years)	n/a		n/a		n/a		n/a		n/a	
Nests/yr: recent order of magnitude	n/a		<50 (U)	11	n/a		300-350 (1960s-1970s)	3	n/a	
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		n/a		n/a		1	15	n/a	
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		n/a		n/a		1	2	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)	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	
Sex ratio: Hatchlings (F / Tot) (N)	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	
Sex ratio: Adults (F / Tot) (N)	n/a		n/a		n/a		n/a		n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Min adult size, CCL or SCL (cm)	n/a		n/a		n/a		53.3 SCL	2	n/a	n/a
Age at maturity (yrs)	n/a		n/a		n/a		n/a		n/a	n/a
Clutch size (n eggs) (N)	n/a		n/a		n/a		73.2 (26)	2	n/a	n/a
Emergence success (hatchlings/egg) (N)	n/a		n/a		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
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	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	N		N		N		N		N	
Foraging ecology (diet or isotopes)	N		N		N		N		N	
Capture-Mark-Recapture	N		N		N		N		N	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Threats										
Bycatch: presence of small scale / artisanal fisheries?	Y	10,12	Y	10,12	Y	10,12	Y	10,12	Y	10,12
Bycatch: presence of industrial fisheries?	Y	10,13	Y	10,13	Y	10,13	Y	10,13	Y	10,13
Bycatch: quantified?	N		N		N		N		N	
Take. Intentional killing or exploitation of turtles	n/a		Y	13,14	n/a		Y	2,6,7,8,13	n/a	
Take. Eggs (illegal)	n/a		Y	12,13	n/a		Y	2,12,13	n/a	
Coastal Development. Nesting habitat degradation	n/a		n/a		n/a		n/a		n/a	
Coastal Development. Photopollution	n/a		Y	10	n/a		Y	10	n/a	
Coastal Development. Boat strikes	n/a		n/a		n/a		n/a		n/a	
Egg predation	n/a		n/a		n/a		n/a		n/a	
Pollution (debris, chemical)	n/a		n/a		n/a		n/a		n/a	
Pathogens	n/a		n/a		n/a		n/a		n/a	
Climate change	n/a		n/a		n/a		n/a		n/a	
Foraging habitat degradation	Y	10	Y	10	n/a		Y	10	Y	10
Other	Y	10	Y	10	n/a		Y	10	Y	10
Long-term projects (>5yrs)										
Monitoring at nesting sites (period: range of years)	n/a		n/a		n/a		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)	n/a		n/a		n/a		n/a		n/a	

	Caretta caretta		*Chelonia mydas*		*Dermochelys coriacea*		*Eretmochelys imbricata*		*Lepidochelys olivacea*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**DC-U**	**Ref #**	**EI-NWIO**	**Ref #**	**LO-WIO**	**Ref #**
Conservation										
Protection under national law	Y	2	Y	2	Y	2	Y	2	Y	2
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	1	14	1	14	1	14	1	14	1	14
N of long-term conservation projects (period: range of years)	n/a		n/a		n/a		n/a		n/a	
In-situ nest protection (eg cages)	n/a		n/a		n/a		n/a		n/a	
Hatcheries	n/a		n/a		n/a		n/a		n/a	
Head-starting	n/a		n/a		n/a		n/a		n/a	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a		n/a		n/a	
Bycatch: onboard best practices	n/a		n/a		n/a		n/a		n/a	
Bycatch: spatio-temporal closures/reduction	n/a		n/a		n/a		n/a		n/a	
Other	n/a		n/a		n/a		n/a		n/a	

Table 2. Nesting beaches in Sudan.

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)
			Long	Lat					
EI-NWIO									
(Al-)Seil Ada Kebir / Seil Ada Kebir Is.	n/a	n/a	19.23333333 N	37.83333333 E	n/a	n/a	12	2	E
Hindi Gidir Is.	n/a	n/a	37.91258333 N	19.38194444 E	n/a	n/a	12	2	E
Mukkawar (Megarsam) Is.	n/a	n/a	37.28969444 N	20.95666667 E	n/a	n/a	12, 14	2	E
Masamirit Is.	n/a	n/a			n/a	n/a	12		
Payer Is.	n/a	n/a			n/a	n/a	12		
Arkyay	n/a	n/a			n/a	n/a	12		
CM NWIO									
Mukkawar (Megarsam) Is.	n/a	n/a			n/a	n/a	12, 14		
Payer Is.	n/a	n/a			n/a	n/a	12		
(Al-)Seil Ada Kebir / Seil Ada Kebir Is.	n/a	n/a	19.23333333 N	37.83333333 E	n/a	n/a	12		

Table 3. International conventions signed by Sudan in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Marine Fishery Administration Law for the Red Sea State	Y	n/a	n/a	All	n/a	Clause 29 prohibits the capture of sharks, turtles, dolphins and other endangered species
African Convention on the Conservation of Nature and Natural Resources	Y	n/a	n/a	All	n/a	Preservation of wildlife in its natural environment. Sea turtles in Annex A
CITES	Y	n/a	n/a	All	n/a	
CMS	Y	n/a	n/a	All	n/a	
CBD	Y	n/a	n/a	All	n/a	
RAMSAR	Y	n/a	n/a	All	n/a	
Jeddah	Y	n/a	n/a	All	n/a	Regional collaboration to protect the fragile Red Sea and Gulf of Aden ecosystems
UNCLOS	Y	n/a	n/a	All	n/a	
PERSGA	Y	n/a	n/a	All	n/a	
National Convention		n/a	n/a		n/a	
Wildlife and National Parks Protection Act (1986)		n/a	n/a	All	Implements CITES	

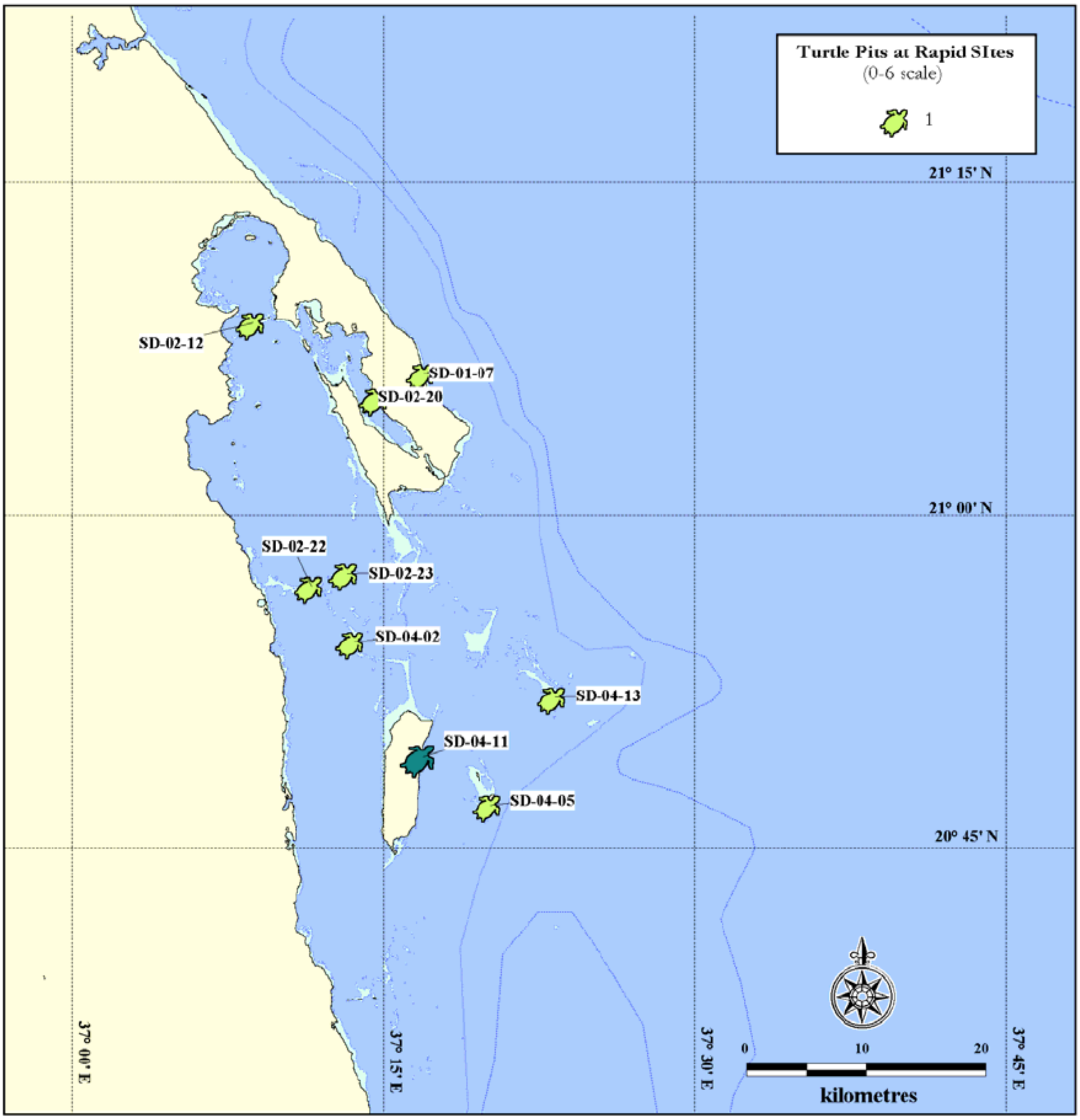

Figure 1. Location of Mukkawar Is. (dark green turtle icon), the main turtle nesting site in Sudan, and other nesting sites in the Dungonab Bay region, which comprises extensive marine habitats used by numerous turtles of several species (reproduced from reference [15]).

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1 RMU: *Chelonia mydas*, North-West Indian Ocean (CM-NWIO)

1.1 Distribution, abundance, trends

1.1.1 Nesting sites

There are only sporadic nesting events by green turtles in the United Arab Emirates [31,32].

1.1.2 Marine areas

There is noticable annual variation in abundance of marine turtles (15%) as assessed by aerial surveys, during which it is challenging to identify species. These aerial surveys only cover Abu Dhabi waters (Table 1; Figure 1). The Green Turtle Conservation Project 2016-2019 identified some of the key foraging grounds for adult turtles in Abu Dhabi, Ras Al Khaimah and Umm Al Quwain, while on-going surveys since 2017 along the East coast of Sharjah Emirate indicate primary development/feeding areas for juveniles in this area (Table 4; Figure 2 and 3 [22]).

1.2 Other biological data

Biological data on green turtles is not applicable as they do not nest in the UAE.

1.3 Threats

1.3.1 Nesting sites

Not applicable, as green turtles nest only sporadically in the UAE [31,32].

1.3.2 Marine areas

The UAE has a strong heritage of artisanal fisheries, with a fleet of dhows and tarads that use a range of fishing gear, of which gargoor, tidal nets and long lines are the most prevalent [25]. Gear and fishing practices have been found to have an associated risk of incidental capture through unsustainable fishing practices (Table 1;[28]). Demersal longlines are also a threat. Other threats to green turtles are boat strikes and marine pollution (Table 1; [12,21]).

1.4 Conservation

Marine turtles in the UAE are protected under national law and several international agreements (Table 3). The conservation efforts in the UAE are on-going (Table 1; [1,2,4,10,24,25]).

1.5 Research

Adult female and male green turtles (n=45) at foraging grounds were tracked in the United Arab Emirates under the Emirates Nature-WWF Green Turtle Conservation Project 2016-2019 (Table 4; Figure 2-4). At least seven turtles were recorded moving from their feeding grounds in the UAE to Ras al Had Reserve in Oman, which is one of the largest nesting areas for the species in the region. The results demonstrate connectivity and confirm the importance of the nesting site in Oman for turtles foraging in the UAE, as well as regionally within the NWIO. Turtles generally stayed 20km off the coast in waters 10-20m deep during migration. The study showed that the Marawah marine protected area in Abu Dhabi is broadly coincident with the foraging areas of turtles (with 84.4% of location fixes located within Marawah), and that foraging sites in Ras Al Khaimah and Umm Al Quwain would need further consideration in support of effective conservation strategies of the population [33]. In addition, age-class and gender composition at feeding grounds obtained through laparoscopy is reported for first time for the UAE [34].

The long-term monitoring programme of marine turtles' foraging areas in Abu Dhabi is still ongoing and includes green and hawksbill turtles. A recently established monitoring programme on the east coast of Sharjah is studying green juvenile habitat utilization and migration behaviour through satellite tagging. Finally, additional baseline research is being generated to provide insights on the impact of marine debris, chemical pollution and common fishing practices on green turtles in the east coast of Sharjah based on stranding data. (Table 4).

2 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

2.1 Distribution, abundance, trends

2.1.1 Nesting sites

The United Arab Emirates has 16 nesting sites for hawksbill turtes (Table 1; Figure 5; [1, 4, 6, 21]) with a stable trend at nesting sites with slight variation (Table 1; [1,2,4,6,23,24]). Further descriptions on nesting areas is available in Table 2.

2.1.2 Marine areas

See details about aerial surveys in 1.1.2. The Marine Turtle Conservation Project identified foraging grounds as Important Turtle Areas (ITAs) particularly in the SW Gulf waters (Abu Dhabi and areas across Saudi Arabia, Qatar). Groundtruthing studies revealed that these discrete and isolated foraging grounds within the Gulf were characterised by hard substrate occupied by coral colonies and reef associated invertebrates (Figure 6-8).

2.2 Other biological data

Biological data on the hawksbill turtles is presented in Table 1. The three numbers presented under nests per year is due to lack of some data from the other Emirates. The combined total number of nests per year for the UAE is 197.3 (2019). However, 2017 data from Jebel Ali is unavailable and long-term data (2001-2018) is only from Abu Dhabi which averages to 152.6 nests per year. The number of nests per year ranges from is 3-260 nests dependent on location (Table 1; [1,3,4,5,6,14,18,23,24,29,30]).

2.3 Threats

2.3.1 Nesting sites

Hawksbill turtles face nesting habitat degradation due to coastal development, climate change, and sporadic illegal take, the latter only occurring in Umm Al Quwain emirate (Table 1; [4,5,7,8,10,15,17,18,28]).

2.3.2 Marine areas

Similar to green turtles, see section 1.3.1 and Table 1.

2.4 Conservation

See 1.4.

2.5 Research

Important Turtle Areas (ITAs) at sea have been identified for this species based on post-nesting tracking information from 75 hawksbill turtles tagged in the UAE, Oman, Iran and Qatar under the Marine Turtle Conservation Project (Table 4).[14]. Foraging habitats were found to be dispersed but primarily located in the SW Gulf where habitat protection could be linked to preservation of shallow water habitats and fishery management. The study also showed that turtles spent an average of 20% of time undertaking summer migration loops, a thermoregulatory response to avoid elevated sea surface temperatures in the Gulf [15].

Table 1. Characteristics of nesting marine turtles in the United Arab Emirates.

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence				
Nesting sites	N		Y	1,4,6,21
Pelagic foraging grounds	N		N	
Benthic foraging grounds	Y	12	Y	7,14,17
Key biological data				
Nests/yr: recent average (range of years)	n/a		152.6 (2001-2018) 407 (2017) 197.3 (2019)	1,4,18,24,29,30
Nests/yr: recent order of magnitude	n/a		3-500	1,3,8,
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a		5	1,4,18
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a		11	1,4
Total length of nesting sites (km)	n/a		20.11	1,4,5,6
Nesting females / yr	n/a		277.7	14
Nests / female season (N)	n/a		1.8 (N=47)	4,5,6
Female remigration interval (yrs) (N)	n/a		N	
Sex ratio: Hatchlings (F / Tot) (N)	n/a		N	
Sex ratio: Immatures (F / Tot) (N)	n/a		N	
Sex ratio: Adults (F / Tot) (N)	n/a		N	
Min adult size, CCL or SCL (cm)	N		CCL (cm): 65	1
Age at maturity (yrs)	N		N	
Clutch size (n eggs) (N)	n/a		58.6 (N=42), 95.7 (N=58)	
Emergence success (hatchlings/egg) (N)	n/a		58.3% (N=69)	1
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		60.2% (N=2,318)	31
Trends				
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a		Variable/stable (2001-2018)	1,2,4,6,23,24
Recent trends (last 20 yrs) at foraging grounds (range of years)	Stable (2004-2018)	17,20	Stable (2004-2018)	17,20

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Oldest documented abundance: nests/yr (range of years)	n/a		149 (2001)	1
Published studies				
Growth rates	N		N	
Genetics	N		Y	9
Stocks defined by genetic markers	N		Y	9
Remote tracking (satellite or other)	Y	27	Y	14,15
Survival rates	N		N	
Population dynamics	N		N	
Foraging ecology (diet or isotopes)	N		Y	14,15
Capture-Mark-Recapture	N		N	
Threats				
Bycatch: presence of small scale / artisanal fisheries?	Y (DLL)	28	Y (DLL)	4,8,10
Bycatch: presence of industrial fisheries?	N		N	
Bycatch: quantified?	N		N	
Take. Intentional killing or exploitation of turtles	N		N	
Take. Eggs (illegal)	N		Y	28
Coastal Development. Nesting habitat degradation	n/a		Y	4,5,7,8,10
Coastal Development. Photopollution	n/a		N	
Coastal Development. Boat strikes	Y	12,28	Y	4,5,7,8
Egg predation	n/a		N	
Pollution (debris, chemical)	Y	21	N	
Pathogens	n/a		n/a	
Climate change	N		Y	10, 15, 17, 18
Foraging habitat degradation	N		Y	14
Other:	N		N	

	Chelonia mydas		*Eretmochelys imbricata*	
RMU	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Long-term projects (>5yrs)				
Monitoring at nesting sites (period: range of years)	n/a		Y (1999-ongoing)	1,2,4,17,20
Number of index nesting sites	n/a		14 (2004-ongoing)	1,2,4
Monitoring at foraging sites (period: range of years)	Y (2004-ongoing)	2,4,17,20	Y (2004-ongoing)	1,2,4,17,20
Conservation				
Protection under national law	Y	1,2,10,25	Y	1,2,10,25
Number of protected nesting sites (habitat preservation) (% nests)	n/a		7 (43%)	25
Number of Marine Areas with mitigation of threats	2	24	2	24
N of long-term conservation projects (period: range of years)	1 (1999-ongoing)	2,4,24	2 (1999-ongoing; 2014-ongoing)	2,4,18,24
In-situ nest protection (eg cages)	N		N	
Hatcheries	N		N	
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	N		N	

Table 2. Nesting beaches in the United Arab Emirates.

RMU / 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	Ref. #
				Long	Lat						
EI-NWIO											
Abu Al Abyad	Y	6 (2001-2014)	n/a	24.201034	53.799258	106.48	100	Google Map	1	B	SWOT
Al Yasat (North & South)	Y	16 (2001-2012)	n/a	24.204829	51.998132	22.73	100	Google Map	1	B	SWOT
Arzanah	Y	14 (2001-2019)	n/a	24.788636	52.561388	1.54	100	Google Map	1	B	SWOT
Bu Tinah	Y	11 (2001-2019)	n/a	24.629578	53.049333	0.6	100	Google Map	1	B	SWOT
Dieynah	Y	23 (2001-2019)	n/a	24.956312	52.398422	1.77	100	Google Map	1	B	SWOT
Ghantoot: Abu Dhabi	Y	3 (2001-2012)	n/a	24.910976	54.890631	9.03	ND	Google Map	1	B	SWOT
Ghasha	Y	8 (2001-2013)	n/a	24.414237	52.650206	3.54	100	Google Map	1	B	SWOT
Jananah	Y	4 (2001-2012)	n/a	24.208259	53.406472	13.42	100	Google Map	1	B	SWOT
Muhayimat (North & South)	Y	8 (2001-2012)	n/a	24.501138	51.727785	7.45	100	Google Map	1	B	SWOT
Qarnen	Y	40 (2001-2019)	n/a	24.93468	52.852006	1.28	100	Google Map	1	B	SWOT
Saadiyat	Y	5 (2001-2019)	n/a	24.551457	54.439667	9.87	100	Google Map	1	B	SWOT

Um Al Kurkum	Y	4 (2001-2012)	n/a	24.392111	52.764922	6.07	100	Google Map	1	B	SWOT
Um Al Hattab	Y	6 (2001-2012)	n/a	24.215793	51.863835	2.84	100	Google Map	1	B	SWOT
Zirku	Y	65 (2001-2011)	n/a	24.881718	53.072809	3.39	100	Google Map	1	B	SWOT
Sir Bu Nair	Y	260 nests (2017)	n/a	25.235076	54.218633	16	100	Google Map	2	u/k	SWOT
Ghantoot: Dubai	Y	44 nests (2018)	n/a	24.95167	54.94858	7.02	100	Google Map	2	u/k	SWOT

*Monthly fieldwork comprising periods of ca.8 d were undertaken between May and August. Patrols were undertaken at hourly intervals between dusk and dawn on Qaru. Track surveys were undertaken on UAM at least once per field period to look for green turtle emergences. In 2012, the islands were surveyed once near the end of the nesting season (August) to confirm levels of green turtle nesting for that season. Environmental conditions in the area, calm weather, and limited trampling of the beach were such that evidence of nesting from the entire season was still easily discernible (Papathanasopoulou Pers.Obs).

Table 3. International conventions signed by the United Arab Emirates in relation to marine turtle conservation.

International Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles
Convention Convention of International Trade in Endangered Species in Wild Fauna and Flora (CITES)	Y	Y	Y	All	Trade regulations through CITES management and authorities	Linked also to national regulation of banning of turtle hunting
Convention of Biological Biodiversity (CBD)	Y	Y	Y	All	National strategic plan for biodiversity	Turtles and habitats are mentioned is several section. The Nagoya protocol under CBD applies to import/export of All speciments of wildlife including turtles
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Y	Y	Y	All	CMS office hosted in Abu Dhabi actions under IOSEA MoU	Protection of Specific Turtles habitats e.g. Sir Bu Nair and Marawah biophere reserve
Memorandum of Understanding on the conservation and management of marine turtles and their habitats (IOSEA)	Y	N	Y	All	IOSEA site network, two sites designated, national reports to secretariat and has published the National Plan of Action for the Conservation of Marine Turtles (2019-2021)	Protection of habitats, scientific research, awareness, international recognition
Convention on weatlands of international importance (Ramsar)	Y	N	Y	All	Critical habitats for turtles including in current Ramsar designated sites such as Sir Bu nair and Ghantoot	Critical habitats for turtles are included as criteras for Ramsar sites
Memorandum of Understanding on the Conservation and Management of Dugongs (*Dugong dugon*) and their Habitats throughout their Range	Y	N	Y	Dugong	All actions suggested under the MoU	There is a synergy between sea turtle habitats and dugong foraging area.

Table 4. Marine turtle projects and databases in the United Arab Emirates.

#	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	EI-NWIO	UAE	Arabian Region	Marine turtle conservation project/hawksbill turtles in the arabian region	Satellite tracking, Argos, Oman, UAE, Iran , Qatar, North western Indian Ocean, foraging Areas	2010	2014	Emirates Nature - WWF	NGO	Environment Agency Abu Dhabi, Environment Protection Areas Authority Sharjah, Qatar University, Department of the Environment Deputy for national environment biodiversity and wildlife Boureau, Ras lafan industural city, Ministry of Environment and Climate Affairs Oman, Ministry environment Qatar, Environmnet Society Oman, Marine Research Foundation, EMEG, Five Oceans	www.emiratesnaturewwf.ae	n/a	Marina Antonopoulo (mantonopoulou@enwwf.ae)	Nicholas Pilcher (npilcher@mrf-asia.org)
T4. 2	CM-NWIO	UAE	Arabian Region	Gulf Green Conservation Project	Satellite Tracking, Argos, Population genetic structure, Oman, UAE,North Western Indian Ocean,	2016	2019	Emirates Nature - WWF	NGO	Environment Agency abu Dhabi, Environment, Environmental Protection and development Authority ras Al Khaimah, UAE Ministry of Climate Change and Environment, Five Oceans, Ministry of Environment,	www.emiratesnaturewwf.ae	n/a	Marina Antonopoulo (mantonopoulou@enwwf.ae)	Nicholas Pilcher (npilcher@mrf-asia.org)

					Foraging Areas					Climate change and International Affairs Oman, Environmnet Society Oman, Marine Research Foundation, Five Oceans				
T4. 3	EI- NWIO	UAE	Arabian Region	Monitoring of Marine Endangered Species	Monitoring, Dugong, Dolphin, Sea Turtle, Hawksbill, Nesting	2000	Ongoing	Environment Agency - Abu Dhabi	Public	Al Nowair Initiative, Wataniya Telecom, Kuwait Coast Guard	www.ead.gov.ae	Government of Abu Dhabi	Himansu Sekhar Das (hsdas@ead.gov.ae)	Hind Al Ameri (hind.alameri@ead.gov.ae)
T4. 4	CM-NWIO	UAE	Arabian Region	Monitoring of Marine Endangered Species	Monitoring, Dugong, Dolphin, Sea Turtle, Hawksbill, Nesting	2004	Ongoing	Environment Agency - Abu Dhabi	Public	Emirates Nature - WWF	www.ead.gov.ae	Government of Abu Dhabi	Himansu Sekhar Das (hsdas@ead.gov.ae)	Hind Al Ameri (hind.alameri@ead.gov.ae)
T4. 5	CM-NWIO	UAE	Arabian Region	Monitoring of Juvenile green turtles in Khor Kalba	Satellite Tracking, Argos, habitat utilisation, migration, UAE,North Western Indian Ocean, Foraging Areas	2018	Ongoing	Environment and Protected Areas Authority Sharjah	Public		www.epaashj.ae	Government of Sharjah	Jimena Rodriguez (jimenamanta@gmail.com)	Brendan Jones (brendan.jones@epaa.shj.ae)
T4. 6	CM-NWIO	UAE	Arabian Region	Monitoring of threats to sea turtles & strandings	Monitoring, Sea turtle, Threats, Mortality, UAE,North Western Indian Ocean, Foraging Areas	2016	Ongoing	Environment and Protected Areas Authority Sharjah	Public	AUS University	www.epaashj.ae	Government of Sharjah	Fadi Yaghmour (fadi.mohd@epaa.shj.ae)	Jimena Rodriguez (jimenamanta@gmail.com)

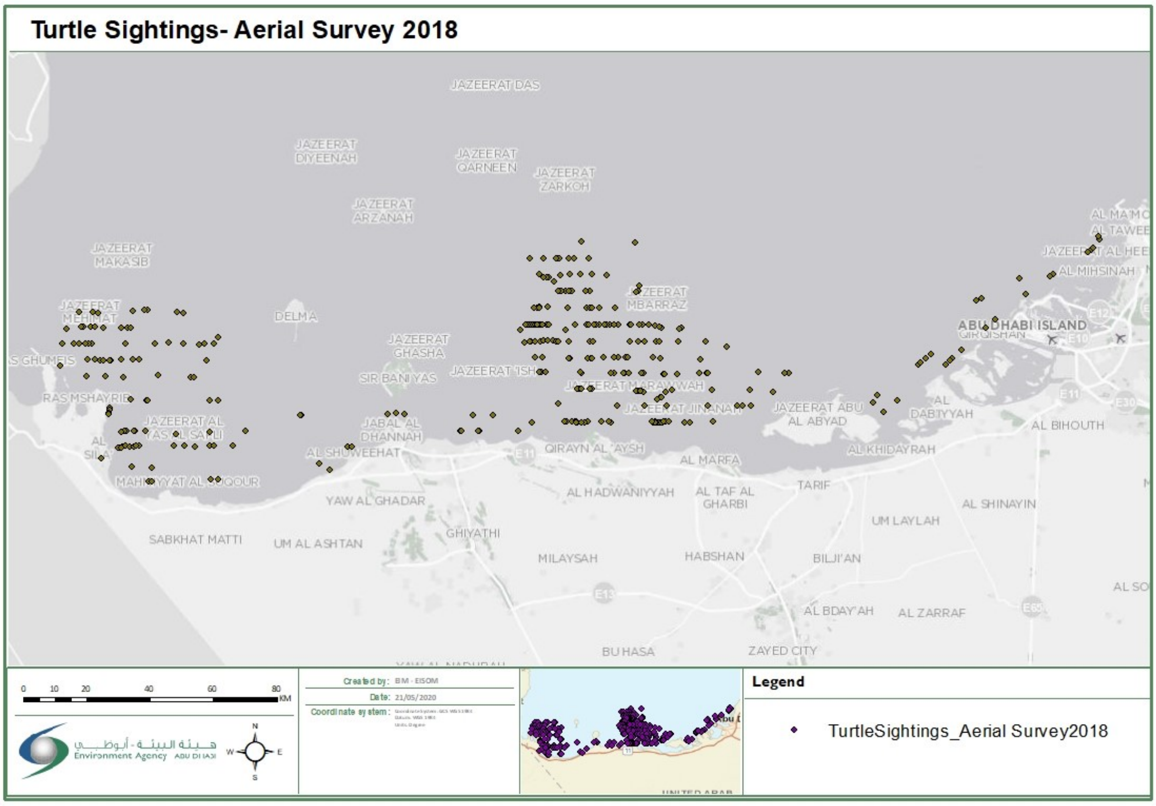

Figure 1. Sightings of green and hawksbill marine turtles in Abu Dhabi, United Arab Emirates

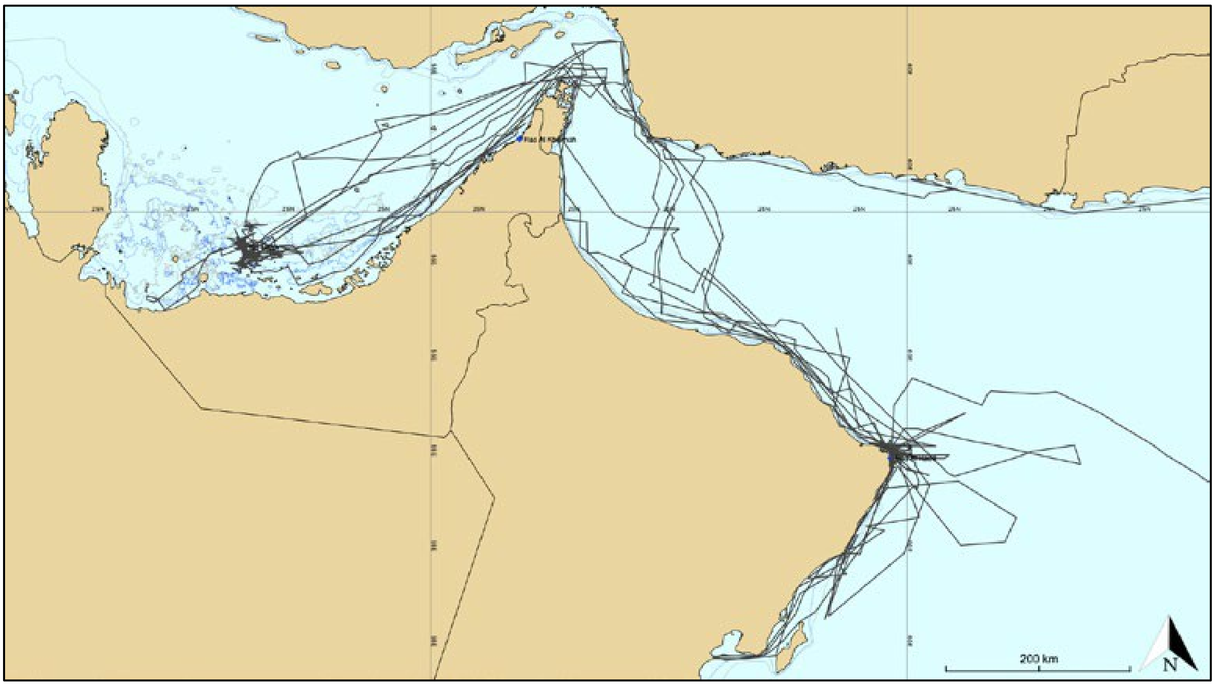

Figure 2. Migration of post-nesting green turtles

Migration tracks for six turtles deployed from Bu Tinah in 2018 that nested in Oman, demonstrating connectivity links between foraging areas in UAE and the nesting site of Ras AL Hadd in Oman [22].

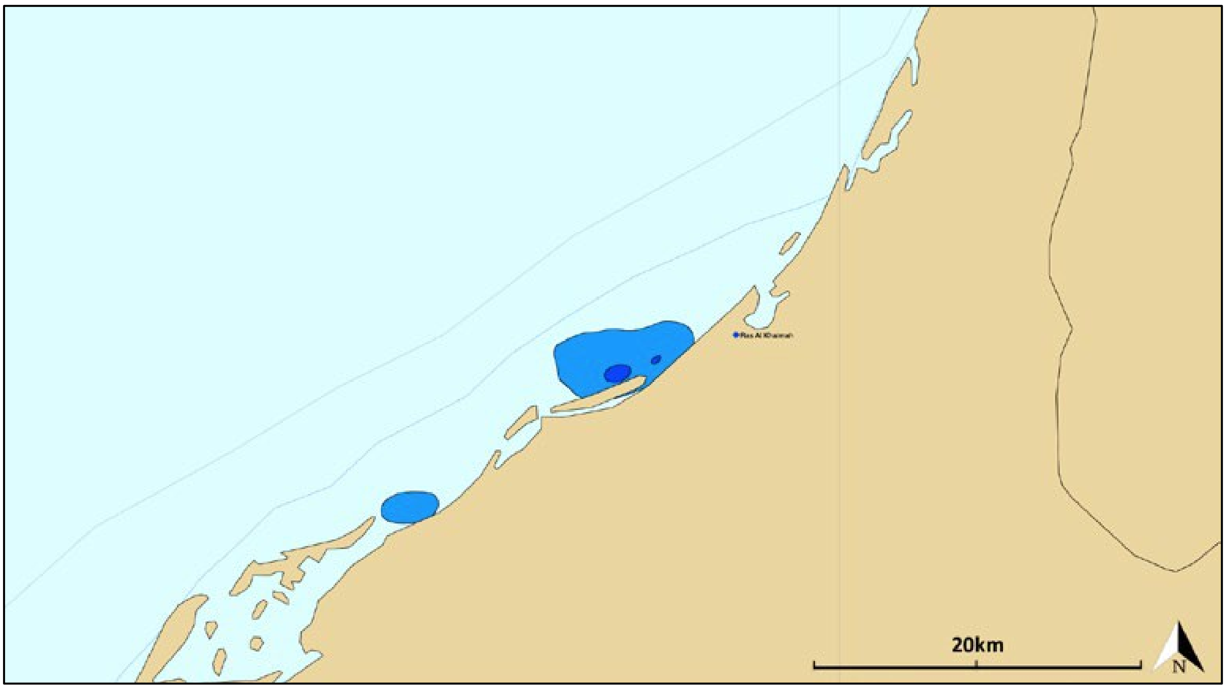

Figure 3. Location of foraging grounds of green turtles.

Locations of foraging grounds off Ras Al Khaimah and Umm Al Quwain: 90% home range (50.1 km^2) and 30% core habitat (1.84 km^2; [22])

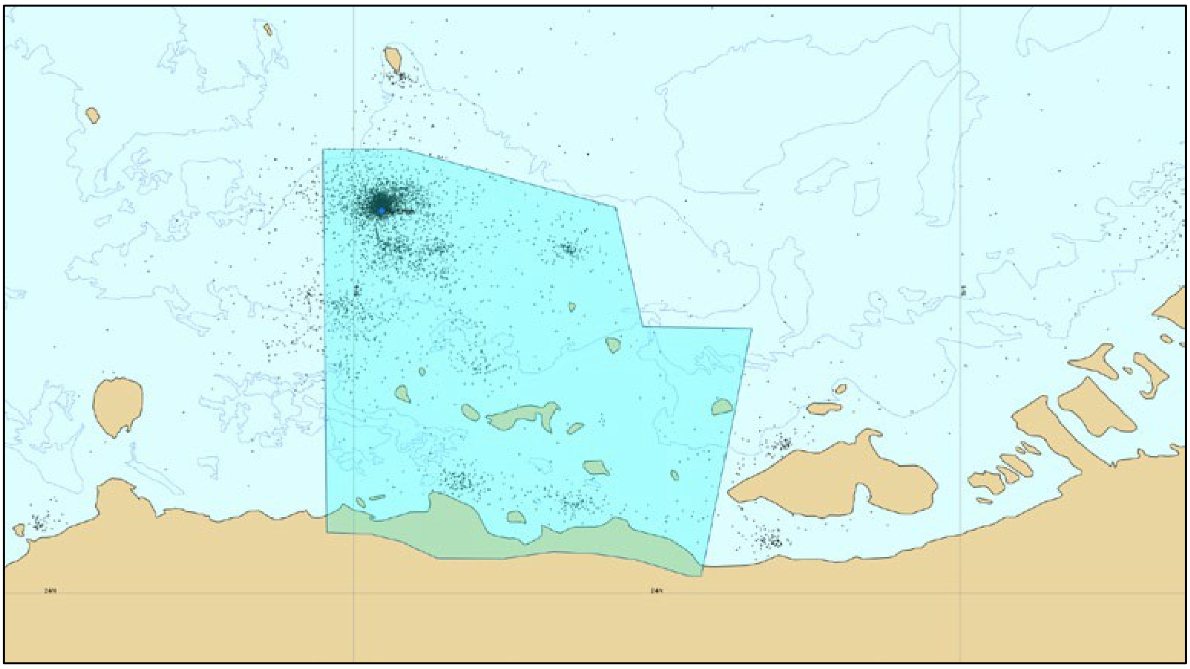

Figure 4. Location of green turtles in a protected area

Location markers for turtles in the vicinity of Marawah Marine Biosphere Reserve between 2016 and 2019. Light blue shape depicts the Reserve and the dense accumulation of points is close to Bu Tinah [22].

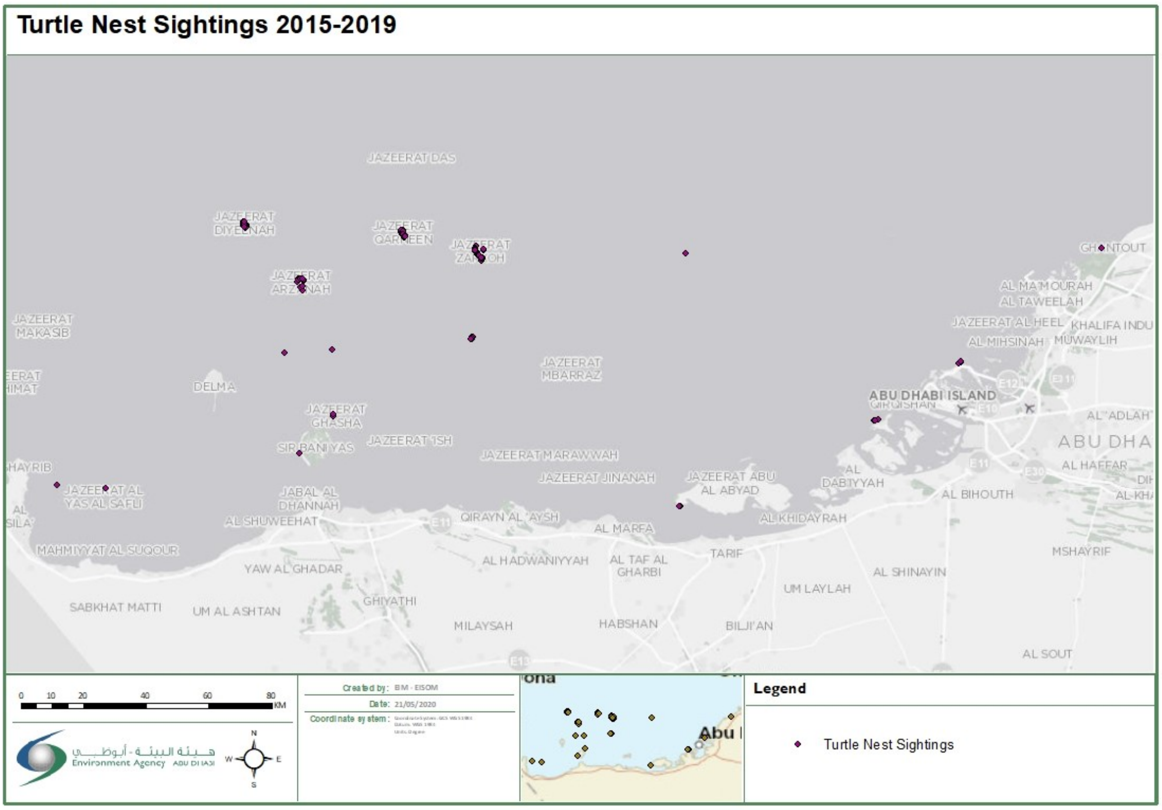

Figure 5. Nesting areas in Abu Dhabi, United Arab Emirates.

Hawksbill nesting occurs mostly at offshore islands in Abu Dhabi, particularaliy in Al Dhafra Region. Green turtles only nest sporadically in the UAE.

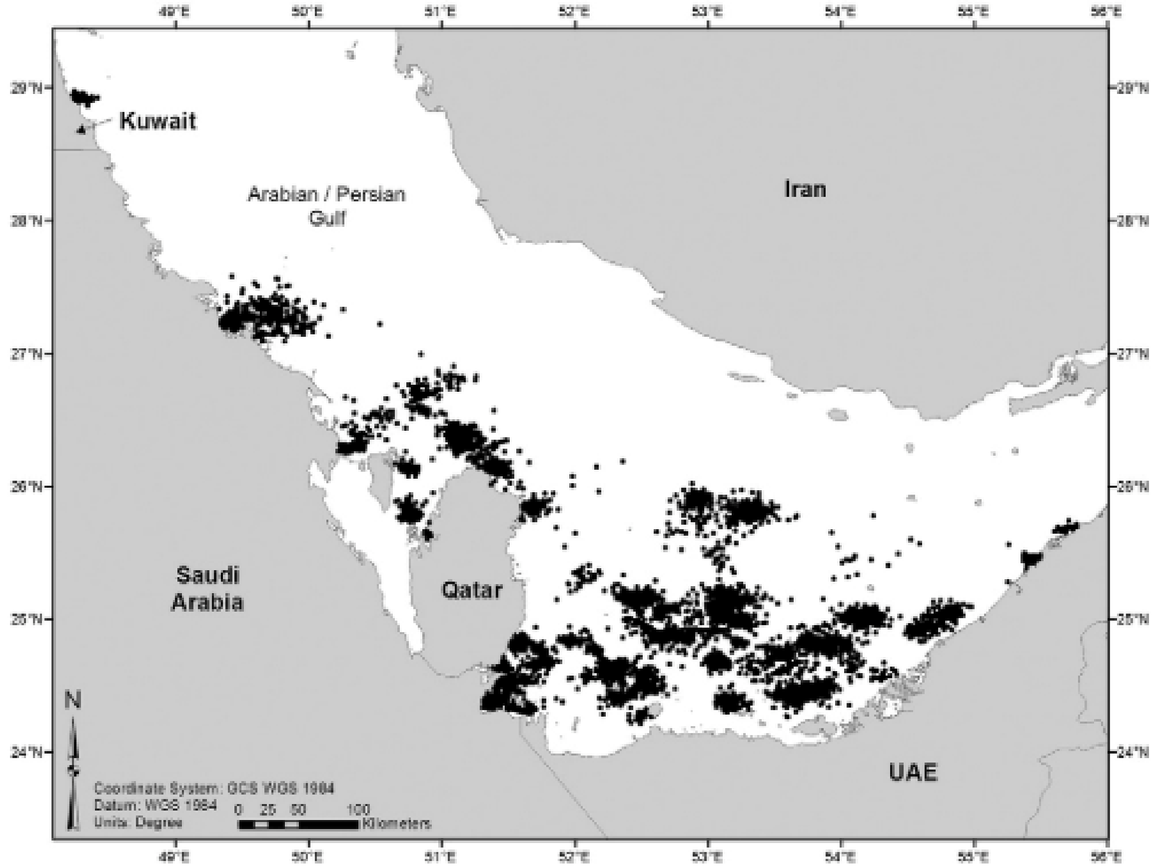

Figure 6. Foraging grounds of hawksbill turtles.

Locations of individual hawksbill turtle foraging grounds in the Gulf depicting a concentration of foraging grounds in waters off Abu Dhabi and southern Qatar, with only a few foraging sites north off Kuwait, Saudi Arabia and Bahrain [14].

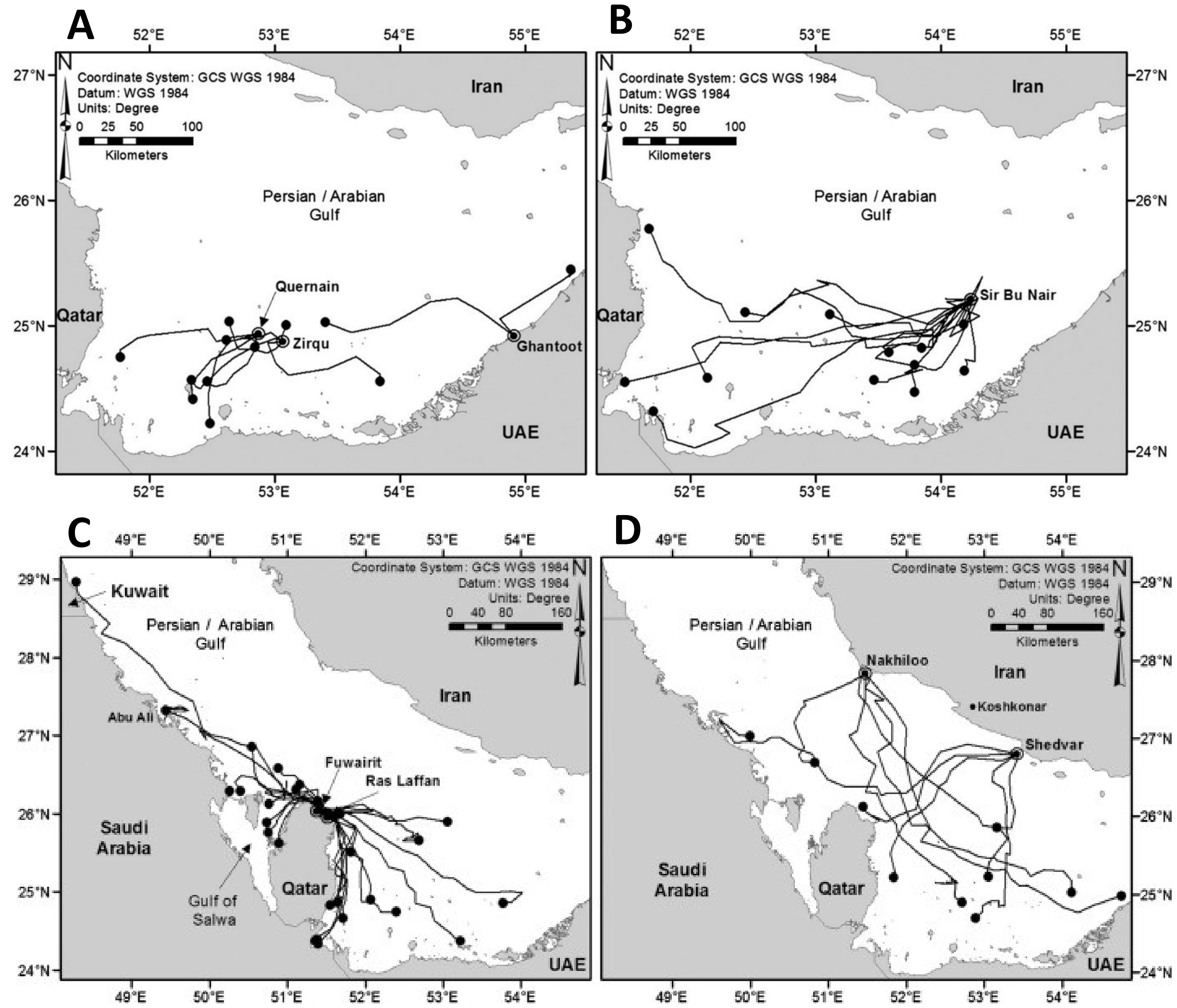

Figure 7. Post-nesting migrations of hawksbill turtles

Trajectories of post-nesting migrations until commencement of foraging activities (black circles) as turtles departed from (a) Quernain, Zirqu and Ghantoot (left), (b) Sir Bu Nair (right), demonstrating a pattern of post nesting migration towards the SW Gulf for turtles nesting in the UAE, (c) from Ras Laffan and Fuwairit in Qatar (left) and (d) along with trajectories from Nakhiloo and Shedvar in Iran (right). This shows that waters within Abu Dhabi and the UAE are of importance for nesting population elsewhere in the region [14].

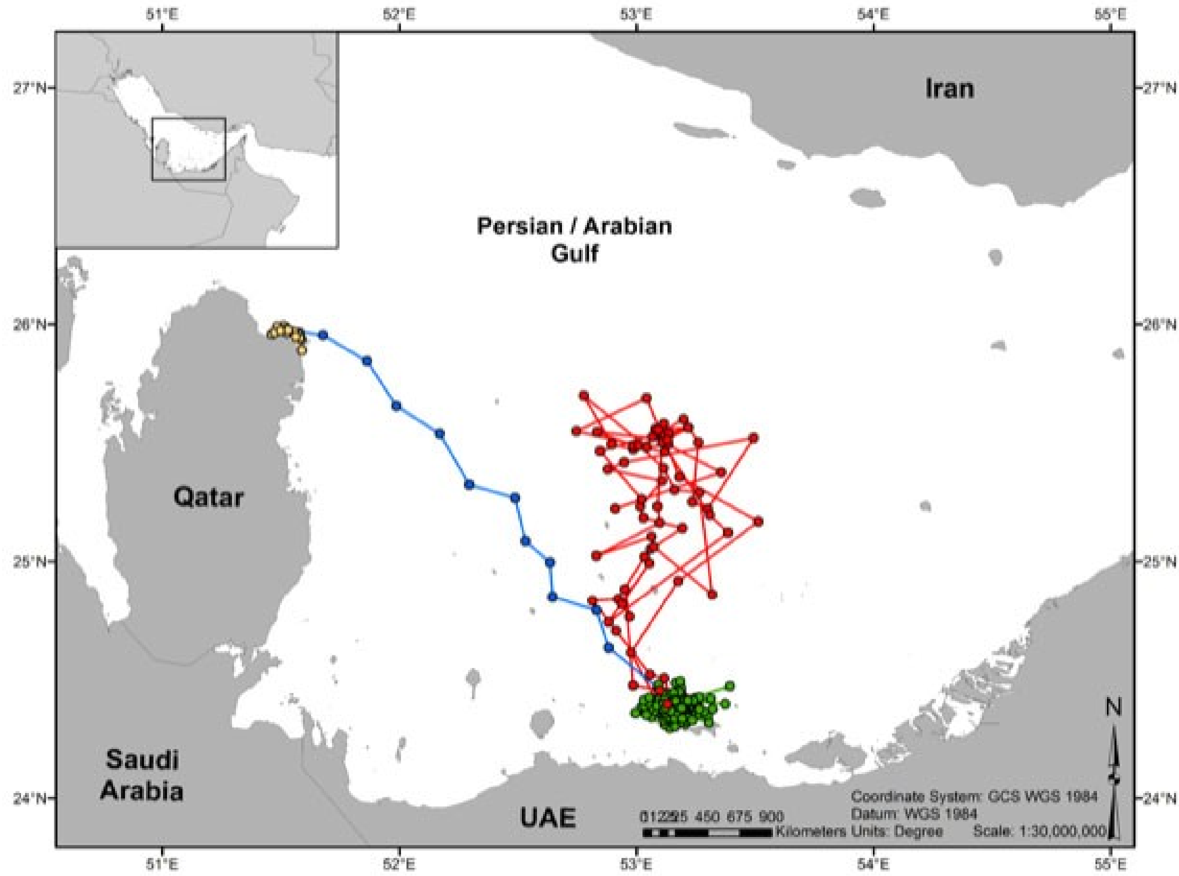

Figure 8. Summer migration loop of hawksbill turtles

Typical migration loop track of a hawksbill turtle that nested in Qatar. Yellow fixes depict internesting movements. Blue track and fixes depict the migration from nesting habitat in Qatar to foraging habitat in the UAE. Red track and location fixes depict the movements away from and returning to the original foraging ground respectively. Green fixes depict movements within the foraging ground [14].

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YEMEN

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1 RMU: *Caretta caretta*, North-West Indian Ocean (CC-NWIO)

1.1 Distribution, abundance, trends

The distribution, abundance, trends, and status of loggerhead turtle (*Caretta caretta*) populations in Yemen are not completely known (Table 1) [3,50,54,65].

1.1.1 Nesting sites

Loggerhead turtles nest in large numbers on Socotra Is. [3] and infrequently on the coast at Sharma – Jethmoon – Dhargham (Figure 1) [22, 28]**.** Nesting has not been reported within the Yemeni portion of the Red Sea [54].

1.1.2 Marine areas

Loggerhead turtles forage for mollusks and crustaceans in bays and estuaries that host their prey [7,50,52]. They use many of the shallow bays and estuaries along the mainland coast of Yemen and coastal areas around the islands as foraging and residence areas [61,62]. Several post-nesting loggerhead turtles migrated from Masirah Is., Oman, to near- and off- shore areas in Yemen [61]. In addition, a few satellite-tagged sub-adult loggerhead turtles released after being captured in fisheries operations near Reunion Is. migrated to the southwestern coast of Yemen [62]. These results indicate a region-wide linking among habitats used by the loggerhead turtles found in Yemen. Satellite tracking of post-nesting loggerhead turtles that nested on Socotra Is. and the mainland coast would fill in important information on habitat use within the region.

1.2 Other biological data

Although some data exist [7,12,53] (Table 2, 5), basic morphometrics for the several nesting aggregations need to be collected along with samples for analysis of genetic affiliations among the nesting groups within the region and beyond. In addition, the information needs to be published so that a better definition of the status of the population can be made. Although assessment of the loggerhead turtles that nest at Socota has been made in recent years (Table 6) [54], the basic biological information has not been published which means that biological data for the population must rely on older summaries [7,12,53].

1.3 Threats

PERSGA/GEF [24] identified nine major issues that are impacting marine turtles and their habitat in the Red Sea: Habitat Destruction, Industrial Activities, Oil and other Hydrocarbons, Maritime Transport, Fisheries, Recreational Activities, Domestic Sewage Pollution, Coral Bleaching, and Desalination [60]. The importance of each of these issues requires evaluation by each country in the region. As part of its evaluation of the importance of these factors, Yemen listed artisanal fishing as a 'moderate' threat and the others as 'small'. Given that more than a decade has passed since the evaluation, the process of defining threats and determining their importance should be re-evaluated. Many of the threats identified to impact marine turtles elsewhere in the world (e.g., various fishing activities, coastal development [12,46,47,48]) are likely to be operating in Yemen, albeit at unquantified levels (Table 1).

1.3.1 Nesting sites

The list of threats to marine turtles while on the nesting beach includes: uncontrolled tourism, use for food (both turtles and their eggs), as well as depredation by ghost crabs, dogs and foxes, and birds, [22, 54] albeit at a "low level" [57]. The people of Socotra consume both turtle meat and eggs which are sold in the market in Hadibo [24,38]. Also, development of coastal urban centers and industry, as well as other activities, pose threats to nesting areas [8].

This suggests that the threats to the nesting areas and the populations are likely to be acting over extended periods of time and that the impact may not be apparent unless long term monitoring data are available for comparison.

1.3.2 Marine areas

There is little specific information about the threats to loggerhead turtles at sea in Yemen. However, there are clear threats to marine turtles from artisanal and commercial fisheries [42,43,44]. The primary threat of marine turtles in Yemen is the Red Sea trawl fishery and the pelagic fishery in the Gulf of Aden [26]. The Red Sea trawl areas cover about 6,200 km^2, including a 550 km^2 shrimp fishery areas [30]. Fishing and turtle habitat (nesting, inter-nesting and some foraging) coincide around Socotra and along both the eastern Gulf of Aden mainland shore and the southern Red Sea coast [37]. Given the variety of fishing methods and gear used [37] turtle bycatch needs to be evaluated to determine the impact.

A review of fishery management in Yemen identified "weak enforcement and low compliance and the widespread illegal, unreported, and unregulated fishing" [2] as major issues that need to be addressed to aid management of the fishing industry [2,45,58]. These comments are relevant to turtle management. Additional threats to marine turtles at sea and in their foraging habitats come from the discharge of wastes and dirty ballast water, particularly in the narrow Strait of Bab al-Mandab at the mouth of the Red Sea [8,27]. The projected change in climate is likely to negatively impact coastal Yemen, including existing infrastructure around harbors and, by inference along the coastal margin where marine turtles nest [1].

1.4 Conservation

The Republic of Yemen is a party to several international conventions, agreements and treaties [16,36,37] including ones that were signed before the unification decree that brought together the People's Democratic Republic of Yemen and the Yemen Arab Republic to form the Republic of Yemen in 1990 (Table 3). For example, Yemen is party to Convention on Biological Diversity, the United Nations Convention on the Law of the Sea, and the United Nations Framework Convention on Climate Change. Recently, Yemen became part of the Convention on International Trade in Endangered Species of wild animals (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Also, Yemen is a party to the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (PERSGA). In addition, Yemen has developed a number of national instruments that deal directly or indirectly with the conservation of marine turtles and the regulation of threatening processes [16,35].

Yemen has only two protected areas (Table 7). The Socotra archipelago that includes the main island of Socotra (12°30'N 54°00'E), Abd al-Khuri, Samha and Darsa islands, as well as Kal-faraon and Sabouniya Islets was declared in 1996. The Ras Isa / Kamaran Is. area was declared in 2009. In addition, there are other areas that have been proposed for protection [24,26].

1.5 Research

At present there is scant information concerning research and conservation groups or their activities in Yemen (Table 4). Research on the biology, ecology, and threats to marine turtles in Yemen needs up-dating. The populations of all species of sea turtles living and breeding in Yemen need to be assessed for their current distribution (nesting and foraging), basic biological characteristics (i.e., adult length and weight, number of eggs, duration of incubation, emergence success, size of hatchlings), as well as their genetic affiliations with other groups in the western Indian Ocean. In addition, long term studies should be initiated to determine growth, movement patterns, and habitat utilisation.

The majority of the scientific work that underpins the current management decision-making is more than a decade old, in many cases the data are two or more decades old. The older data are important because they provide a base-line definition of the status of the species against which current data can be compared. However, it is essential to collect information on the current situation of marine turtles so that conservation management decisions can be made using standardized methods [34] and current data. The majority of recent publications review the older information without adding substantially to the database. It follows that any unpublished information that would help define the current populations should be published as a matter of urgency.

2 RMU: *Chelonia mydas,* North-West Indian Ocean (CM-NWIO)

2.1 Distribution, abundance, trends

The distribution, abundance, trends, and status of Green turtle (*Chelonia mydas*) populations in Yemen are not completely known (Table 1).

2.1.1 Nesting sites

Green turtles (*Chelonia mydas*) nest on mainland beaches, with the most dense nesting occurring along the Sharmah, Jethmoon, and Dhargham coasts, and in low density on the many islands in the Red Sea and in the Socotra Archipelago (Figure 1) [17,21,22,24,59]. The coastal sites of Sharma and Jathmun form a series of beaches (approx. 50km long) broken into sections by rocky headlands. The combined beaches host approximately 1,000 nesting turtles annually [9,19]. Ras Sharma beach appears to be one of the most important nesting areas for the green turtle in the western Arabian Region, including the Red Sea and Gulf of Aden [21]. Other sites include Khor Umaira, Ras Imran, and near Mukalla Sharma [8].

Green turtle mating, as evidenced by the marks made by male claws on the carapaces of nesting females, occurs in June and July with less mating at other times of the year [22]. Marine turtles nest throughout the year, the peak-nesting season is between July and September [21]. Hatchlings were most commonly encountered between October and November [22].

2.1.2 Marine areas

Intertidal and subtidal seagrass beds of the Red Sea [56] and Gulf of Aden are important feeding areas for green turtles [10, 15, 20]. For example, the Al-Luhayah area (30,000 ha) that extends from Midi near the Saudi border to Al-Luhayah (approx. 90 km) contains mangroves, several seagrass beds, sand bars, and mudflats [9]. The area provides habitat for green turtles, dugong (*Dugon dugon*) and waterfowl [9]. Other shallow coastal and reefal areas that host seagrass and algae are probably utilized at some level by foraging green turtles. In addition, Yemen's Red Sea and Gulf of Aden near-shore area is used as a migration corridor by green turtles nesting on Masirah Is. [63]. This movement combined with the movement associated with the coastal nesting within Yemen indicates a region of complex movements by many turtles.

2.2 Other biological data

Basic morphometric data available is 20 or more years old. Current data need to be collected along with samples for analysis of genetic affiliations among the nesting groups (Table 2, 5). In addition, the information needs to be published so that a better definition of the status of the population can be made.

Although assessments of green turtles that nest in Yemen have been made in recent years (Table 6) [46,48,54], the lack of recent data means that biological data for the population must rely on older summaries [10,15,41,53].

2.3 Threats

Nine major threatening processes impact marine turtles and their habitat in Yemen: habitat destruction, industrial activities, oil and other hydrocarbons, maritime transport, fisheries, recreational activities, domestic sewage pollution, coral bleaching, and desalination [24,60]. The importance of each of these issues requires evaluation to determine the impact on each species of marine turtle and their habitat. As part of its evaluation of the importance of these factors, Yemen listed artisanal fishing as a 'moderate' threat and the others as 'small'. [24] Because more than a decade has passed since the evaluation, threats and their importance should be re-evaluated. Many of the threats identified to impact marine turtles elsewhere in the world (e.g., various fishing activities, coastal development [12,46,47,48] are likely to be operating in Yemen, albeit at unquantified levels (Table 1).

2.3.1 Nesting sites

Marine turtles face several threats while nesting in Yemen, including anthropogenic threats (i.e., use of turtles and their eggs for food, "uncontrolled tourism at nesting beaches, incidental bycatch in coastal gillnets and other disturbances" [58]) and non-anthropogenic threats (i.e. depredation by ghost crabs, dogs and foxes, and birds) [22,58]. Threats to turtles using the nesting areas are likely to be acting over extended periods of time albeit at a "low level" [58] and the impact may not be apparent without comparison with long term monitoring data.

2.3.2 Marine areas

Although the risk of capture varies among sea turtle species and the types of fishing gear used, there is a clear threat to marine turtles from artisanal and commercial fisheries [42,43]. The primary threats to marine turtles are from the Red Sea trawl fishery and the pelagic fishery in the Gulf of Aden [26]. The Red Sea trawl areas cover about 6,200 km^2, including 550 km^2 shrimp fishery areas [30]. Fishing and turtle habitat (nesting, inter-nesting, and some foraging) coincide around Socotra and along both the eastern Gulf of Aden mainland shore and the southern Red Sea coast [37]. Given the variety of fishing methods and gear used [37] turtle bycatch needs to be evaluated to determine the impact on the populations. Although the majority of the fishing in the Gulf of Aden targets pelagic species [43, 44], management of the fishing industry in Yemen needs to address "weak enforcement and low compliance and the widespread illegal, unreported, and unregulated fishing" [2] as part of total bycatch reduction and stock management [45,58].

In addition, the discharge of wastes and dirty ballast water, particularly in the narrow Strait of Bab al-Mandab at the mouth of the Red Sea pose lower level threats [8,27]. Also, development of coastal urban centers and industry, as well as other activities, pose threats. In the future, coastal Yemen will be negatively impacted by the projected change in climate [1], including infrastructure around harbors and other coastal areas, including the coastal margin where marine turtles nest.

2.4 Conservation

See 1.4.

2.5 Research

Research on the biology, ecology, and threats to marine turtles in Yemen needs up-dating. At present there is scant information concerning research and conservation groups or their activities in Yemen (Table 4). The populations of sea turtles living and breeding in Yemen need to be assessed for their current distribution (nesting and foraging), basic biological characteristics (i.e. adult length and weight, number of eggs, duration of incubation, emergence success, size of hatchlings), as well as their genetic affiliations with other groups in the western Indian Ocean. In addition, long term studies should be initiated to determine growth, movement patterns, and habitat utilization.

The majority of scientific work that underpins the current management decision-making is more than a decade old, in many cases the data are two or more decades old. The older data are important because they provide a definition of the status of the species against which current data can be compared. However, it is essential to collect information on the current situation of marine turtles so that conservation management decisions can be made using standardized methods [34] and current data. The majority of recent publications review the older information without adding substantially to the database. It follows that any unpublished information that would help define the current populations should be published as a matter of urgency.

3 RMU: *Eretmochelys imbricata*, North-West Indian Ocean (EI-NWIO)

3.1 Distribution, abundance, trends

The distribution, abundance, trends, and status of hawksbill turtle (*Eretmochelys imbricata)* populations in Yemen are not completely known (Table 1). Although several studies [10, 13] and reviews [25,53,54,55] provide access to older data, the abundance and population trends cannot be assessed without current data.

3.1.1 Nesting sites

In Yemen, hawksbill turtles nest on islands in the vicinity of Bab al Mandab [54], mainly on the Kamaran Islands, Makran, Jabal Aziz Islet, and Perim (Berim) Is., which host possibly as many as 500 females annually (Figure 1) [13,15,51]. Peak nesting occurs from December through February [15].

3.1.2 Marine areas

Foraging areas used by hawksbill turtles [55] have not been specifically identified in Yemen [51]. However, because the species is typically associated with coral reefs [15,55], it is likely that the fringing reefs around the islands and the coastal reefs are used for foraging by resident turtles.

3.2 Other biological data

The available data on the morphometrics and other biological data of hawksbill turtles nesting in Yemen are greater than 20 years old (Table 1, 5) [15,25,53,54,55]. The information on the hawksbill turtle population in Yemen requires up-dating using standardized techniques [34] so that comparison to other regional populations can be made. Genetic sampling of nesting and foraging populations to define associations with other regional populations in the north-west Indian Ocean is not complete [11].

3.3 Threats

The major events threatening marine turtles and their habitat in Yemen include: habitat destruction, industrial activities, oil and other hydrocarbons, maritime transport, fisheries, recreational activities, domestic sewage pollution, coral bleaching, and desalination [24,60]. The importance of each of these issues requires evaluation to determine the extent of the impact so that appropriate remediation can be initiated. As part of its evaluation of the importance of these factors, Yemen listed artisanal fishing as a 'moderate' threat and the others as 'small' [24]. Given that more than a decade has passed since the evaluation, the process of defining threats and determining their importance should be re-evaluated. Many of the threats identified to impact marine turtles elsewhere in the world (e.g., various fishing activities, coastal development [12,46,47,48]) are likely to be operating in Yemen, albeit at unquantified levels (Table 1).

3.3.1 Nesting sites

Both anthropogenic threats and non-anthropogenic threats (e.g., use of eggs for food, incidential capture in artisanal and commercial fishing, depredation of eggs and hatchlings by ghost crabs, canids, and birds) are operating in Yemen [22,24,58]. However, the impact on the hawksbill turtle populations needs to be quantified. Unfortunately, long term monitoring data do not exist.

3.3.2 Marine areas

There is a clear threat to marine turtles from artisanal and commercial fisheries, including trawl and the pelagic fisheries [26,42,43]. The Red Sea trawl areas include 550 km^2 shrimp fishery areas [30]. Fishing and turtle habitat (nesting, inter-nesting and some foraging) coincide along both the eastern Gulf of Aden mainland shore and the southern Red Sea coast and around Socotra [37]. Given the variety of fishing methods and gear used [37] turtle bycatch needs to be evaluated to determine the impact [43,44]. Fishery management is one of the major issues that needs to be addressed to aid management of the fishing industry and to help conserve marine turtle populations [2,45,58].

In addition, the discharge of wastes and dirty ballast water, particularly in the narrow Strait of Bab al-Mandab at the mouth of the Red Sea, and the development of coastal urban and industry centers contribute to the habitat degradation that impacts marine turtles [8,27]. The projected sea level rise associated with change in climate, will negatively impact the coastal margin including where marine turtles nest [1].

3.4 Conservation

The Republic of Yemen is a party to multiple international conventions, agreements and treaties [16, 36, 37], including the Convention on Biological Diversity, the United Nations Convention on the Law of the Sea, and the United Nations Framework Convention on Climate Change, the Convention on International Trade in Endangered Species of wild animals (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Table 3). Regionally, Yemen is a party to PERSGA (the Regional Convention for the Conservation of the Red Sea and Gulf of Aden). However, because more than a decade has passed since PERSGA developed the regional action plan for the conservation of marine turtles [17,24], the document should be reviewed and updated to provide continuing guidance for conservation in Yemen. Locally, Yemen has developed a number of national instruments that deal directly or indirectly with the conservation marine turtles and the regulation of threatening processes [16,35].

Yemen has only two protected areas (Table 7). The Socotra archipelago that includes the main island of Socotra (12°30'N 54°00'E), Abd al-Khuri, Samha and Darsa Islands, as well as Kal-faraon and Sabouniya Islets was declared in 1996. Recently (2009) The Ras Isa / Kamaran Is. area was declared. In addition, there are other areas that have been proposed for protection [23,24].

3.5 Research

At present there is little information concerning research and conservation groups and their activities in Yemen (Table 4). Research on the biology, ecology, and threats to marine turtles in Yemen should be updated. The populations of sea turtles living and breeding in Yemen need to be assessed for their current distribution (nesting and foraging), basic biological characteristics (i.e. adult length and weight, number of eggs, duration of incubation, emergence success, size of hatchlings), as well as their genetic affiliations with other groups in the western Indian Ocean. In addition, long term studies should be initiated to determine growth, movement patterns, and habitat utilisation.

The majority of the scientific work needed to support current management decision-making is more than a decade old, in many cases the data are two or more decades old. Collecting current information on the situation of marine turtles in Yemen using standardized methods is necessary so that conservation management decisions can be made [34]. The majority of recent publications review the older information without adding substantially to the database. It follows that any unpublished information that would help define the current populations should be published as a matter of urgency.

4 Other Species

Leatherback (*Dermochelys coriacea*) [21,26,33,53,54] and olive ridley (*Lepidochelys olivacea*) [22,31,32,66] turtles have only been occasionally observed in Yemen.

The leatherback has not been recorded nesting in Yemen [4,26,53,54] and is considered to be a non-resident species in Yemen's waters as they are only seen rarely [26,53,54]. The majority of specimens reported are either a carcass stranded on a beach or an individual caught in fishing gear [26,53].

Some of the olive ridley turtles reported were either stranded on a beach or caught in fishing gear [53]. No nesting sites have been confirmed for the olive ridley turtle in Yemen [54], although at least two individuals have been reported on shore, possibly nesting, recently on the Sharma-Jethmoun-Dhargham coast [46]. It is likely that a population (albeit unquantified) of resident olive ridley turtles use Yemeni territory for foraging [32] but this needs to be confirmed. Unlike loggerheads and green turtles that have been tracked into Yemen territorial waters [62, 63], none of the nine post-nesting olive ridley turtles tracked from Masirah Is. in Oman migrated to Yemen territory [64].

Table 1. Representation and biological characteristics of nesting marine turtle species in Yemen.

	Caretta caretta		*Chelonia mydas*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Occurrence						
Nesting sites	Y	14	Y	14, 19	Y	14, 19
Pelagic foraging grounds	n/a		n/a		n/a	
Benthic foraging grounds	Y	7	Y	13, 19, 20	Y	13
Key biological data						
Nests/yr: recent average (range of years)	n/a		n/a	22	n/a	
Nests/yr: recent order of magnitude	1000	17, 22	10000-15000	10, 15, 17, 21, 22, 46	500	10, 15, 17, 22
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	3	14, 17	3	10, 15, 22,	2	10, 15
Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	6-10	22	6-10	10, 15	6-10	10, 15
Nests/yr at "major" sites: recent average (range of years)	? 1000	21	10000+	10, 15, 22, 46	500	10, 15
Nests/yr at "minor" sites: recent average (range of years)	? 100	21	5000+	10, 15, 22, 46	? 100	10, 15
Total length of nesting sites (km)	10-15	29	50	22. 63	n/a	
Nesting females / yr	n/a		5000-10000	10, 15, 22, 46	100-200	10, 15
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)	n/a		77 SCL	18	n/a	
Age at maturity (yrs)	n/a		n/a		n/a	
Clutch size (n eggs) (N)	n/a		122.4 (5)	18	n/a	
Emergence success (hatchlings/egg) (N)	n/a		n/a		n/a	
Nesting success (Nests/ Tot emergence tracks) (N)	n/a		n/a		n/a	

	Caretta caretta		*Chelonia mydas*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
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/a		n/a		n/a	
Genetics	n/a		Y	11	Y	11
Stocks defined by genetic markers	Y	11	Y	11	Y	11
Remote tracking (satellite or other)	n/a		n/a		n/a	
Survival rates	n/a		n/a		n/a	
Population dynamics	n/a		n/a		n/a	
Foraging ecology (diet or isotopes)	n/a		n/a		n/a	
Capture-Mark-Recapture	n/a		n/a		n/a	
Threats						
Bycatch: presence of small scale / artisanal fisheries?	Y (SN, GN, TR, HL)	6	Y (SN, GN, TR, HL)	6	Y (SN, GN, TR, HL)	6
Bycatch: presence of industrial fisheries?	Y (ST)	6	Y (ST)	6	Y (ST)	6
Bycatch: quantified?	No	6	No	6	No	6
Take. Intentional killing or exploitation of turtles	Y	39	n/a		n/a	
Take. Eggs (illegal)	Y	46	Y	46	n/a	
Coastal Development. Nesting habitat degradation	c	46	n/a		n/a	
Coastal Development. Photopollution	Y	39	Y	39	Y	39
Coastal Development. Boat strikes	Y	39	Y	39	Y	39
Egg predation	Y	39	Y	46	n/a	
Pollution (debris, chemical)	n/a		n/a		n/a	
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						

	Caretta caretta		*Chelonia mydas*		*Eretmochelys imbricata*	
RMU	**CC-NWIO**	**Ref #**	**CM-NWIO**	**Ref #**	**EI-NWIO**	**Ref #**
Long-term projects (>5yrs)						
Monitoring at nesting sites (period: range of years)	Y (1998-2007)	46	Y (2011-2014)	22	n/a	
Number of index nesting sites	2	50, 24	3	22, 24	1?	24
Monitoring at foraging sites (period: range of years)	n/a		n/a		n/a	
Conservation						
Protection under national law	Y	36	Y	36	Y	36
Number of protected nesting sites (habitat preservation) (% nests)	1	36	1	36	1	36
Number of Marine Areas with mitigation of threats	1	36	1	36	1	36
N of long-term conservation projects (period: range of years)	n/a		Y	46	n/a	
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	
Bycatch: fishing gear modifications (eg, TED, circle hooks)	n/a		n/a		n/a	
Bycatch: onboard best practices	n/a		n/a		n/a	
Bycatch: spatio-temporal closures/reduction	n/a		n/a		n/a	

Table 2. Index nesting sites in Yemen.

	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	Monitoring Level (1-2)	Monitoring Protocol (A-F)	Ref#
				Lat	Lon	Lat	Lon	Lat	Lon					
CC-NWIO														
Socotra														
North Shore Socotra	**Y**							12.59667	53.92194			2	A	14
Abalhen beach	(Part of NS Socotra)							12.61666	53.76674			2	A	46
Niet	(Part of NS Socotra)							12.46660	53.50000	1		2	A	14
Shueb	(Part of NS Socotra)							12.53330	53.48330	1		2	A	14
Abdulkuri	(Part of NS Socotra)											2	A	14
Ghubba and Ra’s Qadamah	(Part of NS Socotra)			12.61513	53.76667	12.61666	53.76674			15		2	A	14
Ghubbat Abalhan to Ras Kadama	(Part of NS Socotra)											2	A	14
Mahferhen-Zahek	(Part of NS Socotra)									5		2	A	14
Ra’s Ersel	(Part of NS Socotra)									1		2	A	14
Sibrahoo	(Part of NS Socotra)									2		2	A	14

Mainland														
Al-Fatk – Hawf coast, Al-Mahra	**N**							16.51654	52.69141			2	A	46
Sharma-Jethmoun-Dhargham coast, Hadhramout	**N**			14.82663	50.05104	14.81973	50.02389					2	A	46
CM-NWIO														
Al-Fatk – Hawf coast, Al-Mahra								16.51654	52.69141			2	A	46
Sharma-Jethmoun-Dhargham coast, Hadhramout	**Y**	10000		14.82663	50.05104	14.81973	50.02389					2	A	19, 46
Sharma (Sharmah)	(Part of S J D nesting)		45							1.8		2	A	22
Jethmoon	(Part of S J D nesting)									6 km		2	A	22
Dhargham	(Part of S J D nesting)											2	A	22
Ithmun	(Part of S J D nesting)		120							4.8		2	A	18, 19
between Bab al Mandab and Mukalla	Minor											2	A	18, 19, 22
Musa	Minor		25					13.71778	43.28083	0.24		2	A	18, 19, 22
Shihr	(Part of S J D nesting)		25							0.4		2	A	18, 19
Shuhair,	(Part of S J D nesting)		140							5.6		2	A	18, 19
Perim Is (Barim)	Minor							12.65000	43.41667			2	A	10, 19

EI-NWIO														
Jabal Aziz Is. (= Jazirat Aziz)	**Y**							12.73330	44.88333	~500	ND	ND	A	10, 19
Ras Imran and Azizi Is., Aden	**Y**	500						12.85850	44.70230			2	A	51, 46
Perim Is (Barim)	**Y**							12.65000	43.41667			2	A	10, 19
False Bay Beach	(Part of Perim Is Nesting)									0.365		2	A	10, 19
Shand Bay Beach	(Part of Perim Is Nesting)									0.36		2	A	10, 19
Ras Sheikh Berkhud	(Part of Perim Is Nesting)									0.02		2	A	10, 19
Sharma-Jethmoun-Dhargham coast, Hadhramout	N			14.82663	50.05104	14.81973	50.02389					2	A	46

Table 3. International and Regional conventions Yemen has signed and national laws and regulations Yemen has enacted that concern or impact marine turtles and their habitats. [16,24,26,35,36,37]

Conventions	Signed	Binding	Compliance measured and reported	Species	Conservation actions	Relevance to sea turtles	Contact
International							
Convention on International Trade in Endangered Species of wild animals (CITES, Washington, 1973)	1997	Yes	(updated as needed)	all marine turtles.	regulating international trade of different species of threatened animals. forbids trade of these species in all signatory countries except in exceptional circumstances.	Prohibits trade	Dr. Abdelkader Mohammed Al- Kharraz, ChairmanEnvironment Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 SANA'A
Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn 1979)	2006	Yes	(updated as needed)	all marine turtles.	aims to conserve terrestrial, aquatic and avian migratory species throughout their range.	deals with turtle issues and conservation	Mr. Maeen Lutf Alsewari National Coordinator, Convention Migratory Species (CMS (Environment Protection Authority (EPA) Sana'a, Republic of Yemen P. O. Box 19719 Tel: +967 711488943 Fax: +967 1 207327 Email: maeen_swary@hotmail.com
Indian Ocean South East Asian Memoranda of Understanding (MoU) on Marine turtles	2008	No	Intermittant (updated as needed)	All	Most countries bordering the Red Sea are part of the MoU on Marine Turtles and their Habitats of the Indian Ocean and South-East Asia.	Protects habitat; Helps countries to identify and reduce threats	Mr. Maeen Lutf Alsewari National Coordinator, Convention Migratory Species (CMS (Environment Protection Authority (EPA) Sana'a, Republic of Yemen P. O. Box 19719 Tel: +967 711488943 Fax: +967 1 207327 Email: maeen_swary@hotmail.com
Convention on Biological Diversity (CBD)	1996	Yes	(updated as needed)	All		deals with turtle issues and conservation	Dr. Abdelkader Mohammed Al- Kharraz, ChairmanEnvironment Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 SANA'A
United Nations Convention on the Law of the Sea (UNCLOS)	1987	Yes		de facto: All		Protects habitat	His Excellency Dr. Abubakr A. Al-Qirbi Minister of Foreign Affairs of the Republic of Yemen Ministry of Foreign Affairs
United Nations Framework Convention on Climate Change	1996			de facto: All		indirectly deals with turtle issues	His Excellency Dr. Abubakr A. Al-Qirbi Minister of Foreign Affairs of the Republic of Yemen Ministry of Foreign Affairs

Regional							
PERSGA (Red Sea) [the Regional Convention for the Conservation of the Red Sea and Gulf of Aden] [Jeddah Convention, 1982]	1982	Yes	Self Reporting as requested	de facto: All Marine turtles	Objectives: To improve the sustainable management and use of the RSGA's coastal and marine resources. To conserve the shared marine environment.	Protects habitat; reduce threats	Dr. Mahomed Saeed Almashjari, President of Environment Protection Authority, Environment Protection Authority (EPA). Postal Address: P.O.Box. 19719 Sana'a Yemen Phone +967 (1) 207817Fax +967 (1) 257549/207327Mobile: 967733761109/967777173372E-mail: environment@yemen.net.ye
Protocol Concerning the Conservation of Biological Diversity and the Establishment of Network of Protected Areas in the Red Sea and Gulf of Aden (2005).	2005	Yes			Helps to achieve the above		Dr. Mahomed Saeed Almashjari, President of Environment Protection Authority, Environment Protection Authority (EPA). Postal Address: P.O.Box. 19719 Sana'a Yemen Phone +967 (1) 207817Fax +967 (1) 257549/207327Mobile: 967733761109/967777173372E-mail: environment@yemen.net.ye
Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden (2005).	2005	Yes			Helps to achieve the above		Dr. Mahomed Saeed Almashjari, President of Environment Protection Authority, Environment Protection Authority (EPA). Postal Address: P.O.Box. 19719 Sana'a Yemen Phone +967 (1) 207817Fax +967 (1) 257549/207327Mobile: 967733761109/967777173372E-mail: environment@yemen.net.ye
Protocol Concerning Technical Cooperation to Borrow and Transfer Experts, Technicians, Equipment and Materials in Cases of Emergency (2009).	2009	Yes			Helps to achieve the above		Dr. Mahomed Saeed Almashjari, President of Environment Protection Authority, Environment Protection Authority (EPA). Postal Address: P.O.Box. 19719 Sana'a Yemen Phone +967 (1) 207817Fax +967 (1) 257549/207327Mobile: 967733761109/967777173372E-mail: environment@yemen.net.ye

National[35]							
The Environment Protection Council (EPC) was established in 1990 by Prime Ministerial Decree 94/1990.	1990			All	the general national policy planning for environmental protection and control; responsible for marine turtle conservation.	deals with turtle issues and conservation	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
Law No. 37 of 1991 defines the territorial waters and the exclusive economic zone	1991			de facto: all	It defines the territorial waters and the exclusive economic zones of 200 nautical miles, the boundaries of the islands. It also regulates free passage in the Strait of Bab al- Mandab and emphasizes on the prohibition of dumping any wastes into these zones.	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
The Presidential Resolution on Fishing, Exploitation and Protection of Living Aquatic Resources (Law No. 42)	1991			All	Protection of fisheries resources and regulation of fishing activities; prohibits the use of destructive fishing methods (e.g., poisons, chemicals, explosives).	capture of sea turtles is forbidden	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
Yemeni Law No. 11 of 1993 concerning the Protection of Marine Environment from Pollution	1993			de facto: all	It aims at protection of sea from pollution. It is mainly concerned with pollution by oil and pollution from passing ships. article No. 35, the law prohibits any form of discharge of pollutants of any kind and from any source into the sea without prior treatment.	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
The Ministerial Decree for Specifications of Fishing Vessels and Gear (No. 101)	1995			de facto: All	Defines types of fishing gear	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
Law No. 20 of 1995 aims to deal with procedures for urban planning in all parts of the Republic	1995			de facto: all	Article (3) of the Law aims at best usage of land, organizing its usage for various purposes, protection of the environment from pollution, protection of valleys, water courses, flash flood courses, underground water and the coastline.	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
Prime Ministerial Decree No. 4 (1996)	1996			All	Established Socotra as a protected area; developed a High Committee for Development of Socotra headed by the Deputy Prime Minister and Minister of Planning and Development.	Protects nesting sites on Soctora	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com

Presidential Decree on Law No. 43 of 1997	1997			de facto: all	Regulates fishing exploitation and protection of live aquatic resources.	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
The Technical Secretariat (TS)				de facto: all	co-ordinates and monitors: planning, implementation, environmental protection and natural conservation policy.	deals with turtle issues and conservation	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
The Ministry of Fish Wealth (MFW)				de facto: all	Regulates fishing, issues licenses, and supervises processing and marketing of fish and fisheries products for local consumption and export; responsible for the enforcement of laws and regulations concerning marine resources, including bycatch of endangered species.	indirectly deals with turtle issues	Environmental Protection Authority (EPA) Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816Fax +967 1 207327 Email: epa@epayemen.com
The Public Corporation for Maritime Affairs (PCMA)				de facto: all	Concerned with maritime safety and marine pollution control	protects environment	The Public Corporation of Maritime Affairs Authority (MAA) Ministry of Transport P.O. Box 19395 Sana'a, Yemen Tel: +967 2 414412 Tel: +967 2 419914 pcma@y.net.ye

Table 4. Projects and databases that concern marine turtle in Yemen.

#	RMU	Country	Region / Location	Project Name or descriptive title	Key words	Start date	End date
T4.1	NWIO	Yemen	Socotra Is.	Socotra Society for the protection of turtles			2015
T4.2	NWIO	Yemen	Mainland	Ras Imran society for sea turtles conservation, RISST, Yemen			
T4.3	NWIO	Yemen	Mainland	Yemeni Biological Society.			

Leading organisation	Public / Private	Collaboration with	Reports / Information material	Current Sponsors	Primary Contact (name and Email)
Socotra Society for the protection of turtles	Private		-		Shinihan, H M.

Table 5. Summaries of biological characteristics reported for green, loggerhead and hawksbill turtles nesting in Yemen.

Data presented as mean (n) when available from source. [18,19,22,25]

Location	Species	Source	Year	Life stage	Mean Curved Carapace Length (cm)	Range Curved Carapace Length (cm)	Mean Curved Carapace Width (cm)	Range Curved Carapace Width (cm)	Mean Straight Carapace Length (cm)	Range Straight Carapace Length (cm)	Mean Straight Carapace Width (cm)	Range Straight Carapace Width (cm)	Mean Plastron Length (cm)
Adults													
Sharmah-Jethmoon Coast	Loggerhead	22	2006	Adult	115		105		109		85		92
Sharmah-Jethmoon Coast	Green	22	2006	Adult		90-112		84-98		85-104		67-77	
Sharma Beach	Green	19	1966-1967	Adult	96 (225)	78.7- 113.3	74.9	63.5-86.4					
Sharma Beach	Green	18	1972	Adult	94.2	77.0-117.0	74.5	65.0-86.0					
Jabul Aziz Is.	Hawksbill	19	1966-1967	Adult	69.5 (14)	63-72							
Sharmah-Jethmoon Coast	Green	22	2006	Adult	70-82		60-7		13-16		14-22		100-152
Eggs													
Sharmah-Jethmoon Coast	Loggerhead	22	2006	Egg									
Sharmah-Jethmoon Coast	Green	22	2006	Egg			41-47		36.8-53.5				
Sharma Beach	Green	19	1966-1967	Egg	106 (70-130) 30	42.4	30-47.5						
Abdul Wadi	Green	19	1966-1967	Egg		42.5	40-45	40.4	30-44	1	100	9.6	7 - 13
Sharma Beach	Green	19	1966-1967	Egg	106 (70-130) 30	45.5	41-48	42.3	37.5-47.5	1	50		
Sharma Beach	Green	18	1972	Egg	122.4 (67-179) 5			44.8	35-55	5			

Jabul Aziz Is.	Hawksbill	19	1966-1967	Egg	81.2 (69-99) 5	40.5	38-45			1			
Hatchlings													
Sharmah-Jethmoon Coast	Loggerhead	22	2006	Hatchling									
Sharmah-Jethmoon Coast	Green	22	2006	Hatchling		41-45		34-37		18-25			
Abdul Wadi	Green	19		Hatchling	46.9	44.0 - 48.4			23	(20-28)	20	1	48
Jabul Aziz Is.	Hawksbill	19		Hatchling	42		32						

Nesting season	Peak nesting period underlined; estimated in parenthesizes													
Location	**Species**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Source**
Yemen	Loggerhead				(xxx)	(xxx)	(xxx)	(xxx)	(xxx)	(xxx)				7
	Hawksbill	xxx	xxx										xxx	19, 51
Abdul Wadi	Green	xxx	xxx	xxx	xxx	Xxx	xxx	xxx	xxx	xxx	<u>xxx</u>	<u>xxx</u>	<u>xxx</u>	19
Shuhair	Green										<u>xxx</u>	<u>xxx</u>		19
Shihr	Green										<u>xxx</u>	<u>xxx</u>		19
Sharma	Green	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	<u>xxx</u>	<u>xxx</u>	xxx	18, 19
Ithmum	Green	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	18, 19
Jabul Aziz Is.	Hawksbill	xxx	xxx	xxx										

Table 6 Population assessment of sea turtles in Yemen based on IUCN Red List assessments by Seminoff [48] (green turtle) and Mortimer and Donnelly [40] (hawksbill turtle).

Green turtle										
Subpopulation	**Data Type**	**Past Year**	**Past Mean**	**Pres. Year**	**Present Mean**	**Interval**	**Trend (% change)**	**Citation (Past)**	**Citation (Present)**	**Comment**
CM-NWIO	annual # nesting females	1966, 1972	30-40 fem/night, peak sea	1999	15 females /night, peak season	27 yr	- ≥50 %	10, 18	59	Described as “without any doubt one of the best nesting beaches remaining in the world” (Hirth and Carr 1970).
	Age at (years)	**Age at maturity calculation (see original Source)**	**½ Reproductive Longevity (years)**	**Generation Length (GL; years)**	**3-generation duration ([= GL * 3]; years)**	**Calendar year 3 generations back (= 2001- 3GL)**				
	33.3	Mean of A,B,C	½ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873				
	Past	**Present**		**Subpopulation 3 gen. ago (est.)**	**Current Subpopulation (est.)**	**Estimated 3-generation reduction**	**Notes**			
	1,750	750					Subpopulation declining since at least 1950 (10)			
	(1972)	(1999)	E=	5,409	677	-87%				
			L=	2,564	676	-74%				
	Egg Collect	**Female Harvest**	**Intent. Capture**	**Incident. Capture**	**Habitat Loss**	**Cont.**	**Dis**			
	low	Y (30,33)	?	? ?	?	?	59			

Hawksbill turtle								
						Population trends		
Subpopulation	Location	Data	Years	Number of nesting ♀/season	Data confidence grade	Recent <20 yrs)	Historic (>20 yrs)	Reference
EI-NWIO	Yemen	AF	1960s - 1970s	~ 500?	B	?	?	51

Table 7. Marine Protected Areas in Yemen.

Two areas have been declared; five areas have been recommended. An additional 21 coastal and island area have been identified for possible declaration. (Only coastal and island and areas are presented) [16, 36, 37, 49]

Location	Protected area	Ecosystem	Class	Governorate	Year declared	Size (km^2)	Major habitats and significant species	Impacts and conflicts	Management	Global recognition	Ref #
SOCOTRA	Socotra Islands	Islands	1	Hadramaut	1996	3704.1	Island group without- standing terrestrial plant and animal diversity and endemism, diverse and largely pristine marine environments and biota	Fishing, increasing tourism pressure anticipated	Currently low, expected to become high,	Nominated Biosphere Reserve, GEF biodiversity project	36
KAMARAN	Ras Isa/ Kamaran Is.	Islands	2	Al Hudaydah	2009	106.7	Coral reefs with diverse reef-associated fauna, mangroves	Oil terminal and chronic oil pollution, threat of major oil spill, reef fisheries for aquarium trade	None	None	36
BIR ALI AND PELHAF	Balhaf and Bir Ali area	Coastal plain	2	Shabwah	Proposed	96.4	Group of high aspect islands, scenic coast- line, extensive coral reefs and rich fishing area, bird and turtle nesting, crater lake with mangroves	Tourism development, fishing activities	None	None	36
SHARMAH AND JATHMON	Ras Sharma	Coastal plain	2	Hadramaut	Proposed	62.2	Beach and steep rocky headlands, internationally important nesting site for green turtles	Turtle egg collecting, possible slaughter of turtles	None	None	36
KHAWOR UMAYRAH	Khor Umaira	Coastal plain	2	Lahj	Suggested	34.3	Mixed seagrass and coral habitat, semi-enclosed lagoon with turtle nesting beaches	Fisheries	None	None	36
DHOBBAH (SHIHR)	Dhobba (Shihr)		2		Proposed	Not defined	Sandy beaches, important turtle nesting site	Turtle egg collecting, possibly slaughtering of turtles	None	None	36
BAB AL MANDABB and Perim Is.	Bab-al- Mandab and Perim Is.	Islands & Coastal plain	2	Taiz	Suggested	8.5	Extensive mangrove stands, dense seagrass beds, hawksbill turtle nesting site of global importance	Major shipping lane, pollution, siltation, cutting of mangrove	None	None	36

Other possible MPAs that have been identified that would support marine turtle conservation.											
QISHN		Coastal plain	2	Al Maharah		97					36
RAS AMRAN		Coastal plain	2	Aden		10.5					36
RAS AMRAN		Coastal plain	2	Aden		6.4					36
ALARIRAH		Coastal plain	2	Taiz		4.4					36
ABD AL KURI		Islands	2	Hadramaut		133.5					36
ZOQAR		Islands	2	Al Hudaydah		121.4					36
HONAISH ALKOBRA		Islands	2	Al Hudaydah		71.4					36
JAZIRAT ANTUFASH		Islands	2	Al Hudaydah		42.5					36
		Islands	2	Hadramaut		42.2					36
ZAMHAR		Islands	2	Hajjah		38.2					36
ALZBIR		Islands	2	Al Hudaydah		23					36
BUQLAN		Islands	2	Hajjah		12.7					36
MAYYUN		Islands	2	Aden		12.2					36
AL BADI		Islands	2	Al Hudaydah		11					36
HONAISH ALSOURA		Islands	2	Al Hudaydah		10.2					36
AL URMAK		Islands	2	Al Hudaydah		8.8					36
J. ALTIR		Islands	2	Al Hudaydah		8.4					36
QULENSYA		Islands	2	Hadramut		8.2					36
		Islands	2	Hajjah		2.7					36
		Islands	2	Shabwah		1					36
		Islands	2	Aden		0.7					36

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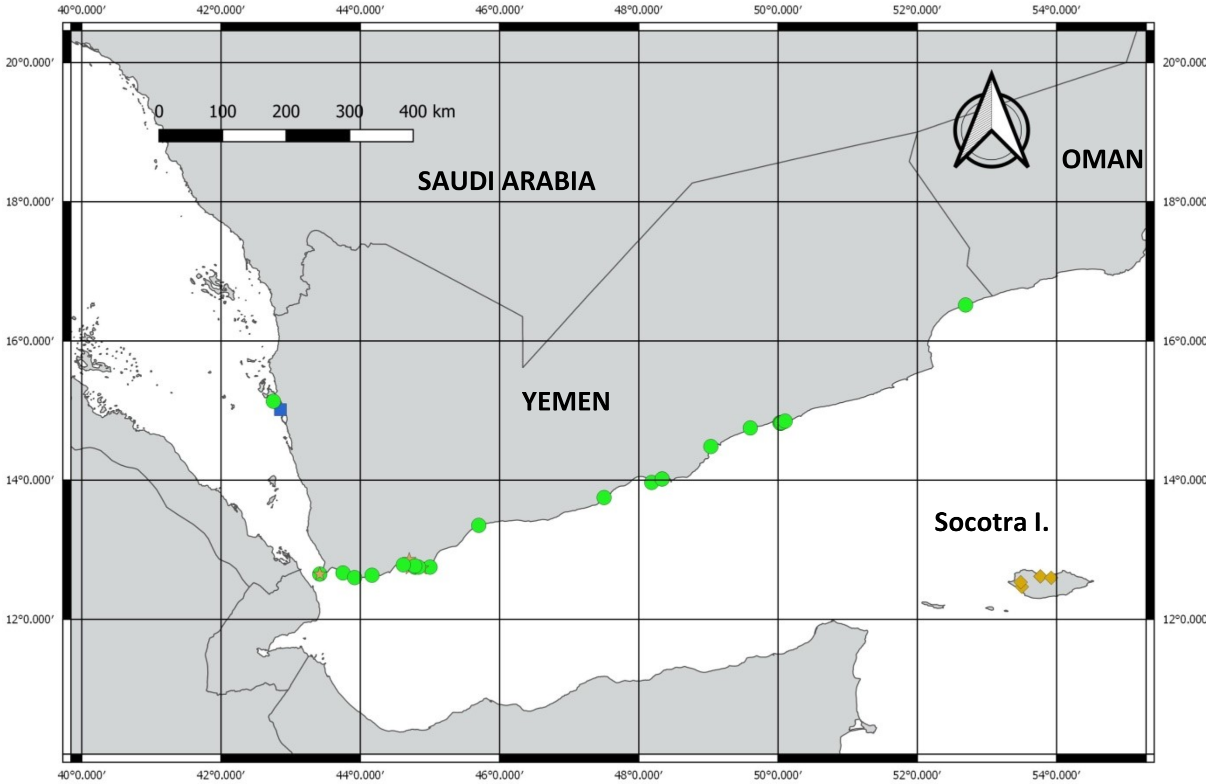

Figure 1. The known marine turtle nesting locations in Yemen, including on the island of Socotra in the Gulf of Aden.

Symbols represent species: Circle, Green Turtle; Diamond, Loggerhead turtle; Star, Hawksbill turtle; Square, Olive Ridley Turtle*. Symbols represent nesting locations, not the number or density of nesting turtles.
***unconfirmed nesting activity by two individual turtles in one season**

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