

# Sea Turtles in the Middle East and South Asia Region

## MTSG Annual Regional Report 2019

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**Photo:** Nesting hawksbill sea turtle (*Eretmochelys imbricata*) at Sheedvar Is., Iran

**Photo Credit:** Asghar Mobaraki

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## REGIONAL OVERVIEW

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Of the 17 countries occurring in the Middle East and South Asia (ME & SA) MTSG Region, 11 are included in this report (Bahrain, Djibouti, Egypt, India, Kuwait, Maldives, Qatar, Saudi Arabia, Sri Lanka, Sudan, Yemen). Four chapters (Bahrain, Djibouti, Maldives, Sudan) have been added and seven chapters (Egypt, India, Kuwait, Qatar, Saudi Arabia, Sri Lanka, Yemen) have been updated since the 2018 report (Phillott and Rees, 2018). Note that the chapters for Djibouti and Sudan would potentially be strengthened by contributions from in-country researchers.

The report presents known information about 11 sea turtle Regional Management Units (RMUs; see Wallace et al., 2010) in the ME & SA, of which information about *Eretmochelys imbricata* in the South-West Indian Ocean is new since the 2018 report (see Phillott and Rees, 2018). Additional information for RMU's in the region can be obtained from relevant publications and reports on sea turtle populations in Bangladesh, Eritrea, Iran, Oman, Pakistan, and the United Arab Emirates. We hope to include more of these countries in the next report.

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

**ME & SA countries contributing to this summary:** Sri Lanka

**ME & SA countries in which nesting of this RMU also occurs:** None known

#### **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 (see *Sri Lanka*).

##### **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 foraging loggerhead populations in Sri Lanka are known (see *Sri Lanka*).

#### **1.2 Other biological data**

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

### **1.3 Threats**

#### **1.3.1 Nesting sites**

Eggs are lost to poachers and predators. Hatchlings may be threatened by increased lighting adjacent to nesting beaches (see *Sri Lanka*).

#### **1.3.2 Marine areas**

The consumption of turtle bycatch occurs in coastal villages of Sri Lanka (see *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 (see *Sri Lanka*).

### **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 (see *Sri Lanka*).

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

**ME & SA countries contributing to this summary:** Yemen

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

### **2.1 Distribution, abundance, trends**

A globally important nesting aggregation for this species occurs in Oman, but no data were obtained from that country.

#### **2.1.1 Nesting sites**

In Yemen, nesting of turtles in this RMU occurs on Socotra Island in the Gulf of Aden, with infrequent nesting also on the nearby Sharma-Jethmoon-Dhargham coast of the country. No clear oldest documented abundance and recent trends for nesting populations of the RMU are known (see *Yemen*).

#### **2.1.2 Marine areas**

Large scale oceanic foraging areas in Yemen's EEZ have been shown for this RMU, from turtles that have nested in Oman. Specific foraging and inter-nesting areas for turtles nesting in Yemen have not been identified, and no clear oldest documented abundance and recent trends for foraging populations of loggerhead turtles in Yemen are known (see *Yemen*).

## **2.2 Other biological data**

Morphological information for all life stages and genetic characteristics of the RMU in Yemen still need to be determined and published (see *Yemen*).

## **2.3 Threats**

### **2.3.1 Nesting sites**

Nesting turtles and their eggs in Yemen 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 of the RMU at Yemeni nesting sites (see *Yemen*).

### **2.3.2 Marine areas**

Fisheries in the Gulf of Aden and Red Sea pose threats to nesting, inter-nesting and foraging turtles in this RMU, likely exacerbated by the weak enforcement, low compliance, and widespread illegal activities reported for fisheries in Yemen. Marine pollution and sea level rise resulting from climate change are additional current and future threats to be managed (see *Yemen*).

## **2.4 Conservation**

Yemen protects turtles in the CC-NWIO RMU through national and international instruments and protected areas, though effectiveness of these methods is unknown (see *Yemen*).

## **2.5 Research**

Understanding of this RMU would benefit from unpublished data sets being made available, further research on the biology, ecology, and threats to loggerhead turtles in Yemen (see *Yemen*) and from publication and inclusion of data from Oman.

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

**ME & SA countries contributing to this summary:** India

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

### **3.1 Distribution, abundance, trends**

#### **3.1.1 Nesting sites**

India only reports nesting turtles in the CM-NEIO RMU in the Andaman and Nicobar Islands, with no known large nesting sites identified to date. No clear oldest documented abundance and recent trends for nesting populations of this RMU in the Andaman and Nicobar Islands of India are known (see *India*).

#### **3.1.2 Marine areas**

Bycatch data from Indian fisheries indicates green turtles in their NEIO RMU inhabit near- and offshore waters in the Bay of Bengal (see *India*). No clear oldest documented abundance and recent trends for foraging populations of leatherback turtles in Indian waters are known (see *India*).

### **3.2 Other biological data**

Biological data for populations of this RMU in India are unknown and a key knowledge gap (see *India*).

### **3.3 Threats**

#### **3.3.1 Nesting sites**

Nesting sites for this RMU in the Andaman and Nicobar Islands are remote, with little known about potential threats to nesting sites, turtles, eggs, and hatchlings (see *India*).

#### **3.3.2 Marine areas**

Fisheries bycatch is the main threats to turtles of this RMU in India (see *India*).

### **3.4 Conservation**

National legislation and international agreements protect turtles in India and its territories. Nests may be protected or relocated to hatcheries at some of the populated islands among the Andaman and Nicobars (see *India*).

### **3.5 Research**

Turtle research in India has not previously focused on this RMU, and activities to determine key biological information and assess the population are required (see *India*).

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

**ME & SA countries contributing to this summary:** Bahrain, Djibouti, Egypt, India, Kuwait, Maldives, Qatar, Saudi Arabia, Sri Lanka, Sudan, Yemen

**ME & SA countries in which nesting of this RMU also occurs:** Oman, Iran, Pakistan

### **4.1 Distribution, abundance, trends**

Oman has one of the two largest NWIO green turtle breeding populations in the region (together with Yemen), but no data were presented for this report

#### **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, Kuwait, India (mainland west coast and Lakshadweep Islands), the Maldives, and Sri Lanka (see *Djibouti, Egypt, India, Kuwait, Maldives, Saudi Arabia, Sri Lanka and Yemen*). The oldest documented abundance and recent trends for nesting populations of this RMU are unknown for countries other than Egypt (see *Egypt*). Egypt and Kuwait report currently stable populations although the population in Kuwait represents no more than 5 nesting individuals in a season (see *Egypt and Kuwait*), while the green turtle population in the Maldives is believed to be decreasing (see *Maldives*).

#### **4.1.2 Marine areas**

Important in-water habitat for the RMU have been identified in the Red Sea (see *Bahrain, Egypt, Saudi Arabia, Sudan* and *Yemen*), Gulf of Aden (see *Yemen*), *Arabian Sea* (see *India, Maldives*), Arabian (Persian) Gulf (see *Qatar, Kuwait* and *Saudi Arabia*), Gulf of Mannar (see *Sri Lanka*), and Lakshadweep Islands (see *India*).

#### **4.2 Other biological data**

Some key biological data for populations of this RMU in Egypt, Kuwait, Maldives, Saudi Arabia, Sri Lanka and Yemen is known (see *Egypt, Kuwait, Maldives, Saudi Arabia, Sri Lanka* and *Yemen*), but no to little information is available for populations in Djibouti and India (see *Djibouti* and *India*).

#### **4.3 Threats**

##### **4.3.1 Nesting sites**

The most common threats at nesting sites that were reported by contributing countries include coastal development (see *Djibouti, Kuwait, Maldives* and *Saudi Arabia*), beach armouring (see *India* and *Maldives*), pollution (see *Djibouti, Maldives* and *Saudi Arabia*), predation (see *Egypt*), illegal take (see *Djibouti, Egypt, Maldives, Saudi Arabia, Sri Lanka, Sudan* and *Yemen*), and tourism (see *Kuwait* and *Yemen*).

##### **4.3.2 Marine areas**

Threats from fisheries (see *Djibouti, India, Kuwait, Sri Lanka, Sudan* and *Yemen*) and consumption of bycatch (see *Sri Lanka*), coastal development and associated pollution (see *Yemen*), and directed take (see *Egypt*) are among the major threats to marine areas and populations important for the CM-NWIO RMU. Removal of seagrass beds by resorts is common in the Maldives (see *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, Kuwait, Maldives and Sri Lanka 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:** India, Sri Lanka

**ME & SA countries in which the RMU also occurs:** Nesting is not known to occur in other countries within this RMU. Leatherbacks recorded in waters of Bahrain, Djibouti, 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**

India and Sri Lanka report 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 (see *India* and *Sri Lanka*). The nesting population known in India is reported as stable for 2008-2017 (see *India*), but the trend for Sri Lankan turtles in the RMU is unknown (see *Sri Lanka*).

#### **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. No clear oldest documented abundance and recent trends for foraging populations of turtles in this RMU in both India and Sri Lanka are known (see *India* and *Sri Lanka*).

### **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 (see *India* and *Sri Lanka*).

### **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 (see *India*). Poaching of leatherback turtle eggs in Sri Lanka is reported (see *Sri Lanka*).

#### **5.3.2 Marine areas**

There are no reports of leatherbacks as bycatch from Sri Lanka, but the species is recorded from different fisheries in India (see *India* and *Sri Lanka*).

### **5.4 Conservation**

National legislation and international agreements protect turtles in 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 (see *India*) and in Sri Lanka, but their contribution to sea turtle conservation is debated in the latter country (see *Sri Lanka*).

### **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 Island from 2001-2004 (see *India*). 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 (see *Sri Lanka*).

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

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

**ME & SA countries in which the RMU also occurs:** Bangladesh

### **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 (see *India* and *Sri Lanka*). No clear oldest documented abundance and recent trends for nesting populations of this RMU in both India and Sri Lanka are known (see *India* and *Sri Lanka*).

#### **6.1.2 Marine areas**

No clear oldest documented abundance and recent trends for foraging populations of this RMU in both India and Sri Lanka are known, but the species is reported frequently from commercial dive sites on reefs in India (see *India* and *Sri Lanka*).

### **6.2 Other biological data**

Little biological data is available for hawksbill turtles in India or Sri Lanka (see *India* and *Sri Lanka*).

### **6.3 Threats**

#### **6.3.1 Nesting sites**

Poaching of eggs is reported by both countries, and nests may be depredated in the Andaman and Nicobar Islands of India (see *India* and *Sri Lanka*).

#### **6.3.2 Marine areas**

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

### **6.4 Conservation**

National legislation and international agreements protect turtles in 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 (see *India*) and in Sri Lanka, but their contribution to sea turtle conservation is debated in the latter country (see *Sri Lanka*).

## 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 (see *Sri Lanka*). Research on the biology, ecology, and threats to populations of the EI-NEIO RMU in both India and Sri Lanka is required (see *India* and *Sri Lanka*).

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

**ME & SA countries contributing to this summary:** Bahrain, Djibouti, Egypt, India, Kuwait, Qatar, Saudi Arabia, Sudan, Yemen

**ME & SA countries in which nesting of this RMU also occurs:** Eritrea, Iran, Oman, UAE

### 7.1 Distribution, abundance, trends

Regionally important nesting aggregations for this RMU also occur in Oman, UAE and Iran, for which no data were presented for this report.

#### 7.1.1 Nesting sites

From west to east, nesting hawksbill turtle populations in the NWIO RMU were reported by Sudan, Djibouti, Egypt, Saudi Arabia (Red Sea and Arabian (Persian) Gulf), Yemen, Qatar, Kuwait, and India (Lakshadweep Islands) (see *Djibouti, Egypt, India, Kuwait, Qatar, Saudi Arabia* and *Yemen*). The oldest documented abundance and recent trends for nesting populations of this RMU are unknown for countries other than Kuwait, Qatar and Sudan. The former two countries report currently stable populations (see *Kuwait* and *Qatar*). 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 (see Egypt, Sudan, and Saudi Arabia), Arabian (Persian) Gulf (see Qatar and Saudi Arabia), and Lakshadweep Islands (see India).

### 7.2 Other biological data

Some key biological data for populations of this RMU in Egypt, Kuwait, Qatar, Saudi Arabia, Sudan, and Yemen is known, but no information is available for populations in Djibouti or India (see listed 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 (see *Kuwait, Qatar* and *Saudi Arabia*), beach armouring (see *India*), pollution (see *Saudi Arabia*), illegal take (see *Egypt, Saudi Arabia, Sudan* and *Yemen*), predation (see *Egypt*) and tourism (see *Kuwait* and *Yemen*).

### **7.3.2 Marine areas**

Threats from fisheries, coastal development and associated pollution (see *Bahrain, Sudan and Yemen*), and directed take (see *Egypt*) 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 the NWIO RMU. Specific conservation actions by individual countries are reported (see *Bahrain, Djibouti, Egypt, India, Kuwait, Qatar, Saudi Arabia, Sudan and Yemen*).

### **7.5 Research**

Egypt and Kuwait are the only contributing countries that describe recent monitoring to establish key information on the biology, ecology and distribution of turtle population in the EI-NWIO RMU (see *Egypt and Kuwait*), but further information is required for all countries. Sharing and/or publication of existing, historical data is strongly encouraged.

## **8 RMU: *Eretmochelys imbricata*, South-West Indian Ocean (EI-SWIO)**

**ME & SA countries contributing to this summary:** Maldives

**ME & SA countries in which nesting of this RMU also occurs:** None

### **8.1 Distribution, abundance, trends**

#### **8.1.1 Nesting sites**

The reported distribution of nesting is likely to be an underestimate in the Maldives. No long-term data are available (see *Maldives*).

#### **8.1.2 Marine areas**

A capture-mark-recapture study of hawksbill turtle numbers in the Maldivian Archipelago suggests ~3,200 turtles, mostly juveniles, and a potentially increasing population (see *Maldives*).

### **8.2 Other biological data**

None available.

### **8.3 Threats**

#### **8.3.1 Nesting sites**

Coastal development, erosion, pollution, and illegal take of hatchlings for the pet trade threaten hawksbill turtles in the Maldives (see *Maldives*).

### **8.3.2 Marine areas**

Hawksbill habitat is threatened by development of resort facilities on coral reefs (see *Maldives*).

### **8.4 Conservation**

National legislation and international agreements protect turtles in the Maldives.

### **8.5 Research**

Research on genetic stocks and migratory patterns would complement ongoing research on the RMU in Maldivian waters (see *Maldives*).

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

**ME & SA countries contributing to this summary:** India

**ME & SA countries in which arribadas nesting of this RMU also occurs:** None

### **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 (see *India*).

#### **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 (see *India*).

### **9.2 Other biological data**

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

#### **9.3.2 Marine areas**

Turtles in this RMU are vulnerable to different fisheries in India (see *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 (see *India*).

#### **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 (see *India*).

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

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

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

#### **10.1 Distribution, abundance, trends**

##### **10.1.1 Nesting sites**

Olive ridley turtles in their NEIO RMU nest across the east coast of mainland India, in the Andaman and Nicobar Islands, and in the south to south-west coast of Sri Lanka (see *India* and *Sri Lanka*). The oldest documented abundance for nesting populations of this RMU in both India and Sri Lanka are unknown, but the nesting population in India is currently believed to be stable (see *India* and *Sri Lanka*).

##### **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 on the eastern coasts of both India and Sri Lanka and potentially further into the Bay of Bengal. The oldest documented abundance and recent trends for foraging populations are unknown (see *India* and *Sri Lanka*).

#### **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 India (see *India* and *Sri Lanka*).

#### **10.3 Threats**

##### **10.3.1 Nesting sites**

Poaching of eggs is reported in Sri Lanka (see *Sri Lanka*) but is now minimal for this RMU in India. However, nests in the latter country are vulnerable to predation, erosion and emergent hatchlings may be affected by photo-pollution (see *India*).

### **10.3.2 Marine areas**

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

### **10.4 Conservation**

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

### **10.5 Research**

The majority of research on olive ridley turtles in India has focused on the arribada populations. Research on the biology, ecology, and threats to populations of the LO-NEIO RMU in both India and Sri Lanka is required (see *India* and *Sri Lanka*).

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

**ME & SA countries contributing to this summary:** Bahrain, India, Maldives

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

### **11.1 Distribution, abundance, trends**

A regionally important nesting aggregation for this RMU also occurs in Oman, for which no data were presented for this report.

#### **11.1.1 Nesting sites**

Olive ridley turtles in their WIO RMU nest across the west coast of mainland India and in the Lakshadweep Islands. A few nests have been recorded in the Maldives (see *Maldives*). The oldest documented abundance for nesting populations of this RMU in India is unknown, but the population is currently believed to be stable (see *India*).

#### **11.1.2 Marine areas**

Bycatch data and stranding records from India, the Maldives, and Yemen suggest olive ridley turtles in this RMU are widespread in near- and offshore waters of the Arabian Sea (see *India* and *Maldives*). No clear oldest documented abundance and recent trends for foraging populations are known.

### **11.2 Other biological data**

Limited key data is available from LO-WIO populations in India (see *India*).

### **11.3 Threats**

#### **11.3.1 Nesting sites**

Olive ridley turtles from their WIO RMU nesting in India are vulnerable to predation, erosion and photo-pollution (see *India*).

#### **11.3.2 Marine areas**

Fisheries operating in India pose a threat to sea turtles (see *India*). 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 (see *Maldives*).

### **11.4 Conservation**

National legislation and international agreements protect turtles in India and the Maldives (see *India* and *Maldives*). Nests may be protected or relocated to hatcheries on mainland India (see *India*).

### **11.5 Research**

Research on the biology, ecology, and threats to populations of the LO-WIO RMU in India, the Maldives and Oman is required. Contribution of existing research data from Oman would notably improve our understanding of this RMU.



**Table 1a. Key biological information for sea turtle RMUs (CC-NEIO; CC-NWIO; CM-NEIO; CM-NWIO; DC-NEIO) in the Middle East and South Asia. Country Chapters: BH- Bahrain; DJ- Djibouti; EG- Egypt; IN- India; KW- Kuwait; MD- Maldives; QA- Qatar; SA- Saudi Arabia; LK- Sri Lanka; SU- Sudan; YE- Yemen.**

| RMU  | <i>Caretta caretta</i> |                  |         |                  | <i>Chelonia mydas</i> |                  |                |                                   | <i>Dermochelys coraicea</i> |                  |
|--|------------------------|------------------|---------|------------------|-----------------------|------------------|----------------|-----------------------------------|-----------------------------|------------------|
|  | CC-NEIO                | Country Chapters | CC-NWIO | Country Chapters | CM-NEIO               | Country Chapters | CM-NWIO        | Country Chapters                  | DC-NEIO                     | Country Chapters |
| <b>Occurrence</b>  |                        |                  |         |                  |                       |                  |                |                                   |                             |                  |
| Nesting sites  | Y                      | SL               | Y       | YE               | Y                     | IN               | Y              | DJ,EG,IN,KW<br>LK,MD,SA,SU,<br>YE | Y                           | IN,LK            |
| Pelagic foraging grounds                                   | n/a                    |                  | n/a     | YE               | n/a                   | IN               | Y (J,A)        | EG,LK,MD                          | n/a                         |                  |
| Benthic foraging grounds                                   | n/a                    |                  | Y       | YE               | n/a                   | IN               | Y (J,A)        | BH,DJ,EG,KW,<br>MD,QA,SA,YE       | n/a                         |                  |
| <b>Key biological data</b>                                 |                        |                  |         |                  |                       |                  |                |                                   |                             |                  |
| Nests/yr: recent average (range of years)                  | 17 (2014-2017)         | SL               | n/a     |                  | n/a                   | IN               | >4,612         | EG,KW,MD,SA,<br>LK                | 1431 (2008-2018)            | IN,LK            |
| Nests/yr: recent order of magnitude                        | n/a                    |                  | 1000    | YE               | n/a                   | IN               | ~10,000-18,000 | DJ,EG,KW,MD,<br>SA,SU,YE          | n/a                         |                  |
| Number of "major" sites (>20 nests/yr AND >10 nests/km yr) | 0                      | SL               | 3       | YE               | n/a                   | IN               | 36             | EG,KW,MD,SA,<br>LK,YE             | 14                          | IN,LK            |
| Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)  | 14                     | SL               | 6-10    | YE               | n/a                   | IN               | 72-100         | EG,KW,MD,SA,<br>LK,YE             | 47                          | IN,LK            |
| Nests/yr at "major" sites: recent average (range of years) | n/a                    |                  | ? 1000  | YE               | n/a                   | IN               | >11,000        | EG,SA,YE                          | 97.46 (2016)                | IN               |
| Nests/yr at "minor" sites: recent average (range of years) | n/a                    |                  | ? 100   | YE               | n/a                   | IN               | >5,200         | EG,KW,SA,YE                       | 3.4 (2016)                  | IN               |
| Total length of nesting sites (km)                         | 35                     | SL               | 10-15   | YE               | n/a                   | IN               | ~172           | EG,KW,SA,LK,<br>YE                | 96                          | LK               |
| Nesting females / yr                                       | n/a                    |                  | n/a     |                  | n/a                   | IN               | 6,000-10,000   | EG,KW,MD,SA,<br>YE                | 170                         | LK               |
| Nests / female season (N)                                  | n/a                    |                  | n/a     |                  | n/a                   | IN               | ~3.4 (>600)    | EG,KW,MD,SA,<br>LK                | 4.9                         | IN               |
| Female remigration interval (yrs) (N)                      | n/a                    |                  | n/a     |                  | n/a                   | IN               | 2-5 (~1,500)   | SA,LK                             | 1                           | IN               |
| Sex ratio: Hatchlings (F / Tot) (N)                        | n/a                    |                  | n/a     |                  | n/a                   | IN               | 0.7            | LK                                | n/a                         |                  |
| Sex ratio: Immatures (F / Tot) (N)                         | n/a                    |                  | n/a     |                  | n/a                   | IN               | 70% (30)       | QA                                | n/a                         |                  |

|  | <i>Caretta caretta</i> |                  |         |                  | <i>Chelonia mydas</i> |                  |                      |                          | <i>Dermochelys coraicea</i> |                  |
|--|------------------------|------------------|---------|------------------|-----------------------|------------------|----------------------|--------------------------|-----------------------------|------------------|
| RMU  | CC-NEIO                | Country Chapters | CC-NWIO | Country Chapters | CM-NEIO               | Country Chapters | CM-NWIO              | Country Chapters         | DC-NEIO                     | Country Chapters |
| Sex ratio: Adults (F / Tot) (N)                                  | n/a                    |                  | n/a     |                  | n/a                   | IN               | n/a                  |                          | n/a                         |                  |
| Min adult size, CCL or SCL (cm)                                  | n/a                    |                  | n/a     |                  | n/a                   | IN               | 73-96 CCL;<br>77 SCL | EG,KW,SA,LK,<br>YE       | 140 CCL                     | IN               |
| Age at maturity (yrs)  | n/a                    |                  | n/a     |                  | n/a                   | IN               | n/a                  |                          | n/a                         |                  |
| Clutch size (n eggs) (N)   | 105.2 (5)              | SL               | n/a     |                  | n/a                   | IN               | 105.2 (2,174)        | EG,SA,LK,YE              | 103.8 (140)                 | IN,LK            |
| Emergence success (hatchlings/egg) (N)                           | n/a                    |                  | n/a     |                  | n/a                   | IN               | 81.6 (>585)          | EG,SA,LK                 | n/a                         |                  |
| Nesting success (Nests/ Tot emergence tracks) (N)                | n/a                    |                  | n/a     |                  | n/a                   | IN               | 62.2% (>5,578)       | EG,SA,LK                 | n/a                         |                  |
| <b>Trends</b>  |                        |                  |         |                  |                       |                  |                      |                          |                             |                  |
| Recent trends (last 20 yrs) at nesting sites (range of years)    | n/a                    |                  | n/a     |                  | n/a                   | IN               | Stable or Decreasing | EG,KW,MD                 | Stable (2008-2017)          | IN               |
| Recent trends (last 20 yrs) at foraging grounds (range of years) | n/a                    |                  | n/a     |                  | n/a                   | IN               | n/a                  |                          | n/a                         |                  |
| Oldest documented abundance: nests/yr (range of years)           | n/a                    |                  | n/a     |                  | n/a                   | IN               | 1,018                | MD                       | n/a                         |                  |
| <b>Published studies</b>   |                        |                  |         |                  |                       |                  |                      |                          |                             |                  |
| Growth rates   | n/a                    |                  | n/a     |                  | N                     | IN               | N                    | BH,DJ,EG,IN,<br>KW,MD,QA | N                           | IN               |
| Genetics   | n/a                    |                  | n/a     |                  | N                     | IN               | Y                    | KW,SA,LK,YE              | Y                           | IN               |
| Stocks defined by genetic markers                                | n/a                    |                  | Y       | YE               | N                     | IN               | Y                    | SA,YE                    | Y                           | IN               |
| Remote tracking (satellite or other)                             | n/a                    |                  | n/a     |                  | N                     | IN               | Y                    | KW,MD,SA,LK              | Y                           | IN               |
| Survival rates   | n/a                    |                  | n/a     |                  | N                     | IN               | N                    | EG,IN,KW,MD,<br>QA       | N                           | IN               |
| Population dynamics  | n/a                    |                  | n/a     |                  | N                     | IN               | N                    | EG,IN,KW,MD,<br>QA       | N                           | IN               |
| Foraging ecology (diet or isotopes)                              | n/a                    |                  | n/a     |                  | N                     | IN               | Y                    | IN,SA                    | N                           | IN               |
| Capture-Mark-Recapture   | n/a                    |                  | n/a     |                  | N                     | IN               | Y                    | EG,MD,LK                 | Y                           | IN,LK            |

|   | <i>Caretta caretta</i> |                  |                 |                  | <i>Chelonia mydas</i> |                  |                           |                         | <i>Dermochelys coraicea</i> |                  |
|---|------------------------|------------------|-----------------|------------------|-----------------------|------------------|---------------------------|-------------------------|-----------------------------|------------------|
| RMU   | CC-NEIO                | Country Chapters | CC-NWIO         | Country Chapters | CM-NEIO               | Country Chapters | CM-NWIO                   | Country Chapters        | DC-NEIO                     | Country Chapters |
| <b>Threats</b>  |                        |                  |                 |                  |                       |                  |                           |                         |                             |                  |
| Bycatch: presence of small scale / artisanal fisheries? | Y (PLL,SN)             | SL               | Y (SN,GN,TR,HL) | YE               | n/a                   | IN               | Y (FP,GN,HL,PLL,SN,ST,TR) | BH,DJ,EG,MD,QA,SA,LK,YE | Y (PLL)                     | LK               |
| Bycatch: presence of industrial fisheries?              | n/a                    |                  | Y (ST)          | YE               | n/a                   | IN               | Y (DN,OTH,PLL,SN,ST)      | BH,MD,SA,YE             | n/a                         |                  |
| Bycatch: quantified?                                    | Y                      | SL               | N               | YE               | n/a                   | IN               | Y                         | BH,SA,LK                | Y                           | LK               |
| Take. Intentional killing or exploitation of turtles    | Y                      | SL               | Y               | YE               | n/a                   | IN               | Y                         | DJ,EG,MD,LK             | Y                           | LK               |
| Take. Egg poaching                                      | Y                      | SL               | Y               | YE               | n/a                   | IN               | Y                         | DJ,EG,MD,SA,LK,YE       | Y                           | LK               |
| Coastal Development. Nesting habitat degradation        | n/a                    |                  | Y               | YE               | n/a                   | IN               | Y                         | DJ,EG,KW,MD,SA          | n/a                         |                  |
| Coastal Development. Photopollution                     | Y                      | SL               | Y               | YE               | n/a                   | IN               | Y                         | DJ,KW,MD,SA,YE          | n/a                         | LK               |
| Coastal Development. Boat strikes                       | n/a                    |                  | Y               | YE               | n/a                   | IN               | Y                         | BH,EG,MD,SA,YE          | n/a                         |                  |
| Egg predation   | Y                      | SL               | Y               | YE               | n/a                   | IN               | Y                         | EG,SA,LK,YE             | Y                           | IN,LK            |
| Pollution (debris, chemical)                            | Y                      | SL               | n/a             |                  | n/a                   | IN               | Y                         | DJ,MD,SA,LK             | n/a                         | IN               |
| Pathogens   | n/a                    |                  | n/a             |                  | n/a                   | IN               | n/a                       |                         | n/a                         |                  |
| Climate change  | n/a                    |                  | n/a             |                  | n/a                   | IN               | Y                         | QA                      | n/a                         |                  |
| Foraging habitat degradation                            | n/a                    |                  | n/a             |                  | n/a                   | IN               | Y                         | BH,QA,SA                | n/a                         |                  |
| Other   |                        |                  | n/a             |                  | N                     | IN               | Y                         | BA,DJ,MD,QA             | N                           | IN               |
| <b>Long-term projects (&gt;5yrs)</b>                    |                        |                  |                 |                  |                       |                  |                           |                         |                             |                  |
| Monitoring at nesting sites (period: range of years)    | 1 (12: 2005-2017)      | SL               | Y (1998-2007)   | YE               | n/a                   | IN               | 4-27 yr                   | EG,KW,MD,SA,YE          | Y (2005-2018)               | IN,LK            |
| Number of index nesting sites                           | n/a                    |                  | 2               | YE               | n/a                   | IN               | 8                         | EG,KW,SA,YE             | 2                           | IN               |
| Monitoring at foraging sites (period: range of years)   | n/a                    |                  | n/a             | YE               | n/a                   | IN               | 11 (2011 - 2019)          | EG                      | n/a                         |                  |

| RMU  | <i>Caretta caretta</i>         |                  |         |                  | <i>Chelonia mydas</i> |                  |              |                                 | <i>Dermochelys coraicea</i> |                  |
|--|--------------------------------|------------------|---------|------------------|-----------------------|------------------|--------------|---------------------------------|-----------------------------|------------------|
|  | CC-NEIO                        | Country Chapters | CC-NWIO | Country Chapters | CM-NEIO               | Country Chapters | CM-NWIO      | Country Chapters                | DC-NEIO                     | Country Chapters |
| <b>Conservation</b>  |                                |                  |         |                  |                       |                  |              |                                 |                             |                  |
| Protection under national law                                      | Y                              | SL               | Y       | YE               | Y                     | IN               | Y            | BH,DJ,EG,IN, KW,MD,QA,SA, LK,YE | Y                           | IN,LK            |
| Number of protected nesting sites (habitat preservation) (% nests) | 2 (U %)                        | SL               | 1       | YE               | 0                     | IN               | >11 (0-100%) | EG,IN,KW,MD, SA,LK,YE           | 7 (U %)                     | IN,LK            |
| Number of Marine Areas with mitigation of threats                  | 16                             | SL               | 1       | YE               | 0                     | IN               | 24           | BH,DJ,LK,YE                     | 16                          | IN,LK            |
| N of long-term conservation projects (period: range of years)      | 2 (1996 to 2000, 2005 to 2012) | SL               | n/a     |                  | 0                     | IN               | >7           | EG,SA,LK,YE                     | 2                           | IN,LK            |
| In-situ nest protection (eg cages)                                 | Y                              | SL               | n/a     |                  | n/a                   | IN               | Y            | LK                              | Y                           | LK               |
| Hatcheries   | Y                              | SL               | n/a     |                  | n/a                   | IN               | Y            | LK                              | Y                           | IN               |
| Head-starting  | Y                              | SL               | n/a     |                  | n/a                   | IN               | Y            | MD,LK                           | N                           | LK               |
| Bycatch: fishing gear modifications (eg, TED, circle hooks)        | n/a                            |                  | n/a     |                  | n/a                   | IN               | Y            | SA                              | n/a                         |                  |
| Bycatch: onboard best practices                                    | n/a                            |                  | n/a     |                  | n/a                   | IN               | Y            | BH,MD,SA                        | n/a                         |                  |
| Bycatch: spatio-temporal closures/reduction                        | n/a                            |                  | n/a     |                  | n/a                   | IN               | Y            | BH,SA                           | n/a                         |                  |
| Other  | Y                              | SL               | n/a     |                  | N                     | IN               | Y            | SA                              | N                           | LK               |

**Table 1b. Key biological information for sea turtle RMUs (EI-NEIO; EI-NWIO; EI-SWIO; LO-NEIO; LO-NEIO (Arr); LO-WIO) in the Middle East and South Asia. Country Chapters: BH- Bahrain; DJ- Djibouti; EG- Egypt; IN- India; KW- Kuwait; MD- Maldives; QA- Qatar; SA- Saudi Arabia; LK- Sri Lanka; SU- Sudan; YE- Yemen.**

| RMU  | <i>Eretmochelys imbricata</i> |                  |                  |                      |                       |                  | <i>Lepidochelys olivacea</i> |                  |                     |                  |                  |                  |
|--|-------------------------------|------------------|------------------|----------------------|-----------------------|------------------|------------------------------|------------------|---------------------|------------------|------------------|------------------|
|  | EI-NEIO                       | Country Chapters | EI-NWIO          | Country Chapters     | EI-SWIO               | Country Chapters | LO-NEIO                      | Country Chapters | LO-NEIO (Arr)       | Country Chapters | LO-WIO           | Country Chapters |
| <b>Occurrence</b>  |                               |                  |                  |                      |                       |                  |                              |                  |                     |                  |                  |                  |
| Nesting sites  | Y                             | IN,LK            | Y                | EG                   | Y                     | MD               | Y                            | IN,LK            | Y                   | IN               | Y                | IN,MD            |
| Pelagic foraging grounds                                   | N                             | IN               | Y                | EG                   | JA                    | MD               | N                            | IN               | N                   | IN               | Y                | SU               |
| Benthic foraging grounds                                   | N                             | IN               | Y                | BH,DJ,KW,QA,SA,SU,YE | JA                    | MD               | N                            | IN               | N                   | IN               | Y                | BH               |
| <b>Key biological data</b>                                 |                               |                  |                  |                      |                       |                  |                              |                  |                     |                  |                  |                  |
| Nests/yr: recent average (range of years)                  | 54 (2014-2017)                | LK               | >515 (1985-2016) | EG,KW,QA,SA          | n/a                   |                  | 8,461 (2000-2017)            | IN,LK            | 23223.5 (2008-2016) | IN               | 1795 (2000-2016) | IN,MD            |
| Nests/yr: recent order of magnitude                        | n/a                           | IN,LK            | >1,240           | KW,QA,SA,SU, YE      | 10s                   | MD               | n/a                          |                  | n/a                 |                  | n/a              |                  |
| Number of "major" sites (>20 nests/yr AND >10 nests/km yr) | 0                             | LK               | 20               | EG,KW,QA,SA, SU,YE   | n/a                   |                  | 32                           | IN,LK            | 2                   | IN               | 14               | IN               |
| Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)  | 17                            | LK               | >60              | EG,KW,QA,SA, SU,YE   | 4                     | MD               | 51                           | IN,LK            | 1                   | IN               | 23               | IN,MD            |
| Nests/yr at "major" sites: recent average (range of years) | n/a                           |                  | 879 (1985-2016)  | QA,SA,YE             | n/a                   |                  | 7320 (2000-201)              | IN               | n/a                 |                  | 1730 (2000-2016) | IN               |
| Nests/yr at "minor" sites: recent average (range of years) | n/a                           |                  | >404 (1975-2015) | EG,KW,QA,SA, YE      | n/a                   |                  | 369 (2000-2016)              | IN               | n/a                 |                  | 64 (2000-2016)   | IN               |
| Total length of nesting sites (km)                         | 40                            | LK               | 21               | EG,SA                | n/a                   |                  | >288                         | IN,LK            | 6                   | IN               | >92              | IN               |
| Nesting females / yr                                       | n/a                           |                  | >300             | SA,YE                | n/a                   |                  | n/a                          |                  | n/a                 |                  | 1                | MD               |
| Nests / female season (N)                                  | n/a                           |                  | 1.9 (69)         | QA,SA                | n/a                   |                  | 1-3                          | LK               | n/a                 |                  | n/a              |                  |
| Female remigration interval (yrs) (N)                      | n/a                           |                  | n/a              |                      | n/a                   |                  | 1-4 (76)                     | LK               | n/a                 |                  | n/a              |                  |
| Sex ratio: Hatchlings (F / Tot) (N)                        | n/a                           |                  | n/a              |                      | n/a                   |                  | n/a                          |                  | n/a                 |                  | n/a              |                  |
| Sex ratio: Immatures (F / Tot) (N)                         | n/a                           |                  | 20% (74)         | QA                   | n/a                   |                  | n/a                          |                  | n/a                 |                  | n/a              |                  |
| Sex ratio: Adults (F / Tot) (N)                            | n/a                           |                  | n/a              |                      | 0.83(1293)-0.95 (714) | MD               | n/a                          |                  | n/a                 |                  | n/a              |                  |
| Min adult size, CCL or SCL (cm)                            | n/a                           |                  | 59.0-67.5 CCL    | KW,QA,SA,SU          | 63 SCL                | MD               | n/a                          |                  | 57 CCL              | IN               | n/a              |                  |

|  | <i>Eretmochelys imbricata</i> |                  |                         |                       |                  |                  | <i>Lepidochelys olivacea</i> |                  |                    |                  |                             |                  |
|--|-------------------------------|------------------|-------------------------|-----------------------|------------------|------------------|------------------------------|------------------|--------------------|------------------|-----------------------------|------------------|
| RMU  | EI-NEIO                       | Country Chapters | EI-NWIO                 | Country Chapters      | EI-SWIO          | Country Chapters | LO-NEIO                      | Country Chapters | LO-NEIO (Arr)      | Country Chapters | LO-WIO                      | Country Chapters |
| Age at maturity (yrs)  | n/a                           |                  | 71.5 ± 3.82             | SA                    | n/a              |                  | n/a                          |                  | n/a                |                  | n/a                         |                  |
| Clutch size (n eggs) (N)   | 115.2 (6)                     | LK               | 76.4 (79)               | EG,QA,SU              | n/a              |                  | 105.1 (30)                   | LK               | 120.58 (246)       | IN               | n/a                         |                  |
| Emergence success (hatchlings/egg) (N)                           | n/a                           |                  | 71.6% (167)             | EG,QA,SA              | n/a              |                  | n/a                          |                  | 0.78 (5362)        | IN               | n/a                         |                  |
| Nesting success (Nests/ Tot emergence tracks) (N)                | n/a                           |                  | ≈63 (30)                | SA                    | n/a              |                  | n/a                          |                  | n/a                |                  | n/a                         |                  |
| <b>Trends</b>  |                               |                  |                         |                       |                  |                  |                              |                  |                    |                  |                             |                  |
| Recent trends (last 20 yrs) at nesting sites (range of years)    | n/a                           |                  | Stable (2001-2016)      | KW,QA                 | n/a              |                  | Stable (2000-2016)           | IN               | Stable (2008-2016) | IN               | Stable (2000-2016)          | IN               |
| Recent trends (last 20 yrs) at foraging grounds (range of years) | n/a                           |                  | n/a                     |                       | Inc. (2012-2019) | MD               | n/a                          |                  | n/a                |                  | n/a                         |                  |
| Oldest documented abundance: nests/yr (range of years)           | n/a                           |                  | <394 (1982-2015)        | EG,KW,QA              | n/a              |                  | n/a                          |                  | n/a                |                  | n/a                         |                  |
| <b>Published studies</b>   |                               |                  |                         |                       |                  |                  |                              |                  |                    |                  |                             |                  |
| Growth rates   | N                             | IN               | N                       | BH,DJ,EG,IN, KW,QA,SU | N                | MD               | N                            | IN               | N                  | IN               | N                           | IN,MD,SU         |
| Genetics   | N                             | IN               | Y                       | SA                    | N                | MD               | Y                            | IN               | Y                  | IN               | Y                           | IN               |
| Stocks defined by genetic markers                                | N                             | IN               | Y                       | SA                    | N                | MD               | Y                            | IN               | Y                  | IN               | Y                           | IN               |
| Remote tracking (satellite or other)                             | N                             | IN               | Y                       | KW,QA                 | N                | MD               | Y                            | IN               | Y                  | IN               | Y                           | MD               |
| Survival rates   | N                             | IN               | N                       | BH,DJ,EG,IN, KW,QA,SU | Y                | MD               | N                            | IN               | N                  | IN               | N                           | IN,MD,SU         |
| Population dynamics  | N                             | IN               | N                       | BH,DJ,EG,IN, KW,QA,SU | Y                | MD               | Y                            | IN               | Y                  | IN               | N                           | IN,MD,SU         |
| Foraging ecology (diet or isotopes)                              | N                             | IN               | N                       | BH,DJ,EG,IN, KW,QA,SU | N                | MD               | N                            | IN               | N                  | IN               | N                           | IN,MD,SU         |
| Capture-Mark-Recapture   | N                             | IN               | Y                       | QA                    | Y                | MD               | Y                            | LK               | N                  | IN               | N                           | IN,MD,SU         |
| <b>Threats</b>   |                               |                  |                         |                       |                  |                  |                              |                  |                    |                  |                             |                  |
| Bycatch: presence of small scale / artisanal fisheries?          | Y (PLL,SN)                    | LK               | Y(FP,GN,HL, SN,ST,TR)   | BH,DJ,QA,SA, SU,YE    | n/a              |                  | Y (DN,PLL,SN)                | IN,LK            | Y (SN,DN)          | IN               | Y (SN,DN,ST,MT)             | BH,IN,SU         |
| Bycatch: presence of industrial fisheries?                       | n/a                           |                  | Y (DN, OTH, PLL,SN,ST ) | BH,SA,YE              | n/a              |                  | Y (PLL,ST,PT)                | IN               | Y (PLL, ST,PT)     | IN               | Y (DN, ST, SN, OTH, PLL,PT) | BH,IN,SU         |

| RMU   | <i>Eretmochelys imbricata</i> |                  |                 |                   |                  |                  | <i>Lepidochelys olivacea</i> |                  |                  |                  |        |                  |
|---|-------------------------------|------------------|-----------------|-------------------|------------------|------------------|------------------------------|------------------|------------------|------------------|--------|------------------|
|   | EI-NEIO                       | Country Chapters | EI-NWIO         | Country Chapters  | EI-SWIO          | Country Chapters | LO-NEIO                      | Country Chapters | LO-NEIO (Arr)    | Country Chapters | LO-WIO | Country Chapters |
| Bycatch: quantified?                                  | Y                             | LK               | Y (FP)          | BH,SA             | N                | MD               | Y                            | LK               | N                | IN               | Y      | BH,MD            |
| Take. Intentional killing or exploitation of turtles  | Y                             | LK               | Y               | DJ,EG,SU          | n/a              |                  | Y                            | LK               | n/a              |                  | N      | IN               |
| Take. Egg poaching                                    | Y                             | LK               | Y               | DJ,EG,SU          | n/a              |                  | Y                            | LK               | n/a              |                  | N      | IN               |
| Coastal Development. Nesting habitat degradation      | n/a                           |                  | Y               | EG,KW,QA,SA       | n/a              |                  | Y                            | IN               | Y                | IN               | Y      | IN               |
| Coastal Development. Photopollution                   | Y                             | LK               | Y               | DJ,KW,QA,SA,SU,YE | n/a              |                  | Y                            | IN,LK            | Y                | IN               | Y      | IN               |
| Coastal Development. Boat strikes                     | n/a                           |                  | Y               | BH,SA,YE          | n/a              |                  | Y                            | IN               | Y                | IN               | Y      | IN,MD            |
| Egg predation   | Y                             | LK               | Y               | EG,QA             | n/a              |                  | Y                            | IN,LK            | Y                |                  | Y      | IN               |
| Pollution (debris, chemical)                          | Y                             | LK               | Y               | SA                | n/a              |                  | Y                            | IN,LK            | Y                |                  | Y      | IN,MD            |
| Pathogens   | n/a                           |                  | n/a             |                   | n/a              |                  | n/a                          |                  | n/a              |                  | n/a    | MD               |
| Climate change  | n/a                           |                  | Y               | QA                | n/a              |                  | n/a                          |                  | n/a              |                  | n/a    |                  |
| Foraging habitat degradation                          | n/a                           |                  | Y               | BH,QA,SA,SU       | n/a              |                  | n/a                          |                  | n/a              |                  | n/a    | SU               |
| Other   | N                             | IN               | Y               | BH,QA,SU          | Y                | MD               | n/a                          |                  | n/a              |                  | n/a    | BH,SU            |
| <b>Long-term projects (&gt;5yrs)</b>                  |                               |                  |                 |                   |                  |                  |                              |                  |                  |                  |        |                  |
| Monitoring at nesting sites (period: range of years)  | 1 (12: 2005-2017)             | LK               | 7-28            | EG,KW,QA,SA       | Y (7: 2012-2019) | MD               | 1 (12: 2005-2017)            | LK               | Y (2008 ongoing) | IN               | N      | IN,MD            |
| Number of index nesting sites                         | n/a                           |                  | 10              | EG,KW,QA,SA,YE    | 0                | MD               | N                            | IN               | 3                | IN               | 0      |                  |
| Monitoring at foraging sites (period: range of years) | n/a                           |                  | 4 (2011 - 2015) | EG,KW,QA,SA,YE    | Y (7: 2012-2019) | MD               | N                            | IN               | N                |                  | N      | BH,IN,MD         |

|  | <i>Eretmochelys imbricata</i> |                  |                  |                              |         |                  | <i>Lepidochelys olivacea</i> |                  |               |                  |        |                  |
|--|-------------------------------|------------------|------------------|------------------------------|---------|------------------|------------------------------|------------------|---------------|------------------|--------|------------------|
| RMU  | EI-NEIO                       | Country Chapters | EI-NWIO          | Country Chapters             | EI-SWIO | Country Chapters | LO-NEIO                      | Country Chapters | LO-NEIO (Arr) | Country Chapters | LO-WIO | Country Chapters |
| <b>Conservation</b>  |                               |                  |                  |                              |         |                  |                              |                  |               |                  |        |                  |
| Protection under national law                                      | Y                             | IN,LK            | Y                | BH,DJ,EG,IN, KW,QA,SA,SU, YE | Y       | MD               | Y                            | IN,LK            | Y             | IN               | Y      | BH,IN,MD,SU      |
| Number of protected nesting sites (habitat preservation) (% nests) | 3 (U %)                       | LK               | >6 (0-100%)      | EG,IN,KW,QA, SA, YE          | 100%    | MD               | 7 (U %)                      | IN,LK            | 2 (50%)       | IN               | 100%   | MD               |
| Number of Marine Areas with mitigation of threats                  | 16                            | LK               | 9                | BH,DJ,IN,KW, SU, YE          | 0       | MD               | 16                           | IN,LK            | 0             | IN               | 6      | BH,SU            |
| N of long-term conservation projects (period: range of years)      | 2                             | LK               | 5 (1986-Present) | EG,QA,SA                     | 4       | MD               | >3                           | IN,LK            | >1            | IN               | 4      | MD               |
| In-situ nest protection (eg cages)                                 | Y                             | LK               | N                | EG,KW,QA,SA                  | 0       | MD               | Y                            | IN,LK            | Y             | IN               | n/a    |                  |
| Hatcheries   | Y                             | LK               | 1                | QA                           | 0       | MD               | Y                            | IN,LK            | Y             | IN               | Y      | IN               |
| Head-starting  | N                             | LK               | N                | EG,KW,QA,SA                  | 2       | MD               | Y                            | LK               | N             | IN               | Y      | MD               |
| Bycatch: fishing gear modifications (eg, TED, circle hooks)        | n/a                           | LK               | Y                | SA                           | U       | MD               | N                            | IN               | N             | IN               | N      | IN               |
| Bycatch: onboard best practices                                    | n/a                           | LK               | Y                | BH,SA                        | Y       | MD               | N                            | IN               | N             | IN               | Y      | BH,MD            |
| Bycatch: spatio-temporal closures/reduction                        | n/a                           | LK               | Y                | BH,SA                        | 0       | MD               | N                            | IN               | N             | IN               | Y      | BH               |
| Other  | Y                             | LK               | Y                | SA                           | N       | MD               | Y                            | LK               | n/a           |                  |        |                  |



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# BAHRAIN

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## Introduction

Sea turtles do not nest in Bahrain and there are no substantiated historic records to 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*) are frequently observed and these two species are reported on in detail below, whereas loggerhead turtles (*Caretta caretta*), leatherback turtles (*Dermochelys coriacea*) and olive ridley turtles (*Lepidochelys olivacea*) are identified from solitary or very infrequent records and are only summarised briefly.

## 1 RMU: *Chelonia mydas*, Northwest Indian Ocean (CM-NWIO)

### 1.1 Distribution, abundance, trends

#### 1.1.1 Nesting sites

No nesting of green turtles currently occurs in Bahrain (Table 1; [9]), but interviews with fishers suggests nesting may have occurred around 30 years ago. Further investigation of the potential for nesting to still occur is required).

#### 1.1.2 Marine areas

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

### 1.2 Other biological data

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

### 1.3 Threats

#### 1.3.1 Nesting sites

There are no nesting sites currently known for Bahrain (Table 1; [9]). Extensive land reclamation projects that alter Bahrain's natural coastline increasingly inhibit the potential for even low-level, sporadic nesting [8,13] except for the Hawar Islands that remain in relatively natural condition [7].

#### 1.3.2 Marine areas

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

## **1.4 Conservation**

Turtles are at least nominally afforded legal protection in Kuwait under several international and national regulations (Table 3), with several Marine Protected Areas established [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 few additional on-going conservation efforts for sea turtles in Bahrain [14]. Education activities and turtle rehabilitation efforts are undertaken by Environment Friends Society and Bahrain Turtle Rescue Team (Al-Muhannadi, unpubl.).

## **1.5 Research**

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

## **2 RMU: *Eretmochelys imbricata*, Northwest Indian Ocean (EI-NWIO)**

### **2.1 Distribution, abundance, trends**

#### **2.1.1 Nesting sites**

No nesting of hawksbill turtles currently occurs in Bahrain (Table 1; [9]), but interviews with fishers suggests nesting may have occurred around 30 years ago. Further investigation of the potential for nesting to still occur is required (Al-Muhannadi, pers.comm.).

#### **2.1.2 Marine areas**

Boat-traffic, fisheries and habitat degradation have all been identified as threats to hawksbill turtles in Bahrain (Table 1 [1,3,6,9]). Turtles are not reportedly target catch for consumption [2,45] but see [9].

### **2.2 Other biological data**

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

### **2.3 Threats**

#### **2.3.1 Nesting sites**

No nesting occurs. However extensive land reclamation projects that alter Bahrain's natural coastline increasingly inhibit the potential for even low-level, sporadic nesting [8,13] except for the Hawar Islands that remain in relatively natural condition [7].

#### **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**

No research on the biology or ecology of 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 any of these species.

**Table 1. Characteristics of nesting marine turtles in Bahrain.**

| RMU  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |             | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |            | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------------|-----------------------------|-------|-------------------------------|------------|------------------------------|-------|
|  | Cc-NWIO                | Ref # | Cm-NWIO               | Ref #       | Dc-U                        | Ref # | Ei-NWIO                       | Ref #      | Lo-WIO                       | Ref # |
| <b>Occurrence</b>  |                        |       |                       |             |                             |       |                               |            |                              |       |
| 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 | N (1 turtle!)               | 10    | Y                             | 1,3,6,9,12 | Y (1 or few turtles)         | 1     |
| <b>Key biological data</b>                                 |                        |       |                       |             |                             |       |                               |            |                              |       |
| 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                          |       |

|  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|------------------------------|-------|
| 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                          |       |
| <b>Trends</b>  |                        |       |                       |       |                             |       |                               |       |                              |       |
| 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                          |       |
| <b>Published studies</b>   |                        |       |                       |       |                             |       |                               |       |                              |       |
| 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                          |       |

|   | <i>Caretta caretta</i>   |       | <i>Chelonia mydas</i>    |                 | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |       |
|---|--------------------------|-------|--------------------------|-----------------|-----------------------------|-------|-------------------------------|-------|------------------------------|-------|
| RMU   | Cc-NWIO                  | Ref # | Cm-NWIO                  | Ref #           | Dc-U                        | Ref # | Ei-NWIO                       | Ref # | Lo-WIO                       | Ref # |
| <b>Threats</b>  |                          |       |                          |                 |                             |       |                               |       |                              |       |
| 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. Egg poaching                                      | 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     |
| <b>Long-term projects (&gt;5yrs)</b>                    |                          |       |                          |                 |                             |       |                               |       |                              |       |
| 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                            |       |

| RMU  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|------------------------------|-------|
|  | Cc-NWIO                | Ref # | Cm-NWIO               | Ref # | Dc-U                        | Ref # | Ei-NWIO                       | Ref # | Lo-WIO                       | Ref # |
| <b>Conservation</b>  |                        |       |                       |       |                             |       |                               |       |                              |       |
| 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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# 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 also occur in low density nesting populations; these two species are reported on in further detail 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*, Northwest 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, but 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 are 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 take of sea turtles and their eggs, with habitat degradation due to coastal development, litter, photopollution, and noise pollution all potentially increasing problems (Table 1; [3,4,6])

#### 1.3.2 Marine areas

Artisanal fisheries are regarded as 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 in Djibouti under several international and national regulations (Table 3), and in several Marine Protected Areas [5,8].

## **1.5 Research**

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

## **2 RMU: *Eretmochelys imbricata*, Northwest 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]) but there are no records of distribution, abundance or trends.

#### **2.1.2 Marine areas**

No data on distribution or abundance of hawksbill turtles in Djiboutian waters are 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 has been reported by either of these species. No information about their biology or ecology is available.

**Table 1. Characteristics of nesting marine turtles in Djibouti.**

| RMU  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|
|  | Cc NWIO                | Ref # | Cm NWIO               | Ref # | Dc U                        | Ref # | Ei NWIO                       | Ref # |
| <b>Occurrence</b>  |                        |       |                       |       |                             |       |                               |       |
| 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   |
| <b>Key biological data</b>                                 |                        |       |                       |       |                             |       |                               |       |
| 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   |

|  | <i>Caretta caretta</i> |              | <i>Chelonia mydas</i> |              | <i>Dermochelys coriacea</i> |              | <i>Eretmochelys imbricata</i> |              |
|--|------------------------|--------------|-----------------------|--------------|-----------------------------|--------------|-------------------------------|--------------|
| <b>RMU</b>   | <b>Cc NWIO</b>         | <b>Ref #</b> | <b>Cm NWIO</b>        | <b>Ref #</b> | <b>Dc U</b>                 | <b>Ref #</b> | <b>Ei NWIO</b>                | <b>Ref #</b> |
| 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          |
| <b>Trends</b>  |                        |              |                       |              |                             |              |                               |              |
| 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          |
| <b>Published studies</b>   |                        |              |                       |              |                             |              |                               |              |
| 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            |

|   | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       |
|---|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|
| RMU   | Cc NWIO                | Ref # | Cm NWIO               | Ref # | Dc U                        | Ref # | Ei NWIO                       | Ref # |
| <b>Threats</b>  |                        |       |                       |       |                             |       |                               |       |
| 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. Egg poaching                                      | n/a                    |       | Y                     | 4     | n/a                         |       | Y                             | 4     |
| 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                           |       |
| <b>Long-term projects (&gt;5yrs)</b>                    |                        |       |                       |       |                             |       |                               |       |
| 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                           |       |

|  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|
| RMU  | Cc NWIO                | Ref # | Cm NWIO               | Ref # | Dc U                        | Ref # | Ei NWIO                       | Ref # |
| <b>Conservation</b>  |                        |       |                       |       |                             |       |                               |       |
| 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/<br>Nesting beach name | Index site | Nests/yr: recent average<br>(range of years) | Crawls/yr: recent average<br>(range of years) | Length (km) | % Monitored | Reference # | Monitoring Level<br>(1-2) | Monitoring<br>Protocol (A-F) |
|----------------------------|------------|--|---|-------------|-------------|-------------|---------------------------|------------------------------|
| <b>Cm NWIO</b>             |            |  |   |             |             |             |                           |                              |
| 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 Island         | n/a        | n/a  | n/a   | n/a         | n/a         | 5           | 2                         | n/a                          |
| <b>Ei NWIO</b>             |            |  |   |             |             |             |                           |                              |
| Ras Siyyan                 | n/a        | n/a  | n/a   | n/a         | n/a         | 1,5         | 2                         | n/a                          |
| Sept Freres Island         | n/a        | n/a  | n/a   | n/a         | n/a         | 1,5         | 2                         | n/a                          |
| <b>Unknown Species</b>     |            |  |   |             |             |             |                           |                              |
| 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.**

| <b>International Conventions</b>                                       | <b>Signed</b> | <b>Binding</b> | <b>Compliance measured and reported</b> | <b>Species</b> | <b>Conservation actions</b> |
|--|---------------|----------------|---|----------------|-----------------------------|
| Marine Fishery Administration Law for the Red Sea State                | Y             | n/a            | n/a                                     | All            | n/a                         |
| African Convention 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                         |
| <b>National Conventions</b>  |               |                |   |                |                             |
| 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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- | # REF | Full reference   |
|-------|--|
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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 Island, Ras Bagdai and Um El-Abas.

Zabargad Island 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 Island 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 island [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 poached occasionally by people living along the coast and fisher-folk with access to remote islands and preyed 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, pers. comm.).

#### **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, unpublished) 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, pers. obs.) [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 Island, 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 program 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 and Small Giftun islands were monitored annually between 2001 and 2008, with an average of 20.7 and 8.2 nests per year reported for each site respectively [1]. For Shedwan island, 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 nest poaching is possible (estimated at 0-10% of total nests; Mancini and ElSadek, pers. obs.). Shedwan Island is not yet protected but a proposal has been made to put it under the jurisdiction of the Red Sea Protectorate (Hanafy, pers. comm.).

#### **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 poached occasionally 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, pers. comm.). Intensified traffic on roads close to the shoreline and therefore to nesting sites is also a cause of concern (Hanafy, pers. obs.).

#### **2.3.2 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, unpublished) 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, pers. obs.) [7,9].

### **2.4 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].

## **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.**

| RMU  | <i>Chelonia mydas</i> |             | <i>Eretmochelys imbricata</i> |          |
|--|-----------------------|-------------|-------------------------------|----------|
|  | CM-NWIO               | Ref #       | EI-NWIO                       | Ref #    |
| <b>Occurrence</b>  |                       |             |                               |          |
| Nesting sites  | Y                     | 1,7         | Y                             | 1        |
| Pelagic foraging grounds                                   | JA                    | 4,5,10      | JA                            | 3, 9, 10 |
| Benthic foraging grounds                                   | JA                    | 3           | n/a                           |          |
| <b>Key biological data</b>                                 |                       |             |                               |          |
| Nests/yr: recent average (range of years)                  | 570.7 (2012-2014)     | 10          | 28.9 (2001-2007)              | 1        |
| 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           | 28.9 (2001-2007)              | 1        |
| 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                           |          |



| RMU  | CM-NWIO                  | Ref #  | EI-NWIO              | Ref # |
|--|--------------------------|--------|----------------------|-------|
| <b>Trends</b>  |                          |        |                      |       |
| 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     |
| <b>Published studies</b>   |                          |        |                      |       |
| 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                    |       |
| <b>Threats</b>   |                          |        |                      |       |
| 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. Egg poaching   | Y                        | 7      | Y                    | 2     |
| Coastal Development. Nesting habitat degradation                 | Y                        | 7      | Y                    | 7     |
| Coastal Development. Photopollution                              | n/a                      |        | n/a                  | 7     |
| 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                  |       |
| Other  | n/a                      |        | n/a                  |       |

| RMU  | CM-NWIO            | Ref #        | EI-NWIO            | Ref #    |
|--|--------------------|--------------|--------------------|----------|
| <b>Long-term projects (&gt;5yrs)</b>                               |                    |              |                    |          |
| 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 |
| <b>Conservation</b>  |                    |              |                    |          |
| 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      |              |                         |                        |   |
| <b>CM-NWIO</b>     |            |   |  |               |          |              |                         |                        |   |
| Umm-Al Abas        | N          | 16.3<br>(2001-2007)                       | 29.4<br>(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<br>(2001-2006)                       | 29.8<br>(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 Island    | Y          | 570.7<br>(2012-2014)                      | 1660<br>(2012-2014)                        | 35.80281      | 23.83475 | 3.0          | 2, 10, Google Earth Pro | 1                      | F (but based on 3-11 consecutive night surveys)                                 |
| <b>EI-NWIO</b>     |            |   |  |               |          |              |                         |                        |   |
| Big Giftun         | NA         | 18.6<br>(2001, 2003-2007)                 | 93.8<br>(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<br>(2001, 2003-2007)                  | 26.8<br>(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 established by the CITES national legislation under the framework |
| 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 monitorin; 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 Island | 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 2 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 poaching of nests by human communities 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 NGO's 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 poaching of nests by human communities 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 NGO's 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 NIO RMU with limited attention given to the solitary nesting population of both the NIO 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 is 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 is extensive nest protection measures and hatcheries being maintained across the mainland coast [9] while there is minimal poaching 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 Island, 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 in 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 Island 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**

Minimal poaching events have 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 have 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.**

| RMU  | <i>Lepidochelys olivacea</i> |       |                 |       |                  |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i>   |       | <i>Eretmochelys imbricata</i> |       |          |       |
|--|------------------------------|-------|-----------------|-------|------------------|-------|-----------------------|-------|----------|-------|---|-------|-------------------------------|-------|----------|-------|
|  | 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 # |
| <b>Occurrence</b>  |                              |       |                 |       |                  |       |                       |       |          |       |   |       |                               |       |          |       |
| 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        |       |
| <b>Key biological data</b>                                 |                              |       |                 |       |                  |       |                       |       |          |       |   |       |                               |       |          |       |
| Nests/yr: recent average (range of years)                  | 132,248 (2008-2016)          | 18    | 7689(2000-2016) | 21    | 1794 (2000-2016) | 1     | n/a                   |       | n/a      |       | All of Nicobar and Little Andaman 1299 (2016) and at 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    | 7320 (2000-201) | 1, 21 | 1730 (2000-2016) | 1     | n/a                   |       | n/a      |       | 97.46 (2016)  | 23    | n/a                           |       | n/a      |       |
|  | <i>Lepidochelys olivacea</i> |       |                 |       |                  |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i>   |       | <i>Eretmochelys imbricata</i> |       |          |       |



| 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      |       |

| RMU  | <i>Lepidochelys olivacea</i> |       |                    |       |                    |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i> |        | <i>Eretmochelys imbricata</i> |       |          |       |
|--|------------------------------|-------|--------------------|-------|--------------------|-------|-----------------------|-------|----------|-------|-----------------------------|--------|-------------------------------|-------|----------|-------|
|  | 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 # |
| <b>Trends</b>  |                              |       |                    |       |                    |       |                       |       |          |       |                             |        |                               |       |          |       |
| 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      |       |
| <b>Published studies</b>   |                              |       |                    |       |                    |       |                       |       |          |       |                             |        |                               |       |          |       |
| 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        |       |

| RMU   | <i>Lepidochelys olivacea</i> |       |                |       |                 |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i> |            | <i>Eretmochelys imbricata</i> |       |          |       |
|---|------------------------------|-------|----------------|-------|-----------------|-------|-----------------------|-------|----------|-------|-----------------------------|------------|-------------------------------|-------|----------|-------|
|   | 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 # |
| <b>Threats</b>  |                              |       |                |       |                 |       |                       |       |          |       |                             |            |                               |       |          |       |
| 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. Egg poaching                                      | 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        |       |

| RMU  | <i>Lepidochelys olivacea</i> |       |          |       |         |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i> |          | <i>Eretmochelys imbricata</i> |       |          |       |
|--|------------------------------|-------|----------|-------|---------|-------|-----------------------|-------|----------|-------|-----------------------------|----------|-------------------------------|-------|----------|-------|
|  | 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 # |
| <b>Long-term projects (&gt;5yrs)</b>                               |                              |       |          |       |         |       |                       |       |          |       |                             |          |                               |       |          |       |
| 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      |       |
| <b>Conservation</b>  |                              |       |          |       |         |       |                       |       |          |       |                             |          |                               |       |          |       |
| 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      |       |

| RMU   | <i>Lepidochelys olivacea</i> |       |          |       |         |       | <i>Chelonia mydas</i> |       |          |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       |          |       |
|---|------------------------------|-------|----------|-------|---------|-------|-----------------------|-------|----------|-------|-----------------------------|-------|-------------------------------|-------|----------|-------|
|   | 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 |          | Eastern limit |          | Central point |           | Length (km) | % Monitored | Reference # | Monitoring Level (1-2) | Monitoring Protocol (A-F) |
|---|------------|---|--|---------------|----------|---------------|----------|---------------|-----------|-------------|-------------|-------------|------------------------|---------------------------|
|   |            |   |  | Lon           | Lat      | Lon           | Lat      | Lon           | Lat       |             |             |             |                        |                           |
| <b>LO-NEIO (Arribada)</b>                 |            |   |  |               |          |               |          |               |           |             |             |             |                        |                           |
| 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           |                        |                           |
| <b>LO-NEIO</b>                            |            |   |  |               |          |               |          |               |           |             |             |             |                        |                           |
| 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 Island                               |            | 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           |                        |                           |
| Sacramento Island                         |            | 1119                                      |  | 82.31629      | 16.59318 | 82.287        | 16.56796 |               |           | 3           |             | 6           |                        |                           |

|                               |  |          |  |          |          |        |          |  |  |    |  |    |  |  |
|-------------------------------|--|----------|--|----------|----------|--------|----------|--|--|----|--|----|--|--|
| 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 |  |  |
| Habalikhathi                  |  | ~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 |  |  |
| Sonapur                       |  |          |  | 84.78614 | 19.11217 |        |          |  |  |    |  | 16 |  |  |
| Agarnasi                      |  | ~300-400 |  | 86.80545 | 20.50289 |        |          |  |  |    |  | 17 |  |  |
| Akashdia Island (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 |  |
| Kharakheta-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-Kharakheta      |  | 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 |  |  |
| 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 |  |  |
| Harihreshwar                            | 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 |  |  |
| <b>CM-NEIO</b>        |  |    |  |          |          |        |          |           |           |   |  |    |  |  |
| 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  |  |  |
| 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 |  |  |
| 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 |  |  |
| 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 |  |  |
| 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<br>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 |  |  |

|   |  |     |  |          |          |        |          |           |           |     |  |    |  |  |
|---|--|-----|--|----------|----------|--------|----------|-----------|-----------|-----|--|----|--|--|
| 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  |  |  |
| <b>CM-NWIO</b>                          |  |     |  |          |          |        |          |           |           |     |  |    |  |  |
| 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  |  |  |
| 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 |   |   |
| <b>DC-NEIO</b>        |   |     |  |          |          |        |          |           |           |     |  |   |   |   |
| 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 |   |   |
| 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  |  |  |
| <b>EI-NWIO</b>         |  |  |  |  |  |  |  |           |           |  |  |    |  |  |
| Agatti                 |  |  |  |  |  |  |  | 72.193788 | 10.853976 |  |  | 12 |  |  |
| <b>EI-NEIO</b>         |  |  |  |  |  |  |  |           |           |  |  |    |  |  |
| 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  |  |  |
| 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  |  |  |

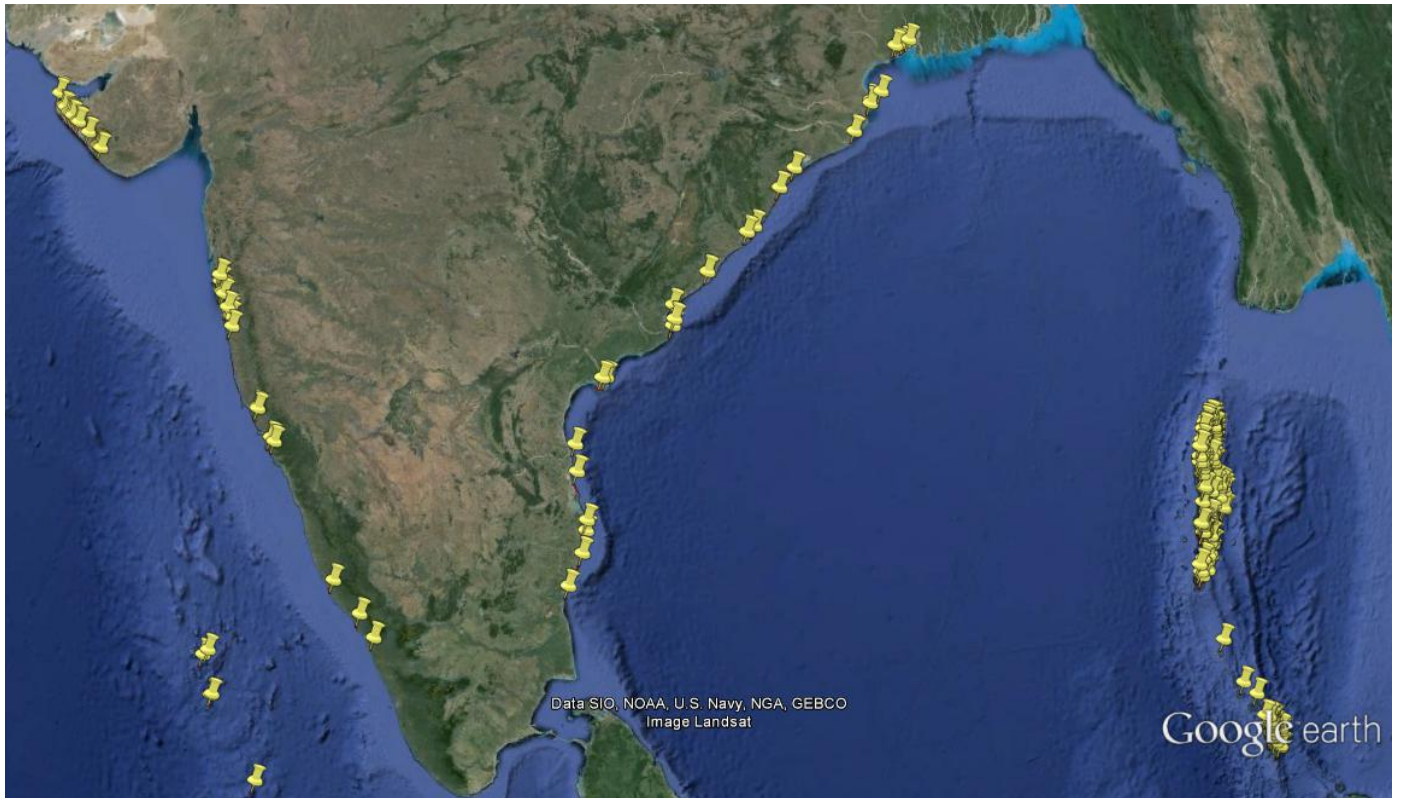


|                |  |  |  |  |  |  |  |           |           |  |  |   |  |  |
|----------------|--|--|--|--|--|--|--|-----------|-----------|--|--|---|--|--|
| English        |  |  |  |  |  |  |  | 93.119474 | 12.135428 |  |  | 1 |  |  |
| Interview      |  |  |  |  |  |  |  | 92.666926 | 12.890229 |  |  | 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 |  |  |
| 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 | Conservation actions | Relevance to sea turtles |
|---------------------------|--------|---------|----------------------------------|---------|----------------------|--------------------------|
| IOSEA NIOMTTF             | Y      | N       | Y                                | All     |                      |                          |





**Figure 1. Nesting areas for all sea turtle species in India: reproduced from reference 1.**

## References

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|-------|---|
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# KUWAIT

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## 1 RMU: *Chelonia mydas*, Northwest 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-Maradim 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 Island (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 Island, 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 on-going 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 Island should be prioritised, together with genetic characterisation of the turtles foraging there.

Monitoring of Qaru Island 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*, Northwest 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**

Limited information on hawksbill marine areas in Kuwait has been published. However, several coastal foraging sites have been identified for adult females [8]. One adult male was known to be resident at Qaru [6] and a single adult female migrated to Kuwait's coastal waters from a distant nesting area [7].

### **2.2 Other biological data**

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

### **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 Island and Um Al-Maradim (Table 4, [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.**

|  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       |
|--|-----------------------|-------|-------------------------------|-------|
| RMU  | CM-NWIO               | Ref # | EI-NWIO                       | Ref # |
| <b>Occurrence</b>  |                       |       |                               |       |
| 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)                         | 6,7,8 |
| <b>Key biological data</b>                                 |                       |       |                               |       |
| 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                   |       | n/a                           |       |
| Emergence success (hatchlings/egg) (N)                     | N/a                   |       | n/a                           |       |
| Nesting success (Nests/ Tot emergence tracks) (N)          | N/a                   |       | N/a                           |       |
|  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       |
| RMU  | CM-NWIO               | Ref # | EI-NWIO                       | Ref # |

| RMU  | <i>Chelonia mydas</i> |         | <i>Eretmochelys imbricata</i> |         |
|--|-----------------------|---------|-------------------------------|---------|
|  | CM-NWIO               | Ref #   | EI-NWIO                       | Ref #   |
| <b>Trends</b>  |                       |         |                               |         |
| 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 |
| <b>Published studies</b>   |                       |         |                               |         |
| Growth rates   | N                     |         | N                             |         |
| Genetics   | Y                     | 4       | N                             |         |
| Stocks defined by genetic markers                                | N                     |         | N                             |         |
| Remote tracking (satellite or other)                             | Y                     | 1,2     | Y                             | 2,8     |
| Survival rates   | N                     |         | N                             |         |
| Population dynamics  | N                     |         | N                             |         |
| Foraging ecology (diet or isotopes)                              | N                     |         | N                             |         |
| Capture-Mark-Recapture   | N                     |         | N                             |         |
| <b>Threats</b>   |                       |         |                               |         |
| 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. Egg poaching   | 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                           |         |

| RMU  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       |
|--|-----------------------|-------|-------------------------------|-------|
|  | CM-NWIO               | Ref # | EI-NWIO                       | Ref # |
| Foraging habitat degradation                                       | n/a                   |       | n/a                           |       |
| Other:   | n/a                   |       | n/a                           |       |
| Monitoring at nesting sites (period: range of years)               | Y (2008-2015)         | 1,2,3 | Y (2008-2015)                 | 1,2,3 |
| 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                           |       |
| <b>Conservation</b>  |                       |       |                               |       |
| 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                             |       |
| 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. 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 |           | Length (km) | % Monitored | Reference # | Monitoring Level (1-2) | Monitoring Protocol | Ref. # |
|---|------------|---|--|---------------|-----------|-------------|-------------|-------------|------------------------|---------------------|--------|
|   |            |   |  | Long          | Lat       |             |             |             |                        |                     |        |
| <b>CM-NWIO</b>                                |            |   |  |               |           |             |             |             |                        |                     |        |
| <b>Qaru Island - Beach A</b>                  | Y          | 7 (2004-2015)                             | 12 (2004-2015)                             | 48.776344     | 28.817623 | 0.65        | 100         | 1,4         |                        | *                   | 1      |
| <b>Umm Al-Maradim Island – beach B (west)</b> | N          | 15 (2004) - no nesting since!             | N/A  | 48.650499     | 28.678678 | 0.19        | 100         | 1,4         |                        | *                   |        |
| <b>EI-NWIO</b>                                |            |   |  |               |           |             |             |             |                        |                     |        |
| <b>Qaru Island -Beach A</b>                   | Y          | 17 (2008-2011), 4 (2013), 25 (2015)       | 33 (2008-2011), 11 (2013), 31 (2015)       | 48.776344     | 28.817623 | 0.65        | 100         | 2,3,5       |                        | *                   |        |
| <b>Umm Al-Maradim Island- Beach B (West)</b>  | Y          | 1 (2013), 1 (2015)                        | 3 (2013), 1 (2015)                         | 48.650499     | 28.678678 | 0.19        | 100         | 2,3,5       |                        | *                   |        |
| <b>Umm Al-Maradim Island- Beach C (North)</b> | Y          | 13 (2008-2011), 4 (2013), 10 (2015)       | 18 (2008-2011), 4 (2013)                   | 48.682345     | 28.652999 | 0.23        | 100         | 2,3,5       |                        | *                   |        |
| <b>Ras Al Zour -beach d</b>                   | N          | N/A                                       | N/A  | 48.391319     | 28.741793 | 2.6         | 100         | 2           |                        |                     |        |

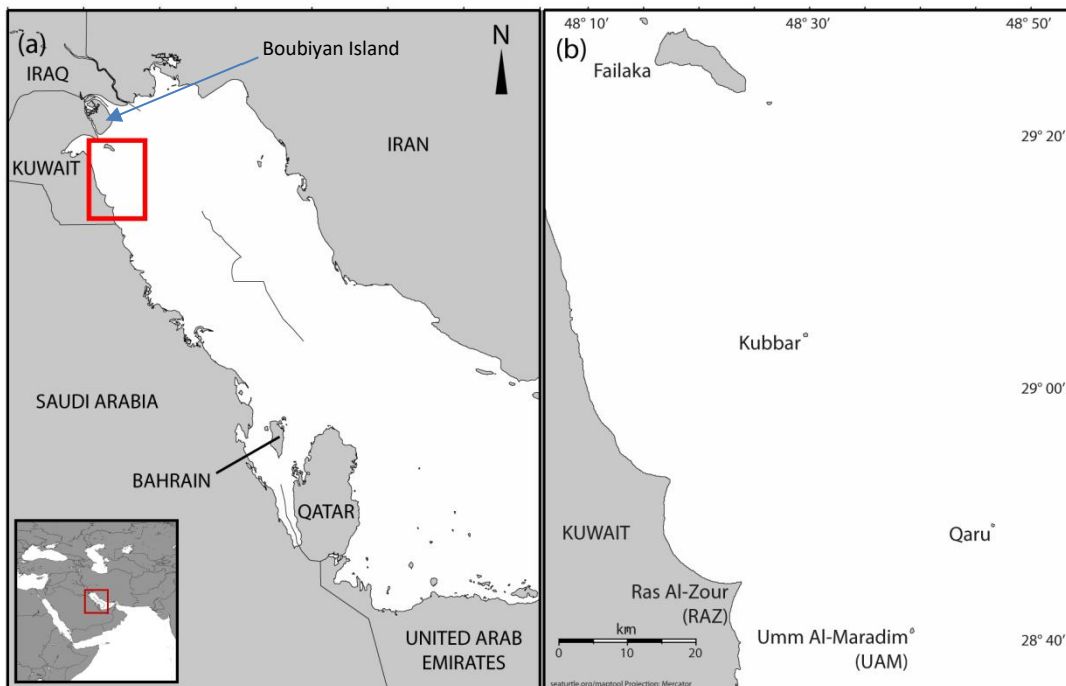
\*Monthly fieldwork comprising periods of ca.8 d were undertaken between May and August. Patrols were undertaken at hourly intervals between dusk and dawn on Qaru. Track surveys were undertaken on UAM at least once per field period to look for green turtle emergences. In 2012, the islands were surveyed 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 and 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 Island 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. |

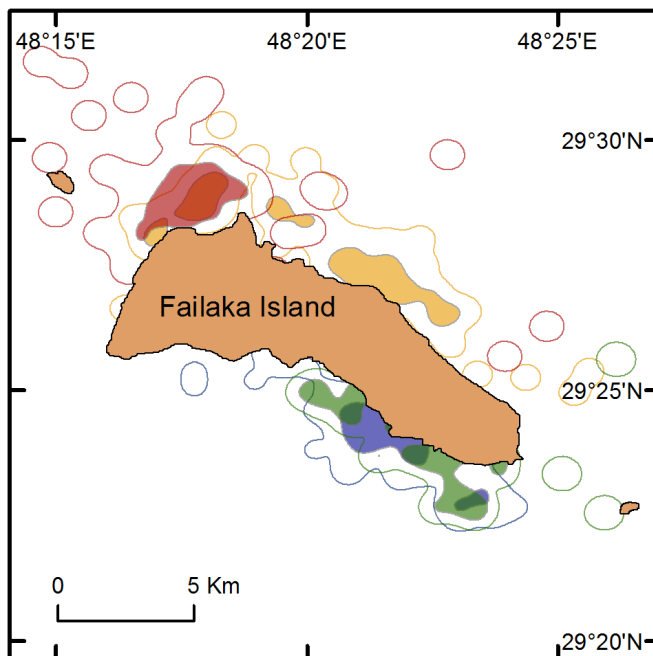
**Table 4. Marine turtle projects and databases in Kuwait.**

| #    | 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-NWIO  | 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 | <a href="http://www.seaturtle.org/tracking/?project_id=503">http://www.seaturtle.org/tracking/?project_id=503</a> |                  | ALan F Rees<br>a.f.rees@exeter.ac.uk | Nancy Papathanasopoulou<br>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 | <a href="http://www.seaturtle.org/tracking/?project_id=503">http://www.seaturtle.org/tracking/?project_id=503</a> |                  | ALan F Rees<br>a.f.rees@exeter.ac.uk | Nancy Papathanasopoulou<br>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                                   | <a href="http://www.seaturtle.org/tracking/?project_id=921">http://www.seaturtle.org/tracking/?project_id=921</a> |                  | ALan F Rees<br>a.f.rees@exeter.ac.uk | Nancy Papathanasopoulou<br>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 Island as a foraging / overwintering area. Home ranges of four green turtles are presented here. Figure reproduced from [2].

## References

| # REF | Full reference   |
|-------|--|
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| 2     | Rees, AF, Papathanasopoulou, N, Godley, BJ 2018. Satellite tracking of sea turtles in Kuwait: findings and further research needs. <i>Indian Ocean Turtle Newsletter</i> 28: 23-26.  |
| 3     | Papathanasopoulou N. 2015a. Turtles in Kuwait Unpublished data 2008-2011, 2013, 2015 nesting seasons.  |
| 4     | Al-Mohanna, SY, Al-Zaidan, AY, George, P 2014. Green turtles ( <i>Chelonia mydas</i> ) of the north-western Arabian Gulf, Kuwait: the need for conservation. <i>Aquatic Conservation: Marine and Freshwater Ecosystems</i> . 24: 166-178   |
| 5     | Papathanasopoulou, N 2015b KTCP July 2015 report summary, unpublished  |
| 6     | Rees, AF, Al-Hafez AA, Papathanasopoulou N 2013. Utility of sea turtle photo ID techniques: the example of a male hawksbill in Kuwait. <i>Indian Ocean Turtle Newsletter</i> 17: 23-25   |
| 7     | Pilcher NJ, Antonopoulou M, Perry L, Abdel-Moati MA, Al Abdessalaam TZ, Albeldawi M, Al Ansi M, Al-Mohannadi SF, Al Zahlawi N, Baldwin R, Chikhi A, Das HS, Hamza S, Kerr OJ, Al Kiyumi A, Mobaraki A, Al Suwaidi HS, Al Suweidi AS, Sawaf M, Tourenq C, Williams J, Willson A. 2014. Identification of Important Sea Turtle Areas (ITAs) for hawksbill turtles in the Arabian Region. <i>JExpMarBiolEcol</i> 460: 89-99 |
| 8     | Rees AF, Papathanasopoulou N, Godley BJ 2019 Tracking hawksbills in Kuwait: contributions to regional behavioural insights. <i>Chelonian Conservation and Biology</i> 18: 86-90  |



# MALDIVES

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## 1 RMU: *Chelonia mydas*, Northwest Indian Ocean (CM-NWIO)

### 1.1 Distribution, abundance, trends

#### 1.1.1 Nesting sites

Green sea turtle are the most common species of turtle found nesting in the Maldives [1,3], with nesting confirmed on 36 islands. The actual number of nesting sites is likely much greater than the recorded number. Many islands report turtle nesting activity but the nesting species and level of nesting activity 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 (Fig. 2; Table 2, 3).

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 2).

#### 1.1.2 Marine areas

Green sea turtles can be observed all throughout the archipelago and, as of the end of 2018, a citizen science photo ID initiative that began in 2013 has identified at least 660 individual green turtles across 13 atolls. Both juveniles and adults are seen 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] (Table 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].

### 1.2 Other biological data

Hatching success varies between 33.7 to 96.8% and average incubation time before hatching is 56.2 days [3].

### 1.3 Threats

#### 1.3.1 Nesting sites

Poaching 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 reportedly poached [1]. Eggs and turtles are usually taken for personal consumption as food. Hunting of turtles seem to be more opportunistic than through organised effort. 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 2).

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. Dumping of waste on the beach is a common practice in many islands, this causes pollutants and other debris to accumulate on the beach leading to the degradation of the condition of the beach. Light pollution due to night time activity can disrupt turtle nesting and can confuse hatchlings as well [1] (Table 2).

Severe erosion of beaches, a common issue in the Maldives, can reduce the length of beach stretch 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 [17]

### **1.3.2 Marine areas**

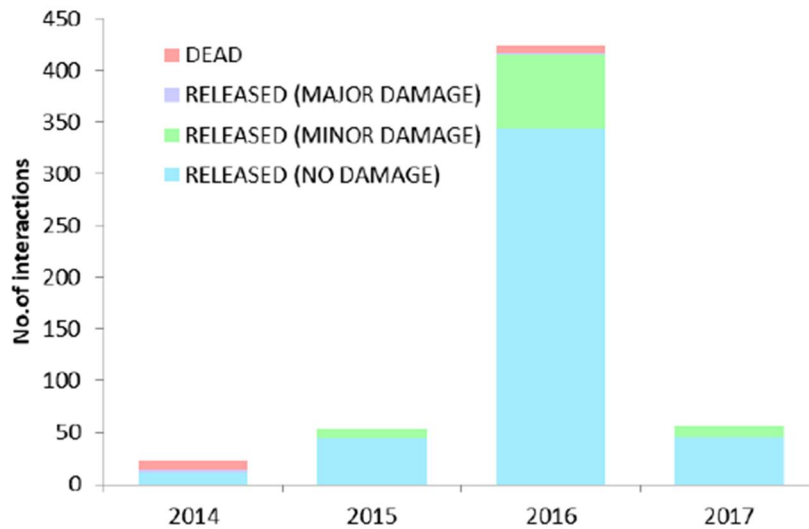
Removal of sea grass beds is a common practice especially in resorts as they are considered to be unsightly. Poaching of turtles from foraging grounds is reported but is not as common as poaching from nesting sites (Table 2).

Bycatch of turtles is reported in long line fisheries 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 with no damage. It is unknown why such a large number of turtles were caught in 2016 compared to other years.

**Table 1. Number of turtles caught as bycatch in long line fisheries 2014-2017 [4][5]**

| Year | Number of vessels | Reported annual bycatch |
|------|-------------------|-------------------------|
| 2014 | 71                | 24                      |
| 2015 | 28                | 53                      |
| 2016 | 42                | 424                     |
| 2017 | 34                | 56                      |

**Figure 1. Fate of turtles caught in long line fisheries (2014-2017) [4].**



More than 700 stranding 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. Poaching 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 and was in effect until 2015. Poaching of eggs was not banned under this moratorium. In 2006, poaching of turtle eggs was banned from 14 islands of the Maldives. Eggs could legally be poached from other islands until 2016.

Although turtles and their eggs are legally protected, poaching of turtles and eggs is still quite common in the country. Better enforcement of existing legislature 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 amongst locals 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*, Southwest Indian Ocean (EI-SWIO)**

### **2.1 Distribution, abundance, trends**

#### **2.1.1 Nesting sites**

Hawksbill turtles are confirmed to nest in 7 islands of the Maldives. Five of these islands are located in Baa atoll. 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 have not been carried out so trends at nesting sites is not known (Fig. 3; Table 2, 3).

#### **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] although this may be due to data mainly being obtained from coral reef surveys, the preferred habitat of hawksbill turtles (Table 2).

Maldivian waters are home to at least 3200 hawksbill turtles [12], 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 atoll of Baa may be a particularly important habitat for juveniles [3] (Table 2).

### **2.2 Other biological data**

None available.

### **2.3 Threats**

#### **2.3.1 Nesting sites**

Poaching of hatchlings for pet trade. Destruction and degradation of nesting sites due to coastal development, erosion and pollution [1] (Table 2).

#### **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 2).

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

### **2.4 Conservation**

See section 1.4.

## **2.5 Research**

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

## **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 in the country. Only 3 nesting events are recorded to date. All of these were recorded in late 2018 to early 2019. A nest was observed on the island of Hanimaadhoo in Haa Dhaalu atoll, a false nesting event at Coco Palm Dhunikolhu in Baa atoll and two hatchlings were found on the island of Muravandhoo in Raa atoll (Fig. 3; Table 2, 3).

#### **3.1.2 Marine areas**

Olive Ridelys 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 620 entangled or stranded Olive Ridley turtles were found between 1 January 2014 and 31 December 2018 [PS] (Table 2).

### **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. Flipper amputation due to entanglement in derelict fishing nets is commonly reported. The use of fishing nets in Maldives is extremely rare and it is thought that the ghost nets and entangled turtles in Maldivian waters originate from other South Asian and South East Asian countries [6].

### **3.4 Conservation**

See section 1.4.

### **3.5 Research**

Genetics- Tissue samples were taken from 45 *L. olivacea* found entangled in ghost nets in the Maldives between 2017 and 2018. The mtDNA control region was compared with nesting females along Masirah Island, Oman (n=33) and available published haplotypes from nesting females in India [12] and Sri Lanka [13] and Australia [14]. Mixed stock analyses will be performed to find which population entangled *L. olivacea* drifting into the Maldives belong too [PS]

Predictive models- Random forest classifiers are being built to better estimate which fishing net characteristics are most problematic to *L. olivacea* and estimate total number of unseen turtles entangled in all nets [PS].

**Table 2. Key biological information for sea turtles in the Maldives**

| RMU  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|--|-----------------------|-------|-------------------------------|-------|------------------------------|------|
|  | CM-NWIO               | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| <b>Occurrence</b>  |                       |       |                               |       |                              |      |
| 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                          |      |
| <b>Key biological data</b>                                 |                       |       |                               |       |                              |      |
| 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) | 12                    | PS    | n/a                           |       | 0                            |      |
| Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)  | 24                    | PS    | 4                             | PS    | 2                            | PS   |
| Nests/yr at "major" sites: recent average (range of years) | n/a                   |       | n/a                           |       | n/a                          |      |
| Nests/yr at "minor" sites: recent average (range of years) | n/a                   |       | n/a                           |       | n/a                          |      |
| Total length of nesting sites (km)                         | n/a                   |       | n/a                           |       | n/a                          |      |
| Nesting females / yr                                       | 103                   | 1     | n/a                           |       | 1                            | PS   |

| RMU  | <i>Chelonia mydas</i>     |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|--|---------------------------|-------|-------------------------------|-------|------------------------------|------|
|  | CM-NWIO                   | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| 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)-<br>0.93 (668) | 1,3   | 0.83(1293)-<br>0.95 (714)     | 1,3   | n/a                          |      |
| Min adult size, CCL or SCL (cm)                                  | n/a                       |       | 63 SCL                        | PS    | n/a                          |      |
| Age at maturity (yrs)  | n/a                       |       | n/a                           |       | n/a                          |      |
| Clutch size (n eggs) (N)   | n/a                       |       | n/a                           |       | 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                          |      |
| <b>Trends</b>  |                           |       |                               |       |                              |      |
| Recent trends (last 20 yrs) at nesting sites (range of years)    | Dec. (1984-<br>2015)      | 1,2   | n/a                           |       | n/a                          |      |
| Recent trends (last 20 yrs) at foraging grounds (range of years) | n/a                       |       | Inc. (2012-<br>2019)          | PS    | n/a                          |      |
| Oldest documented abundance: nests/yr (range of years)           | 1018 (1984)               | 2     | n/a                           |       | n/a                          |      |



| RMU   | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|---|-----------------------|-------|-------------------------------|-------|------------------------------|------|
|   | CM-NWIO               | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| <b>Published studies</b>                                |                       |       |                               |       |                              |      |
| Growth rates  | N                     |       | N                             |       | N                            |      |
| Genetics  | N                     |       | N                             |       | N                            |      |
| Stocks defined by genetic markers                       | N                     |       | N                             |       | N                            |      |
| 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    | Y                             | PS    | N                            |      |
| <b>Threats</b>  |                       |       |                               |       |                              |      |
| Bycatch: presence of small scale / artisanal fisheries? | Y (PLL)               |       | n/a                           |       | N                            |      |
| Bycatch: presence of industrial fisheries?              | n/a                   |       | n/a                           |       | N                            |      |
| Bycatch: quantified?                                    | N                     |       | N                             |       | 41 (OTH)                     | 6    |
| Take. Intentional killing or exploitation of turtles    | Y                     | 1,2   | n/a                           |       | n/a                          |      |

| RMU  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|--|-----------------------|-------|-------------------------------|-------|------------------------------|------|
|  | CM-NWIO               | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| Take. Egg poaching                               | Y                     | 1,2   | n/a                           |       | n/a                          |      |
| Coastal Development. Nesting habitat degradation | Y                     | 1     | n/a                           |       | n/a                          |      |
| 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  | Y                     | PS    | N                             |       | n/a                          |      |
| Pet Trade  | Y                     | PS    | Y                             | PS    | n/a                          |      |

| RMU  | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|--|-----------------------|-------|-------------------------------|-------|------------------------------|------|
|  | CM-NWIO               | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| <b>Long-term projects (&gt;5yrs)</b>                               |                       |       |                               |       |                              |      |
| Monitoring at nesting sites (period: range of years)               | Y (2012-2019)         | PS    | Y (7: 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                            |      |
| <b>Conservation</b>  |                       |       |                               |       |                              |      |
| 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)                                 | 0                     |       | 0                             |       | 0                            |      |
| Hatcheries   | 0                     |       | 0                             |       | 0                            |      |
| 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    |

| RMU   | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |      |
|---|-----------------------|-------|-------------------------------|-------|------------------------------|------|
|   | CM-NWIO               | Ref # | EI-SWIO                       | Ref # | LO-WIO                       | Ref# |
| Bycatch: spatio-temporal closures/reduction | 0                     |       | 0                             |       | 0                            |      |
| Other                                       | N                     |       | N                             |       | N                            |      |

**Table 3. 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 |           | Length (km) | % Monitored | Reference # | Monitoring Level (1-2) | Monitoring Protocol (A-F) |
|--------------------------|------------|---|--|---------------|-----------|-------------|-------------|-------------|------------------------|---------------------------|
|                          |            |   |  | Lat           | Lon       |             |             |             |                        |                           |
| <b>EI-NWIO</b>           |            |   |  |               |           |             |             |             |                        |                           |
| Anhenfushi (Baa)         | N          | 1 (2015)                                  |  |               |           |             |             | 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          |                        |                           |
| Ufuligiri (Baa)          | N          | 4 (2016-2017)                             |  | 5.016839      | 72.97005  |             |             | PS          |                        |                           |
| Voavah (Baa)             | N          | 1 (2013)                                  |  | 5.3166        | 73.07805  |             |             | PS          |                        |                           |

| 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           | Lon       |             |             |             |                        |                           |
| <b>CM-NWIO</b>                  |            |   |  |               |           |             |             |             |                        |                           |
| Anhenfushi (Baa)                | N          | 3 (2015)                                  |  |               |           |             |             | 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)                                  |  |               |           |             |             | 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)                            | 25 (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)                                 | 32 (2018)                                  |               |           |             |             | PS          |                        |                           |

| 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           | Lon       |             |             |             |                        |                           |
| Fenfushi (Raa)           | N          | 10 (2014-2015)                            |  |               |           |             |             | 10          |                        |                           |
| Funaddoo (Thaa)          | N          | 18 (2015)                                 |  | 5.012335      | 72.958938 |             |             | 1           |                        |                           |
| Gaadhoo (Laamu)          | N          | 61 (2018)                                 |  | 2.198367      | 73.128615 |             |             | PS          |                        |                           |
| Gangehi (Alif Alif)      | N          | 2 (2018)                                  |  | 1.821844      | 73.452293 |             |             | PS          |                        |                           |
| Hanimaadhoo (Haa Dhaalu) | N          | 1 (2018)                                  |  |               |           |             |             |             |                        |                           |
| 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)                                  |  |               |           |             |             | 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           |                        |                           |

| 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           | Lon       |             |             |             |                        |                           |
| Kanimeedhoo (Thaa)            | N          | 98 (2015)                                 |  | 4.343866      | 73.608452 |             |             | 1           |                        |                           |
| Kanufushigaathu finolhu (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)                                  |  |               |           |             |             | 2           |                        |                           |
| Kuredu (Lhaviyani)            | N          | 9 (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           |                        |                           |
| Maarikilu (Baa)               | N          | 6 (2013)                                  |  |               |           |             |             | 9           |                        |                           |
| Medufinolhu (Baa)             | N          | 16 (2013-2018)                            | 25 (2017-18)                               | 5.337         | 72.9514   |             |             | PS          |                        |                           |
| Milaidhoo (Baa)               | N          | 1 (2018)                                  |  | 5.016184      | 72.966779 |             |             | PS          |                        |                           |



| 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           | Lon       |             |             |             |                        |                           |
| Olhuveli (Laamu)                 | N          | 10 (2011-2018)                            |  |               |           |             |             | PS          |                        |                           |
| Rannaalhi (Kaafu)                | N          | 3 (1984)                                  |  | 1.81504       | 73.40717  |             |             | 2           |                        |                           |
| Reethi Rah (Kaafu)               | N          | 4 (2017)                                  | 11 (2017)                                  | 3.903401      | 73.357486 |             |             | PS          |                        |                           |
| Velaa (Noonu)                    | N          | 6 (2015)                                  |  |               |           |             |             | 1           |                        |                           |
| Vilingili (Kaafu)                | N          | 2 (1984)                                  |  | 5.831083      | 73.20963  |             |             | 2           |                        |                           |
| <b>LO-NWIO</b>                   |            |   |  |               |           |             |             |             |                        |                           |
| Hanimaadhoo (Haa Dhaalu)         | N          | 1 (2018)                                  |  | 6.7431        | 73.1659   |             |             | PS          |                        |                           |
| Muravandhoo (Raa)                | N          | 1 (2018)                                  |  | 5.6076        | 72.9521   |             |             | PS          |                        |                           |
| <b>Non species specific data</b> |            |   |  |               |           |             |             |             |                        |                           |
| Burehifasdhoo (Noonu)            | N          | 6 (2010)                                  | N  | 5.965803      | 73.368214 |             |             | 9           |                        |                           |
| Faadhoo (Lhaviyani)              | N          | 26 (2010)                                 | N  | 5.431721      | 73.63064  |             |             | 9           |                        |                           |

| 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           | Lon       |             |             |             |                        |                           |
| Fainu (Raa)                  | N          | 27 (2010)                                 | N  | 5.463993      | 73.034147 |             |             | 9           |                        |                           |
| Goidhoo (Baa)                | N          | 25 (2010)                                 | N  | 4.873322      | 72.99762  |             |             | 9           |                        |                           |
| Hulhudhuffaaruu (Raa)        | N          | 10 (2010)                                 | N  | 5.764955      | 73.012015 |             |             | 9           |                        |                           |
| Ifuru (Raa)                  | N          | 15 (2010)                                 | N  | 5.707661      | 73.024438 |             |             | 9           |                        |                           |
| Karimmavattaru (Noonu)       | N          | 48 (2010)                                 | N  | 5.670712      | 73.387782 |             |             | 9           |                        |                           |
| Kunfunadhoo (Baa)            | N          | 420 (1984)                                | N  | 5.1115555     | 73.078833 |             |             | 1           |                        |                           |
| Kunfunadhoo (Baa)            | N          | 5 (2010)                                  | N  | 5.1115555     | 73.078833 |             |             | 9           |                        |                           |
| Kuramaadhoo (Noonu)          | N          | 10 (2010)                                 | N  | 5.873508      | 73.143754 |             |             | 9           |                        |                           |
| Kurendhoo (Lhaviyani)        | N          | 1 (2010)                                  | N  | 5.334024      | 73.463463 |             |             | 9           |                        |                           |
| Maafilaafushi (Lhaviyani)    | N          | 26 (2010)                                 | N  | 5.362518      | 73.415696 |             |             | 9           |                        |                           |
| Madhiriguraidhoo (Lhaviyani) | N          | 3 (2010)                                  | N  | 5.469646      | 73.559641 |             |             | 9           |                        |                           |

| 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           | Lon       |             |             |             |                        |                           |
| Madhirivaadhoo (Baa)     | N          | 16 (2010)                                 | N  | 5.268994      | 73.161184 |             |             | 9           |                        |                           |
| Maduvari (Lhaviyani)     | N          | 106 (2010)                                | N  | 5.285021      | 73.502144 |             |             | 9           |                        |                           |
| Medhafushi (Noonu)       | N          | 4 (2010)                                  | N  | 5.744538      | 73.324161 |             |             | 9           |                        |                           |
| Meedhupparu (Raa)        | N          | 5 (2010)                                  | N  | 5.45621       | 72.980186 |             |             | 9           |                        |                           |
| Olhugiri (Baa)           | N          | 58 (2010)                                 | N  | 5.001348      | 72.906105 |             |             | 9           |                        |                           |
| Undoodhoo (Baa)          | N          | 13 (2010)                                 | N  | 5.274509      | 73.042485 |             |             | 9           |                        |                           |

**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 Sea Turtle Task Force | Y      | Y       | Y                                | ALL     |                          |
| IOTC   | Y      | Y       | Y                                | ALL     | Resolution 12/04         |



Figure 2. Green sea turtle nesting sites in the Maldives.

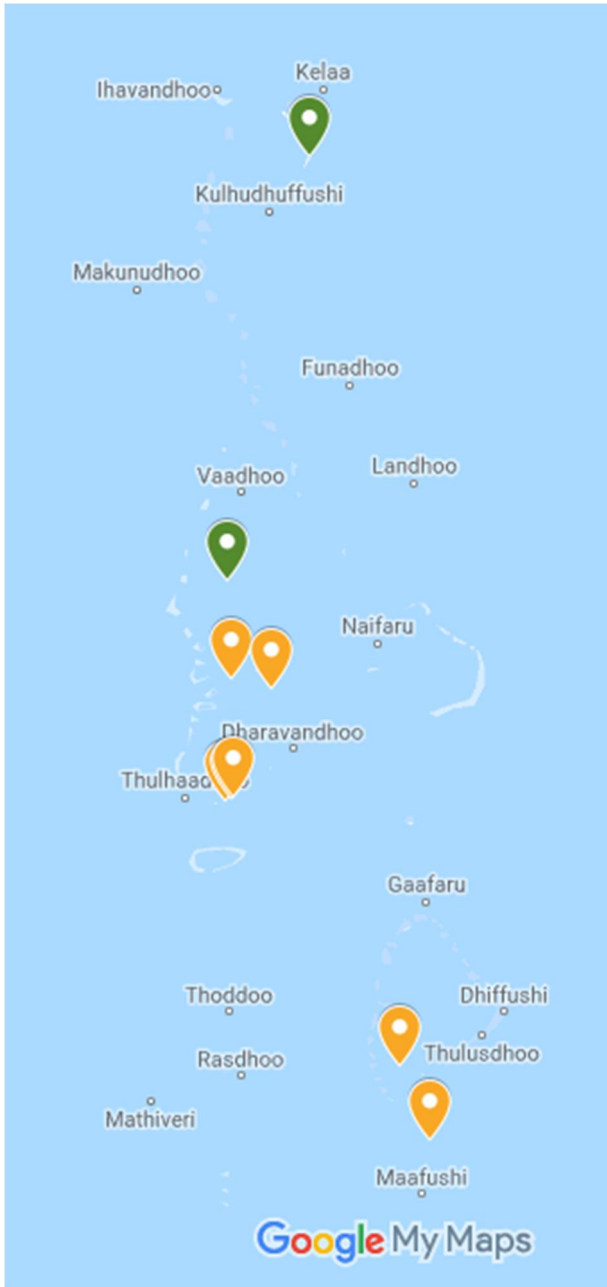


Figure 3. Nesting sites for hawksbill (orange) and olive ridley sea turtles (green) in the Maldives.

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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 northeast 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). I am unaware of any 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.**

| RMU  | <i>Eretmochelys imbricata</i>                                   |           | <i>Chelonia mydas</i> |       |
|--|---|-----------|-----------------------|-------|
|  | EI NWIO   | Ref #     | CM NWIO               | Ref # |
| <b>Occurrence</b>  |   |           |                       |       |
| 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     |
| <b>Key biological data</b>                                 |   |           |                       |       |
| 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 SD17.1 (?)                                       | 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                   |       |

| RMU  | <i>Eretmochelys imbricata</i>    |        | <i>Chelonia mydas</i> |       |
|--|----------------------------------|--------|-----------------------|-------|
|  | EI NWIO                          | Ref #  | CM NWIO               | Ref # |
| <b>Trends</b>  |                                  |        |                       |       |
| 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                   |       |
| <b>Published studies</b>   |                                  |        |                       |       |
| 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                     |       |
| <b>Threats</b>   |                                  |        |                       |       |
| 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. Egg poaching   | 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     |

| RMU  | <i>Eretmochelys imbricata</i>  |        | <i>Chelonia mydas</i> |       |
|--|--------------------------------|--------|-----------------------|-------|
|  | EI NWIO                        | Ref #  | CM NWIO               | Ref # |
| Other  | Y                              | 7      | Y                     | 7     |
| <b>Long-term projects (&gt;5yrs)</b>                               |                                |        |                       |       |
| 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                   |       |
| <b>Conservation</b>  |                                |        |                       |       |
| 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     |             |             |             |                        |                           |
| <b>EI-NWIO</b>           |            |   |  |               |         |             |             |             |                        |                           |
| 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 Island          | 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)    |

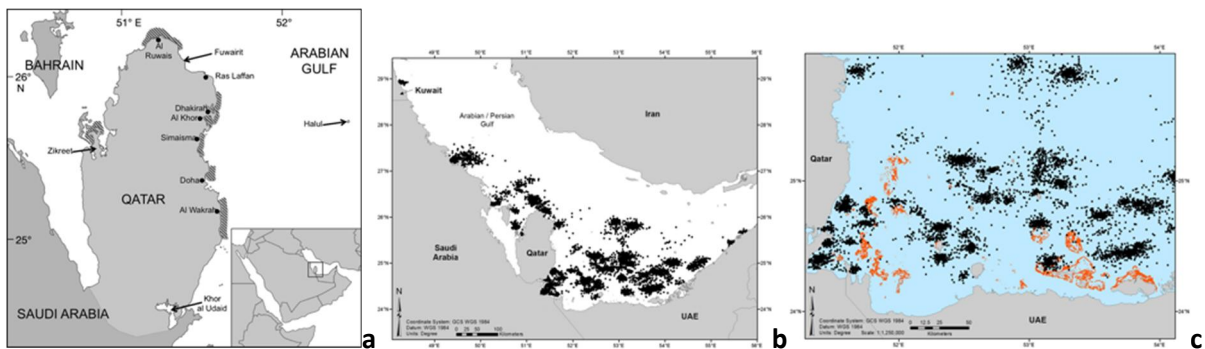
Ctd.

| 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<br><mantonopoulou@enwwf.ae> | Nicolas J. Pilcher<br><npilcher@mrf-asia.org> | N                  | -                | Fuwairit<br>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.**  
(reproduced from reference 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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- | # REF | Full reference   |
|-------|--|
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# SAUDI ARABIA

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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.

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 Island in Oman [29]. Recent records of marine turtle carcasses stranded in Bahrain included juvenile and adult sized green turtles and hawksbill turtles as well as adult sized Olive Ridley (*Lepidochelys olivacea*) [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 northwest 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 transshipment of oil through the Red 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 devices (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 as UNCLOS (United Nations Convention on the Law of the Sea (Table 3) and treaties 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 (5408 km<sup>2</sup>) 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<sup>2</sup>) and Umm al Qamar (ca. 2 km<sup>2</sup>) have been established [33]. In the Arabian (Persian) Gulf the marine protected area is the Jubail Wildlife Sanctuary (ca. 2410 km<sup>2</sup>) 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 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 re-nesting 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.

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 on the eastern coast of Bahrain [13]. The closest loggerhead turtle nesting occurs on Masirah Island in Oman [29]. Recently, marine turtle carcasses of juvenile and adult sized green turtles, hawksbill turtles, and olive ridley (*Lepidochelys olivacea*) 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 northwest Indian Ocean is not complete [3, 11]. Hawksbill, green, loggerhead, olive ridley, and leatherback 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 transshipment 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 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.
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- 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<sup>2</sup>) includes marine, coastal and terrestrial habitats [33]. In addition, two relatively small areas: the Yanbu Royal Commission Protected Area (ca. 5 km<sup>2</sup>) and Umm al Qamar (ca. 2 km<sup>2</sup>) have been proclaimed [33]. In the Arabian (Persian) Gulf, marine protected areas include: the Jubail Wildlife Sanctuary (ca. 2410 km<sup>2</sup>) 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 analyze 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 minimizing 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.

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

| RMU  | <i>Eretmochelys imbricata</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |            | <i>Chelonia mydas</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |            | <i>Eretmochelys imbricata</i><br>Red Sea<br>North-West Indian Ocean |            | <i>Chelonia mydas</i><br>Red Sea<br>North-West Indian Ocean |           |
|--|--|------------|--|------------|---|------------|---|-----------|
|  | EI-NWIO  | Ref #      | CM-NWIO  | Ref #      | EI-NWIO   | Ref #      | CM-NWIO   | Ref #     |
| <b>Occurrence</b>  |  |            |  |            |   |            |   |           |
| 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    |
| <b>Key biological data</b>                                 |  |            |  |            |   |            |   |           |
| 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        |

| RMU  | <i>Eretmochelys imbricata</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |       | <i>Chelonia mydas</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |       | <i>Eretmochelys imbricata</i><br>Red Sea<br>North-West Indian Ocean |       | <i>Chelonia mydas</i><br>Red Sea<br>North-West Indian Ocean |       |
|--|--|-------|--|-------|---|-------|---|-------|
|  | 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)<br>CCL (cm)                      | 59 (499)   | 2     | 73 (2844)  | 2     | n/a   |       | 89 (n= 303)   | 2     |
| Mean adult size, CCL or SCL (cm)<br>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<br>(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   |       |
| <b>Trends</b>  |  |       |  |       |   |       |   |       |
| 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   |       |
| <b>Published studies</b>   |  |       |  |       |   |       |   |       |
| Growth rates   | n/a  |       | n/a  |       | n/a   |       | n/a   |       |
| Genetics   | Y  | 3     | Y  | 37    | n/a   |       | Y   | 37    |

| RMU   | <i>Eretmochelys imbricata</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |             | <i>Chelonia mydas</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |             | <i>Eretmochelys imbricata</i><br>Red Sea<br>North-West Indian Ocean |             | <i>Chelonia mydas</i><br>Red Sea<br>North-West Indian Ocean |             |
|---|--|-------------|--|-------------|---|-------------|---|-------------|
|   | 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   |             |
| <b>Threats</b>  |  |             |  |             |   |             |   |             |
| 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. Egg poaching                                      | 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   |             |

| RMU  | <i>Eretmochelys imbricata</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |       | <i>Chelonia mydas</i><br>Arabian (Persian) Gulf<br>North-West Indian Ocean |       | <i>Eretmochelys imbricata</i><br>Red Sea<br>North-West Indian Ocean |       | <i>Chelonia mydas</i><br>Red Sea<br>North-West Indian Ocean |       |
|--|--|-------|--|-------|---|-------|---|-------|
|  | 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   |       |
| <b>Long-term projects (&gt;5yrs)</b>                               |  |       |  |       |   |       |   |       |
| 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   |       |
| <b>Conservation</b>  |  |       |  |       |   |       |   |       |
| 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) | Western limit |     | Eastern limit |     | Central point |          | Length (km) | % Monitored | Reference # | Monitoring Level (1-2) | Monitoring Protocol (A-F) |
|---------------------------------------|------------|---|--|---------------|-----|---------------|-----|---------------|----------|-------------|-------------|-------------|------------------------|---------------------------|
|                                       |            |   |  | Long          | Lat | Long          | Lat | Lat           | Long     |             |             |             |                        |                           |
| <b>CM-NWIO Arabian (Persian) Gulf</b> |            |   |  |               |     |               |     |               |          |             |             |             |                        |                           |
| Karan Island (=Jazirat Karan)         | Y          | n/a                                       | n/a  |               |     |               |     | 27.71250      | 49.82500 | 2.03        | Variable    | 2, 21, 30   | 2                      | C                         |
| Jana Island (= Jazirat Jana)          | Y          | n/a                                       | n/a  |               |     |               |     | 27.36389      | 49.90000 | 1.1         | Variable    | 2, 21, 30   | 2                      | C                         |
| Kurayn Island (= Jazirat Kurayn)      | N          | n/a                                       | n/a  |               |     |               |     | 27.64583      | 49.82083 | >1          | Variable    | 21          | 2                      | A                         |
| Jurayd Island (= Jazirat Jurayd)      | N          | n/a                                       | n/a  |               |     |               |     | 27.19167      | 49.99028 | 1.8         | Variable    | 21          | 2                      | A                         |
| Harqus Island (= 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                         |
| <b>CM-NWIO Red Sea</b>                |            |   |  |               |     |               |     |               |          |             |             |             |                        |                           |
| 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 Island                        | N          | n/a                                       | n/a  |               |     |               |     | 18.21808      | 40.72467 | < >1        |             | 9           | 2                      | A                         |
| Al Hasani Island                      | N          | n/a                                       | n/a  |               |     |               |     | 24.97770      | 37.08360 | < >1        |             | 9           | 2                      | A                         |
| Al Umm Island                         | 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 Island (Mashabih)              | N          | n/a                                       | n/a  |               |     |               |     | 25.61561      | 36.52741 | < >1        |             | 9           | 2                      | A                         |



|                                    |   |     |     |  |  |  |  |          |          |      |  |              |   |      |
|------------------------------------|---|-----|-----|--|--|--|--|----------|----------|------|--|--------------|---|------|
| Birema Island (Mashabih)           | N | n/a | n/a |  |  |  |  | 25.61706 | 36.50349 | < >1 |  | 9            | 2 | A    |
| Danak Island                       | N | n/a | n/a |  |  |  |  | 19.51666 | 40.03333 | < >1 |  | 9            | 2 | A    |
| Disan Island                       | N | n/a | n/a |  |  |  |  | 16.94747 | 41.70651 | < >1 |  | 21           | 2 | A    |
| Dohar Island                       | N | n/a | n/a |  |  |  |  | 19.82607 | 39.89924 | < >1 |  | 9            | 2 | A    |
| Dorish Island                      | 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 Island                      | N | n/a | n/a |  |  |  |  | 24.97720 | 37.04880 | < >1 |  | 9            | 2 | A    |
| Mafsubber/Sabiya Island            | N | n/a | n/a |  |  |  |  | 18.26409 | 40.75501 | < >1 |  | 9            | 2 | A    |
| Maghabiya Island                   | N | n/a | n/a |  |  |  |  | 18.25194 | 40.73250 | < >1 |  | 9            | 2 | A    |
| Malathu Island                     | N | n/a | n/a |  |  |  |  | 19.74928 | 39.90855 | < >1 |  | 9            | 2 | A    |
| Maliha Island                      | 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 Island                 | N | n/a | n/a |  |  |  |  | 20.28556 | 39.48472 | < >1 |  | 9            | 2 | A    |
| Qalib Island 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                         | Y | n/a | n/a |  |  |  |  | 24.26670 | 37.53333 | > 2  |  | 2, 21, 34, 9 | 2 | B, D |
| Ras Baridi                         | Y | n/a | n/a |  |  |  |  | 24.28330 | 37.51660 | > 2  |  | 2, 21, 34, 9 | 2 | B, D |
| Ras Baridi                         | 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 Island (Sharbayn)            | N   | n/a | n/a |  |  |  |  | 18.71861 | 40.48889 | < >1 |          | 9          | 2 | A |
| Sharm Al Khaur Island                 | 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 Island      | N   | n/a | n/a |  |  |  |  | 28.05904 | 35.03275 | < >1 |          | 9          | 2 | A |
| Sila Island                           | N   | n/a | n/a |  |  |  |  | 27.65000 | 35.28330 | < >1 |          | 9          | 2 | A |
| Sirrain (Sirrayn ) Island             | N   | n/a | n/a |  |  |  |  | 19.62545 | 40.67169 | < >1 |          | 21, 9      | 2 | A |
| Tidhkar Island                        | 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 Island                          | N   | n/a | n/a |  |  |  |  | 27.93835 | 34.54176 | < >1 |          | 21, 9      | 2 | A |
| Walih Island                          | N   | n/a | n/a |  |  |  |  | 27.78330 | 35.16660 | < >1 |          | 9          | 2 | A |
| Waqada Island                         | N   | n/a | n/a |  |  |  |  | 25.34020 | 36.95830 | < >1 |          | 9          | 2 | A |
| Wasaliyat Island (S)                  | N   | n/a | n/a |  |  |  |  | 17.78439 | 41.43237 | < >1 |          | 21, 9      | 2 | A |
| <b>EI-NWIO Arabian (Persian) Gulf</b> |     |     |     |  |  |  |  |          |          |      |          |            |   |   |
| Karan Island (=Jazirat Karan)         | Yes | n/a | n/a |  |  |  |  | 27.71250 | 49.82500 | 2.03 | Variable | 2, 21, 30  | 2 | C |
| Jana Island (= Jazirat Jana)          | Yes | n/a | n/a |  |  |  |  | 27.36389 | 49.90000 | 1.1  | Variable | 2, 21, 30  | 2 | C |
| Kurayn Island (= Jazirat Kurayn)      | No  | n/a | n/a |  |  |  |  | 27.64583 | 49.82083 | >1   | Variable | 21         | 2 | A |
| Jurayd Island (= Jazirat Jurayd)      | No  | n/a | n/a |  |  |  |  | 27.19167 | 49.99028 | 1.8  | Variable | 21         | 2 | A |
| Harqus Island (= 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 |
| <b>EI-NWIO Red Sea</b>                |     |     |     |  |  |  |  |          |          |      |          |            |   |   |
| E. Tiran Island                       | N   | n/a | n/a |  |  |  |  | 27.93835 | 34.54176 |      |          | 9          | 2 | A |

|                            |   |     |     |  |  |  |  |          |          |  |  |    |   |   |
|----------------------------|---|-----|-----|--|--|--|--|----------|----------|--|--|----|---|---|
| N. Tiran Island            | N | n/a | n/a |  |  |  |  | 27.93835 | 34.54176 |  |  | 9  | 2 | A |
| W. Sinafir Island          | N | n/a | n/a |  |  |  |  | 27.93453 | 34.69686 |  |  | 9  | 2 | A |
| E. Shusha Island           | N | n/a | n/a |  |  |  |  | 27.91660 | 34.70000 |  |  | 9  | 2 | A |
| E. Sinafir Island          | N | n/a | n/a |  |  |  |  | 27.91660 | 34.71000 |  |  | 9  | 2 | A |
| E. Barqan Island           | N | n/a | n/a |  |  |  |  | 27.90000 | 35.06660 |  |  | 9  | 2 | A |
| S. Barqan Island           | N | n/a | n/a |  |  |  |  | 27.90000 | 35.06660 |  |  | 9  | 2 | A |
| Sila Island                | 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 Island             | N | n/a | n/a |  |  |  |  | 25.55467 | 36.86708 |  |  | 9  | 2 | A |
| Waqada Island              | N | n/a | n/a |  |  |  |  | 25.34020 | 36.95830 |  |  | 9  | 2 | A |
| Al Hasani Island (S)       | N | n/a | n/a |  |  |  |  | 24.97770 | 37.08360 |  |  | 9  | 2 | A |
| Maliha Island              | N | n/a | n/a |  |  |  |  | 25.03330 | 37.11660 |  |  | 9  | 2 | A |
| Qalib Island chain         | N | n/a | n/a |  |  |  |  | 25.16038 | 37.16071 |  |  | 9  | 2 | A |
| Qalib Island chain         | 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 Island ( S)    | N | n/a | n/a |  |  |  |  | 20.28556 | 39.48472 |  |  | 9  | 2 | A |
| Dohar Island               | N | n/a | n/a |  |  |  |  | 19.82607 | 39.89924 |  |  | 9  | 2 | A |
| Malathu Island             | 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 Island               | N | n/a | n/a |  |  |  |  | 19.51666 | 40.03333 |  |  | 9  | 2 | A |
| Sharbain Island (Sharbayn) | N | n/a | n/a |  |  |  |  | 18.71861 | 40.48889 |  |  | 9  | 2 | A |

|                         |   |     |     |  |  |  |  |          |          |  |  |   |   |   |
|-------------------------|---|-----|-----|--|--|--|--|----------|----------|--|--|---|---|---|
| Tidhkar Island          | N | n/a | n/a |  |  |  |  | 18.94662 | 40.61646 |  |  | 9 | 2 | A |
| Muska Island            | N | n/a | n/a |  |  |  |  | 18.81759 | 40.63626 |  |  | 9 | 2 | A |
| Dorish Island           | N | n/a | n/a |  |  |  |  | 18.50696 | 40.66418 |  |  | 9 | 2 | A |
| Sirrain Island          | N | n/a | n/a |  |  |  |  | 19.62545 | 40.67169 |  |  | 9 | 2 | A |
| Al Hala Island          | N | n/a | n/a |  |  |  |  | 18.21808 | 40.72467 |  |  | 9 | 2 | A |
| Maghabiya Island        | N | n/a | n/a |  |  |  |  | 18.25194 | 40.73250 |  |  | 9 | 2 | A |
| Al Umm Island           | N | n/a | n/a |  |  |  |  | 18.27353 | 40.73385 |  |  | 9 | 2 | A |
| Mafsubber/Sabiya Island | N | n/a | n/a |  |  |  |  | 18.26409 | 40.75501 |  |  | 9 | 2 | A |
| Zuqaq Island (Zukak)    | N | n/a | n/a |  |  |  |  | 18.04180 | 40.80290 |  |  | 9 | 2 | A |
| Abu Rukaba Island       | N | n/a | n/a |  |  |  |  | 19.49732 | 40.89333 |  |  | 9 | 2 | A |
| Pelican Island          | N | n/a | n/a |  |  |  |  | 19.24312 | 40.93769 |  |  | 9 | 2 | A |
| Wasaliyat Island (S)    | N | n/a | n/a |  |  |  |  | 17.68450 | 41.02490 |  |  | 9 | 2 | A |
| Jebel Sabaya Island     | N | n/a | n/a |  |  |  |  | 18.59140 | 41.06440 |  |  | 9 | 2 | A |
| Qutu Island             | N | n/a | n/a |  |  |  |  | 18.48778 | 41.06694 |  |  | 9 | 2 | A |
| Dhahrat Simer Island    | N | n/a | n/a |  |  |  |  | 17.83330 | 41.16670 |  |  | 9 | 2 | A |
| Hadara Island           | 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 Island (S)    | N | n/a | n/a |  |  |  |  | 17.78439 | 41.43237 |  |  | 9 | 2 | A |
| Dhi Dhayaha Island      | N | n/a | n/a |  |  |  |  | 16.88950 | 41.46310 |  |  | 9 | 2 | A |
| Disan Island            | N | n/a | n/a |  |  |  |  | 16.92048 | 41.69518 |  |  | 9 | 2 | A |
| Towasela Island         | N | n/a | n/a |  |  |  |  | 16.46887 | 41.87841 |  |  | 9 | 2 | A |
| Marrak Island           | N | n/a | n/a |  |  |  |  | 16.42306 | 41.90556 |  |  | 9 | 2 | A |
| Dohrab Island           | N | n/a | n/a |  |  |  |  | 16.30458 | 41.96911 |  |  | 9 | 2 | A |

|                       |   |     |     |  |  |  |  |          |          |  |  |      |   |   |
|-----------------------|---|-----|-----|--|--|--|--|----------|----------|--|--|------|---|---|
| Firan Island          | N | n/a | n/a |  |  |  |  | 17.17733 | 42.20503 |  |  | 9    | 2 | A |
| Dahert Simer Island   | N | n/a | n/a |  |  |  |  | 16.48896 | 42.29981 |  |  | 21,9 | 2 | A |
| Simer Island (Zamhar) | N | n/a | n/a |  |  |  |  | 16.29450 | 42.32441 |  |  | 9    | 2 | A |
| Fara fir Island       | 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   |
|---|--------|--|---|---------------------|---|--------------------------|---|
| <b>International</b>  |        |  |   |                     |   |                          |   |
| 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<br>Department of Protected Areas Planning<br>Saudi Wildlife Authority Riyadh, Saudi Arabia E-Mail: a_atlassy<br>[ 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 |                             |                              |  |                                  |  |
| <b>National</b>  |      |     |                             |                              |  |                                  |  |
| 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 <i>Royal Decree No. 7/505M, dated 28/3/1406</i> , 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, dated  |  |  |  |  | setting standards for the environment and for carrying out a program 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 program of environmental impact assessment.             |  |  |

|  |  |  |  |                           |  |   |  |
|--|--|--|--|---------------------------|--|---|--|
| <p>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</p> |  |  |  | <p>All marine turtles</p> | <p>Hunting, exploitation, and protection of the marine living natural resources in the territorial waters of the Kingdom of Saudi Arabia is regulated by law.</p>  | <p>In Addition to regulating all fishing and maritime commercial exploitation, this law prohibits the taking of marine mammals, marine turtle and seabird eggs.</p> | <p>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)</p> |
| <p>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.</p>   |  |  |  |                           | <p>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.</p> | <p>Requires permit to conduct research</p>  | <p>Authority empowered with the implementation of this law in Saudi Arabia is: Department of Military Survey, The Ministry of Defence and Aviation.</p>                        |

**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                  |
| <b>Leading organization</b> | <b>Public/Private</b>   | <b>Collaboration with</b> | <b>Reports / Information material</b>    | <b>Current Sponsors</b>           | <b>Contact (name and Email)</b>   |            | <b>Database available</b> | <b>PIT tagging</b> | <b>Remote tracking</b>   | <b>Ref #</b>                 |                        |                   |                  |                 |                     |
| 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 |
| <b>NESTING ADULTS</b>       |                   |             |        |               |             |        |               |           |        |
| 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    |
| <b>EGGS</b>                 |                   |             |        |               |             |        |               |           |        |
| 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      |        |
| <b>HATCHLINGS</b>           |                   |             |        |               |             |        |               |           |        |
| 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    |
| <b>NESTING CYCLE</b>        |                   |             |        |               |             |        |               |           |        |
| 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.         |  |

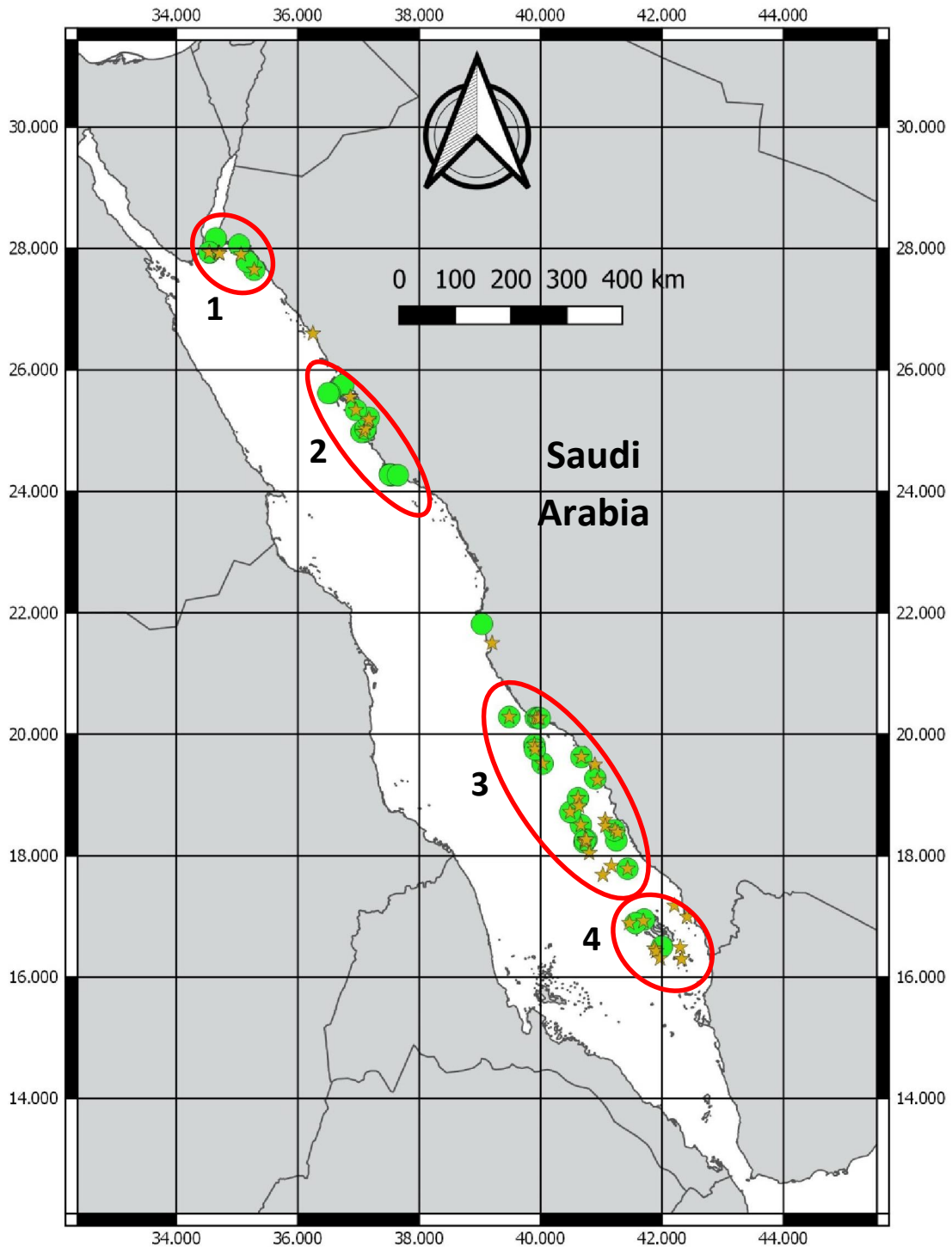
**Table 6. Protected marine areas in Saudi Arabia.**

| 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 islands, 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." |
| <b>MPAs Declared</b>                   |   |
| 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 km <sup>2</sup> and encompasses fringing reefs, mangroves, and seabird nesting sites.   |
| Umm al Qamari:                         | Established in 1977 and covering an area of only 2 km <sup>2</sup> , 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 km <sup>2</sup> , 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.  |
| <b>de facto and Planned MPAs</b>       |   |
| Jubail Wildlife Sanctuary:             | This is a <i>de facto</i> protected area awaiting Royal declaration. Established in 1994 and covering an area of 2300 km <sup>2</sup> , research and baseline surveys to identify the main ecosystems were carried out after the Gulf war. 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 and 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 km <sup>2</sup> , 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 km <sup>2</sup> , 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 km <sup>2</sup> , 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 km <sup>2</sup> , 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 km <sup>2</sup> , 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 island 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 km <sup>2</sup> , 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 km <sup>2</sup> , this a high-quality inshore reef complex that is also an important seabird area.   |
| Marsa as-Sarraj:               | Proposed to cover 200 km <sup>2</sup> , 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 km <sup>2</sup> , 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 km <sup>2</sup> , this is a marshland area with extensive offshore reefs, threatened by oil pollution and other waste disposal.  |
| Ash-Shu'aybah and Mastaba:     | Proposed to cover ca. 100 km <sup>2</sup> , 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.                             |

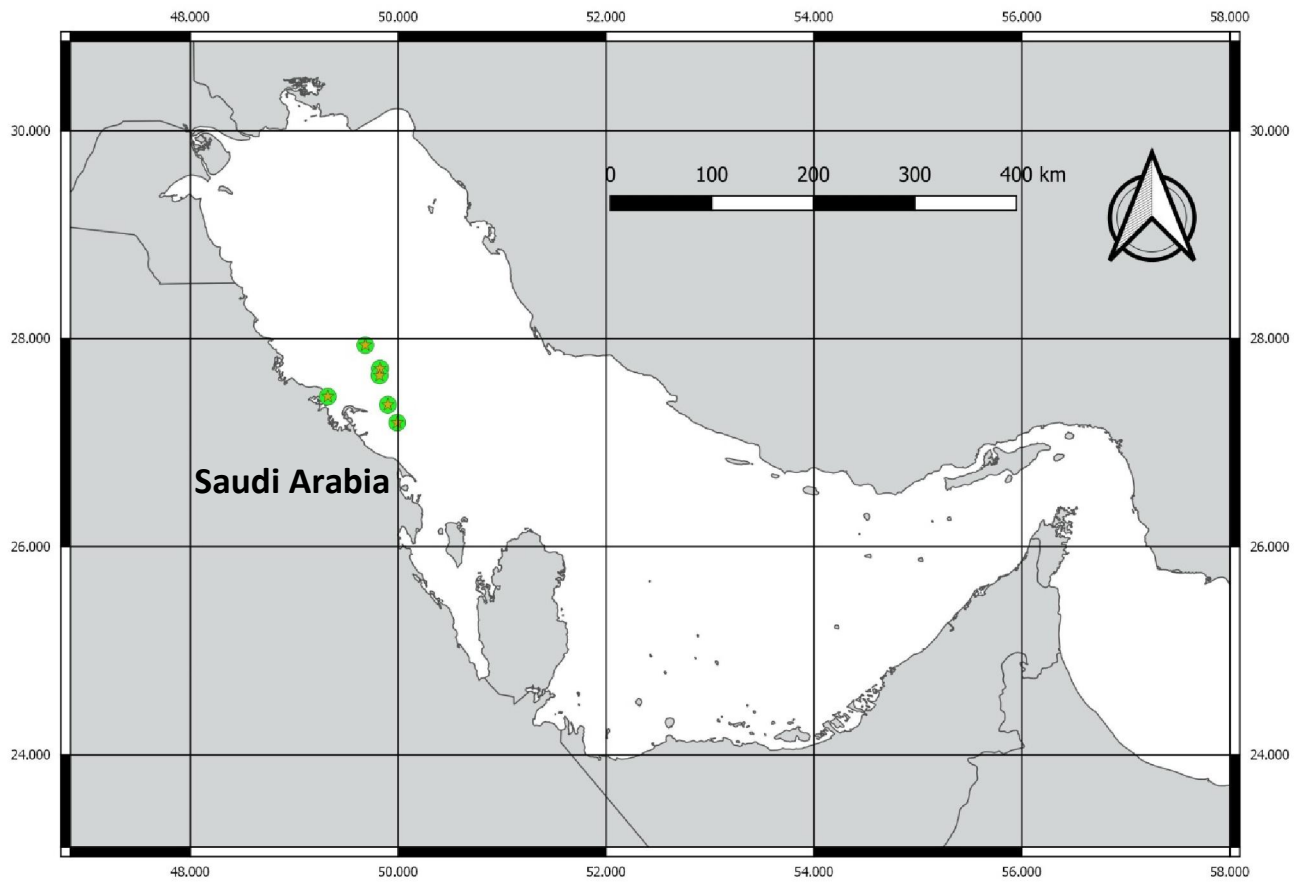
|                                       |   |
|---------------------------------------|---|
| Qishran:                              | This is a complex of coral reefs, coral spits, seagrass beds and extensive mangroves. It is an important seabird and dugong habitat.  |
| Outer Farasan Bank:                   | 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 km <sup>2</sup> , 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 km <sup>2</sup> , 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 km <sup>2</sup> , these are two lagoons with abundant fringing corals and mangroves.  |





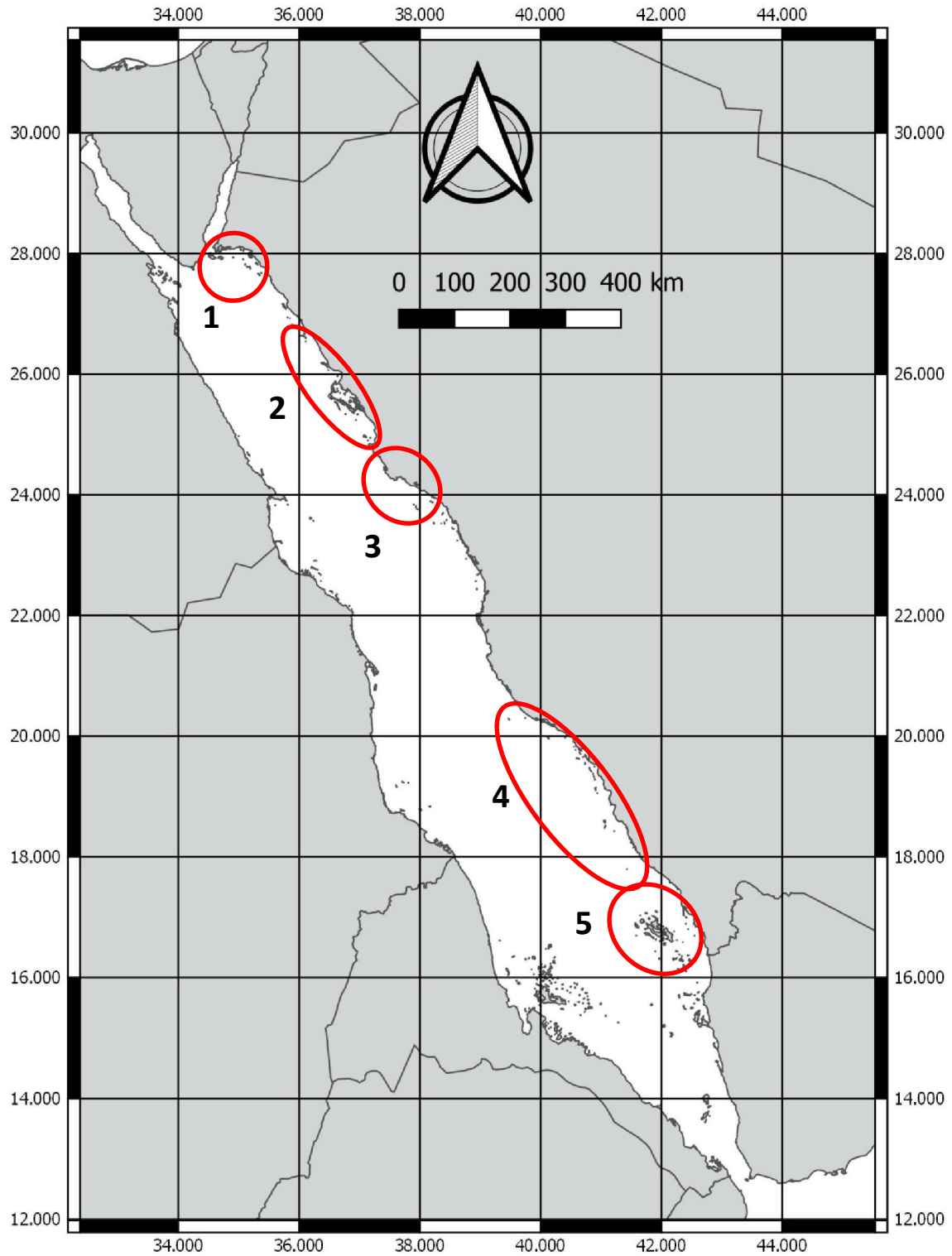
**Figure 1. Red Sea region showing know nesting sites in the Kingdom Saudi Arabia.**

The general pattern of nesting can be divided into four areas: (1) the area in the vicinity of Tiran Island Sanifar Islands, (2) the area between Wejeh and Yanbu, including the Wejeh 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



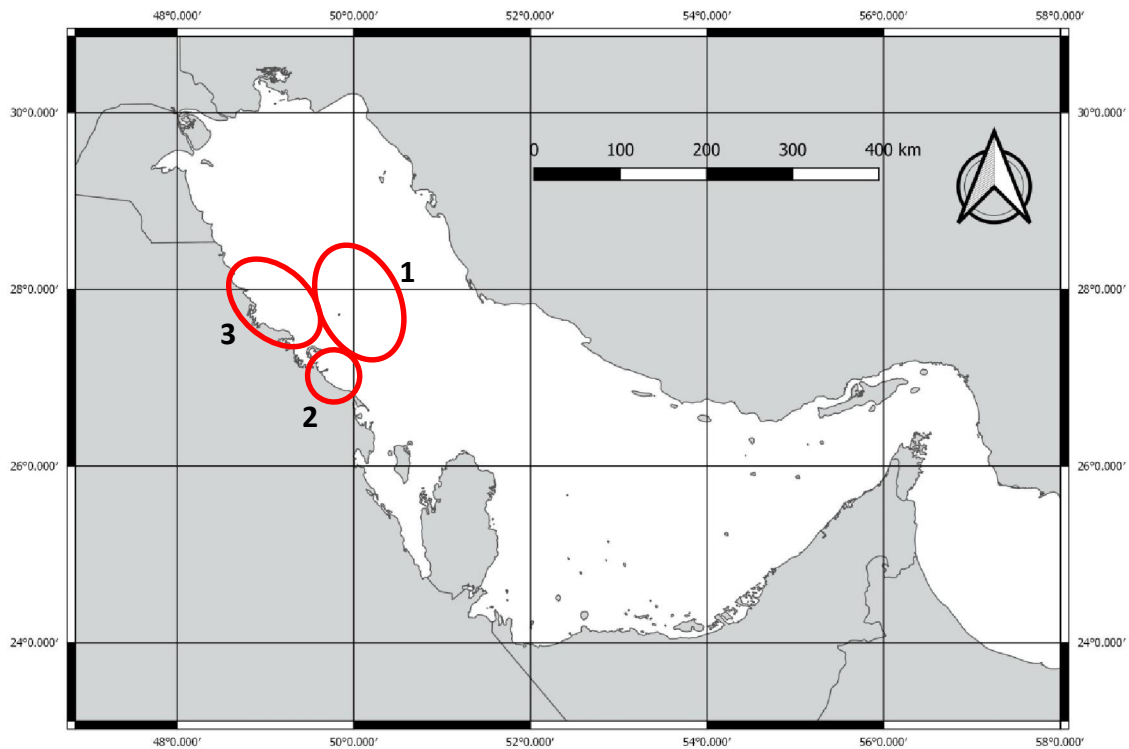
**Figure 2. Arabian (Persian) Gulf region showing marine turtle nesting sites in the Kingdom Saudi Arabia.**

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 Island 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**

Southern and south-western coast of Sri Lanka are the main turtle nesting sites but nesting spans from Mount Lavinia on the western coast to Arugambay on the eastern coast (Figure 1) [1,2,4,6,8,9,18,61]. Only a small number of nests of loggerheads are reported annual [11] probably less than 25 nests per year (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**

Egg poaching by villagers and meat consumption of turtle bycatch by fishers (Table 1).

##### **1.3.1 Nesting sites**

Poaching of eggs by villagers. Increase in artificial light in the nesting beaches [74]. Egg predation 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] (Table 1).

#### **1.4 Conservation**

Sea turtles are 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 the 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 who 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 100,000.00 [62].

In 1995 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 that was previously involved in egg poaching had been trained in turtle biology and research and had been employed by TCP as turtle nest protectors. The TCP also recruited research officers to carry out research activities such as flipper tagging, collecting biometric and nesting frequency data etc. A similar project had been 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 has been conducted by various NGOs which may have led to the reduction in egg poaching and killing of turtles for meat especially in Kosgoda and Rekawa areas [31]. An *in situ* turtle nest protection program has been initiated recently in the east coast of Sri Lanka [61] which was inaccessible earlier 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; Anonymous, 2006). The area is bounded 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 not protected and hence, local community can disturb nesting beaches and foraging areas such as removing sand, lighting the 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 after keeping in tanks for 5 days to 2 weeks [34]. Hatcheries are illegal and attempt to issue licence to hatcheries was not successful so far [29].

Community education and awareness programs on plastic pollution in the 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. Testudinales 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]. Although hatcheries are used as an *ex situ* conservation tool of sea turtles, their contribution towards conservation of sea turtles is highly debated [34,75]. A survey showed that these hatcheries are operated by private owners and their prime motive is profit, relying on tourists for their viability and poor ecological practices are employed due to lack of scientific know-how [32,75].

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

### **2.1 Distribution, abundance, trends**

#### **2.1.1 Nesting sites**

Southern and south-western coast of Sri Lanka is where the main turtle nesting taking place but the nesting span from Mount Lavinia in the western coast to Arugambay in the eastern coast (Figure 1) [1,2,4,6,8,9,18,61]. High nesting abundance of green turtles was observed in Rekawa, Kosgoda, Kahandamodara and Bundala while scattered nesting was observed in the other beaches [1,3,15,16]. Green turtle nesting takes place throughout the year with a peak in April and March to May can be considered as the nesting season [15,16]. The green turtle is the most frequent nesting turtle in Sri Lanka, contributing about 96% nests at Rekawa [15] and 90% at Kosgoda [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 turtle females tagged in Rekawa sanctuary migrated to foraging grounds in Gulf of Mannar Biosphere Reserve off the coast of Tamil Nadu, India; 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**

Egg poaching and meat consumption (Table 1).

### **2.3.1 Nesting sites**

Egg poaching by villagers. Increase in artificial light in the nesting beaches [74]. Egg predation by Indian gerbi and Indian bush rat [77] (Table 1).

### **2.3.2 Marine areas**

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

Before the civil war started in 1983, the fishermen of the south and particularly those along the east coast sent the sea turtles that were accidentally caught in their nets to the collecting centers and from those places the turtles were used to periodically transport to Jaffna in large lorry consignments and in a most cruel manner [58]. However, this transportation gradually decreased after the amendment of the FFPO in 1972 (Personnel communications with the local community in the nesting areas). Kalpitiya in the northwestern coast had been the main location for the turtle slaughtering since the civil war began in Jaffna 1983 [38]. Many turtles are accidentally caught and drowned in fishing gear [39]. During 1999 and 2000 a turtle rescue programme had been initiated at Kandakkuliya in Kalpitiya where the bycatch turtles trapped in gill nets were released with the support from fishermen [39]. Moreover, there are reports witnessing the butchery and selling of live turtles openly in Kandakuliya and north-western parts of the island [39,48]. In 2008 [31] a survey reported that 45% of the villagers at Kandakkuliya consume turtle meat mostly from bycatch. However, a survey carried out in 2014 reported that incidental capture of sea turtles in two fishing sites: Negambo and Beruwala is not very significant reporting olive ridley followed by green turtles as the most abundant species caught in fishing gear [68]. Some fishers however, are willing to rescue the entangled turtles while some do not [38] and a more recent survey shows that the percentage of fishers who release bycatch had increased from 63% in the past to 90% [66].

## **2.4 Conservation**

See Section 1.4.

## **2.5 Research**

Nesting behaviour of female green turtles was studied at the Rekawa and Kosgoda rookery reporting similar patterns in the two rookeries with a peak in warmer months from February to May [15,16]. The reproductive output of green turtles has been studied for five years, collecting data on the female green turtles from Kosgoda beach. It showed larger females have a higher reproductive output, laying larger eggs, bigger clutches, and produce a greater number of eggs in total for a season [26]. 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, with 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 the nesting activities in the south and southwestern coast, sea turtles migrate back to their foraging grounds in Gulf of Mannar Biosphere Reserve off the

coast of Tamil Nadu and Lakshadweep Islands in Southern India [25]. In Sri Lanka bycatch was thought to be the leading cause of mortality for the island's turtle population [50]. However, some reports show that people in the north are accomplished turtle-catchers and known to use a variety of nets to capture sea turtles and there is a high demand for turtle meat from the northern areas [45].

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**

Southern and south-western coast of Sri Lanka is the main turtle nesting taking place but the nesting span from Mount Lavinia in the western coast to Arugambay in the eastern coast (Figure 1) [1,2,4,6,8,9,18,61]. High frequency of leatherback nesting is observed in the Godawaya beach in southern Sri Lanka [10]. But overall only a small number of leatherbacks nest in Sri Lankan beaches [9].

##### **3.1.2 Marine areas**

No data available.

#### **3.2 Other biological data**

No data available.

#### **3.3 Threats**

Egg poaching and meat consumption (Table 1).

##### **3.3.1 Nesting sites**

Egg poaching by villagers. Increase in artificial light in the nesting beaches [74]. Egg predation by Indian gerbi and Indian bush rat [77].

##### **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 coast of Sri Lanka is where the main turtle nesting taking place but the nesting span 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**

Egg poaching and meat consumption (Table 1).

#### **4.3.1 Nesting sites**

Egg poaching by villagers. Increase in artificial light in the nesting beaches [74]. Egg predation by Indian gerbi and Indian bush rat [77].

#### **4.3.2 Marine areas**

Consumption of meat from bycatch is a threat for sea turtles in marine areas is from fisheries through bycatch which is known to be high along the western and north-western coasts of Sri Lanka [48, 66,73].

### **4.4 Conservation**

Highly endangered hawksbill turtle has also been hunted for its carapace to provide raw materials for the tortoiseshell trade [41]. A survey of illegal tortoiseshell trade in Sri Lanka carried out in 1994, 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, tortoiseshell trade has been greatly reduced due to the strict rules and public awareness and education programmes conducted by the government and non-government organizations [67] 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**

Southern and south-western coast of Sri Lanka is where the main turtle nesting taking place but the nesting span from Mount Lavinia in the western coast to Arugambay in the eastern coast (Figure 1) [1,2,4,6,8,9,18,61]. High nesting abundance was observed in Rekawa, Kosgoda, Kahandamodara and Bundala while scattered nesting were observed in the other beaches [1,3,15,16]. Olive ridley turtle is the second-most frequent nester in Sri Lankan beaches while other three species visit occasionally (unpublished observations). In recent years, a declining trend in nesting frequency of sea turtles has been observed in Rekawa [14].

#### **5.1.2 Marine areas**

Olive ridley tagged in Orissa has been recorded in the coastal waters of eastern Sri Lanka [11]. Observations on re-nesting and post migratory behaviours of olive ridleys nesting at Kosgoda and Rekawa beaches show high nest site fidelity [12,16,17,19,69].

### **5.2 Other biological data**

Data not available.

### **5.3 Threats**

Egg poaching and meat consumption (Table 1).

#### **5.3.1 Nesting sites**

Egg poaching by villagers. Increase in artificial light in the nesting beaches [74]. Egg predation by Indian gerbi and Indian bush rat [77].

#### **5.3.2 Marine areas**

Consumption of meat from bycatch is a threat for sea turtles in marine areas is from fisheries through bycatch which is known to be high along the western and north-western coasts of Sri Lanka [48, 66,73].

### **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.**

| RMU  | <i>Caretta caretta</i> |                     | <i>Chelonia mydas</i> |                     | <i>Dermochelys coriacea</i> |                     |
|--|------------------------|---------------------|-----------------------|---------------------|-----------------------------|---------------------|
|  | CC-NEIO                | Ref #               | CM-NWIO               | Ref #               | DC-NEIO                     | Ref #               |
| <b>Occurrence</b>  |                        |                     |                       |                     |                             |                     |
| 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                    |                     | JA                    | 25                  | n/a                         |                     |
| Benthic foraging grounds                                   | n/a                    |                     | n/a                   |                     | n/a                         |                     |
| <b>Key biological data</b>                                 |                        |                     |                       |                     |                             |                     |
| 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 | 12                    | 1,10,15,16,17,18,61 | 1                           | 1,10,15,16,17,18,61 |
| 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                     | 20                  | n/a                         |                     |
| Female remigration interval (yrs) (N)                      | n/a                    |                     | 2.5-3.5               | 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                  | 22                  | 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 (2740/5281)      | 26                  | n/a                         |                     |

| RMU  | <i>Caretta caretta</i> |                | <i>Chelonia mydas</i> |                | <i>Dermochelys coriacea</i> |                |
|--|------------------------|----------------|-----------------------|----------------|-----------------------------|----------------|
|  | CC-NEIO                | Ref #          | CM-NWIO               | Ref #          | DC-NEIO                     | Ref #          |
| <b>Trends</b>  |                        |                |                       |                |                             |                |
| 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                         |                |
| <b>Published studies</b>   |                        |                |                       |                |                             |                |
| 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             |
| <b>Threats</b>   |                        |                |                       |                |                             |                |
| Bycatch: presence of small scale / artisanal fisheries?          | PLL, SN                | 27,28,38,46,48 | PLL, SN               | 27,28,38,46,48 | PLL                         | 27,28,38,46,48 |
| 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. Egg poaching   | Y                      | 45,57,58,59,34 | Y                     | 45,57,58,59,34 | Y                           | 45,57,58,59,34 |
| Coastal Development. Nesting habitat degradation                 | Y                      | 49,60,74       | y                     | 49,60,74,77    | Y                           | 49,60,74,77    |
| Coastal Development. Photo pollution                             | Y                      | 74             | Y                     | 74             | Y                           | 74             |
| Coastal Development. Boat strikes                                | n/a                    |                | n/a                   |                | n/a                         |                |
| Egg predation  | Y                      | 15, 61,77      | Y                     | 15,16, 61,77   | Y                           | 15,61,77       |
| Pollution (debris, chemical)                                     | Y                      | 80             | Y                     | 80             | Y                           | 80             |

| RMU  | <i>Caretta caretta</i> |                     | <i>Chelonia mydas</i> |                               | <i>Dermochelys coriacea</i> |                     |
|--|------------------------|---------------------|-----------------------|-------------------------------|-----------------------------|---------------------|
|  | 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  |                        |                     |                       |                               |                             |                     |
| <b>Long-term projects (&gt;5yrs)</b>                               |                        |                     |                       |                               |                             |                     |
| 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                         |                     |
| <b>Conservation</b>  |                        |                     |                       |                               |                             |                     |
| 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         | 16                    | 62,63,64,65                   | 16                          | 62,63,64,65         |
| N of long-term conservation projects (period: range of years)      | 3                      | 14,15,73,76,78,79   | 3                     | 14,15,73,76,78,79             | 3                           | 14,15, 73,76,78,79  |
| 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  |                        |                     |                       |                               |                             |                     |



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

| RMU  | <i>Eretmochehlys imbricata</i> |                     | <i>Lepidochelys olivacea</i> |                     |
|--|--------------------------------|---------------------|------------------------------|---------------------|
|  | EI- NEIO                       | Ref #               | LO-NEIO                      | Ref #               |
| <b>Occurrence</b>  |                                |                     |                              |                     |
| 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                          |                     |
| <b>Key biological data</b>                                 |                                |                     |                              |                     |
| 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 | 12                           | 1,10,15,16,17,18,61 |
| 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 nests                    | 17                  |
| Female remigration interval (yrs) (N)                      | n/a                            |                     | 1-4 years                    | 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                          |                     |

| RMU  | <i>Eretmocehlyls imbricata</i> |                | <i>Lepidochehlyls olivacea</i> |                |
|--|--------------------------------|----------------|--------------------------------|----------------|
|  | EI- NEIO                       | Ref #          | LO-NEIO                        | Ref #          |
| <b>Trends</b>  |                                |                |                                |                |
| 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                            |                |
| <b>Published studies</b>   |                                |                |                                |                |
| 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             |
| <b>Threats</b>   |                                |                |                                |                |
| Bycatch: presence of small scale / artisanal fisheries?          | PLL,SN                         | 27,28,38,46,48 | PLL                            | 27,28,38,46,48 |
| 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. Egg poaching   | Y                              | 45,57,58,59,34 | Y                              | 45,57,58,59,34 |
| Coastal Development. Nesting habitat degradation                 | Y                              | 49,60,74       | Y                              | 49,60,74       |
| Coastal Development. Photopollution                              | Y                              | 74             | Y                              | 74             |
| Coastal Development. Boat strikes                                | n/a                            |                | n/a                            |                |
| Egg predation  | Y                              | 15, 61,77      | Y                              | 15, 61,77      |
| Pollution (debris, chemical)                                     | Y                              | 80             | Y                              | 80             |
| Pathogens  | n/a                            |                | n/a                            |                |
| Climate change   | n/a                            |                | n/a                            |                |

| RMU  | <i>Eretmocehlys imbricata</i> |                     | <i>Lepidochehlys olivacea</i> |                     |
|--|-------------------------------|---------------------|-------------------------------|---------------------|
|  | EI- NEIO                      | Ref #               | LO-NEIO                       | Ref #               |
| Foraging habitat degradation                                       | n/a                           |                     | n/a                           |                     |
| Other  |                               |                     |                               |                     |
| <b>Long-term projects (&gt;5yrs)</b>                               |                               |                     |                               |                     |
| 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                           |                     |
| <b>Conservation</b>  |                               |                     |                               |                     |
| 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         | 16                            | 62,63,64,65         |
| N of long-term conservation projects (period: range of years)      | 3                             | 14,15, 73,76,78,79  | 3                             | 14,15, 73,76,78,79  |
| In-situ nest protection (eg cages)                                 | Y                             | 15,16,61            | Y                             | 15,16,61            |
| Hatcheries   | Y                             | 29                  | Y                             | 29,35,37,44,75      |
| 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  |                               |                     |                               |                     |

**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 (N)      | Lat (E)  |             |             |                      |                        |                           |
| <b>CC-NEIO</b>           |            |   |  |               |          |             |             |                      |                        |                           |
| 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                         |
| <b>CM-NWIO</b>           |            |   |  |               |          |             |             |                      |                        |                           |
| 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                   |                        |                           |
| <b>DC-NEIO</b>           |            |   |  |               |          |             |             |                      |                        |                           |
| 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 |
| <b>EI-NEIO</b> |  |                  |            |           |          |      |     |                      |   |   |
| Kumana         |  | 16 (2015)        |            | 81.717518 | 6.527416 | 7    |     | DWC Unpublished data | 1 | B |
| <b>LO-NEIO</b> |  |                  |            |           |          |      |     |                      |   |   |
| 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       | Reports / Information material | Current Sponsors | Primary Contact (name and Email)     | Other Contacts (name and Email)                |
|------|-----|------------------------|-----------------------------------|---|------------|----------|-------------------------------------|-----------------|--------------------------|--------------------------------|------------------|--------------------------------------|--|
| T4.1 |     | Rekawa beach, Tangalle | In-situ nest protection programme | Flipper tag, Sattalite tag, Nesting female; Northern Indian Ocean | 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, Sattalite tag, Nesting female; Northern Indian Ocean | 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, Sattalite tag, Nesting female; Northern Indian Ocean | 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         | Nesting female; Northern Indian Ocean                             | 2012       | ongoing  | Department of Wildlife Conservation | Public          |                          |                                |                  | DG, DWC                              | P.A.C.N.B. Suraweera channasuraweera@yahoo.com |
| T4.5 |     | Bundala                | Nest protection programme         | Nesting female; Northern Indian Ocean                             | 2014       | ongoing  | Department of Wildlife Conservation | Public          |                          |                                |                  | DG, DWC                              | P.A.C.N.B. Suraweera channasuraweera@yahoo.com |
| T4.6 |     | Kumana                 | Nest protection programme         | Nesting female; Northern Indian Ocean                             | 2013       | ongoing  | Department of Wildlife Conservation | Public          |                          |                                |                  | DG, DWC                              | P.A.C.N.B. Suraweera channasuraweera@yahoo.com |

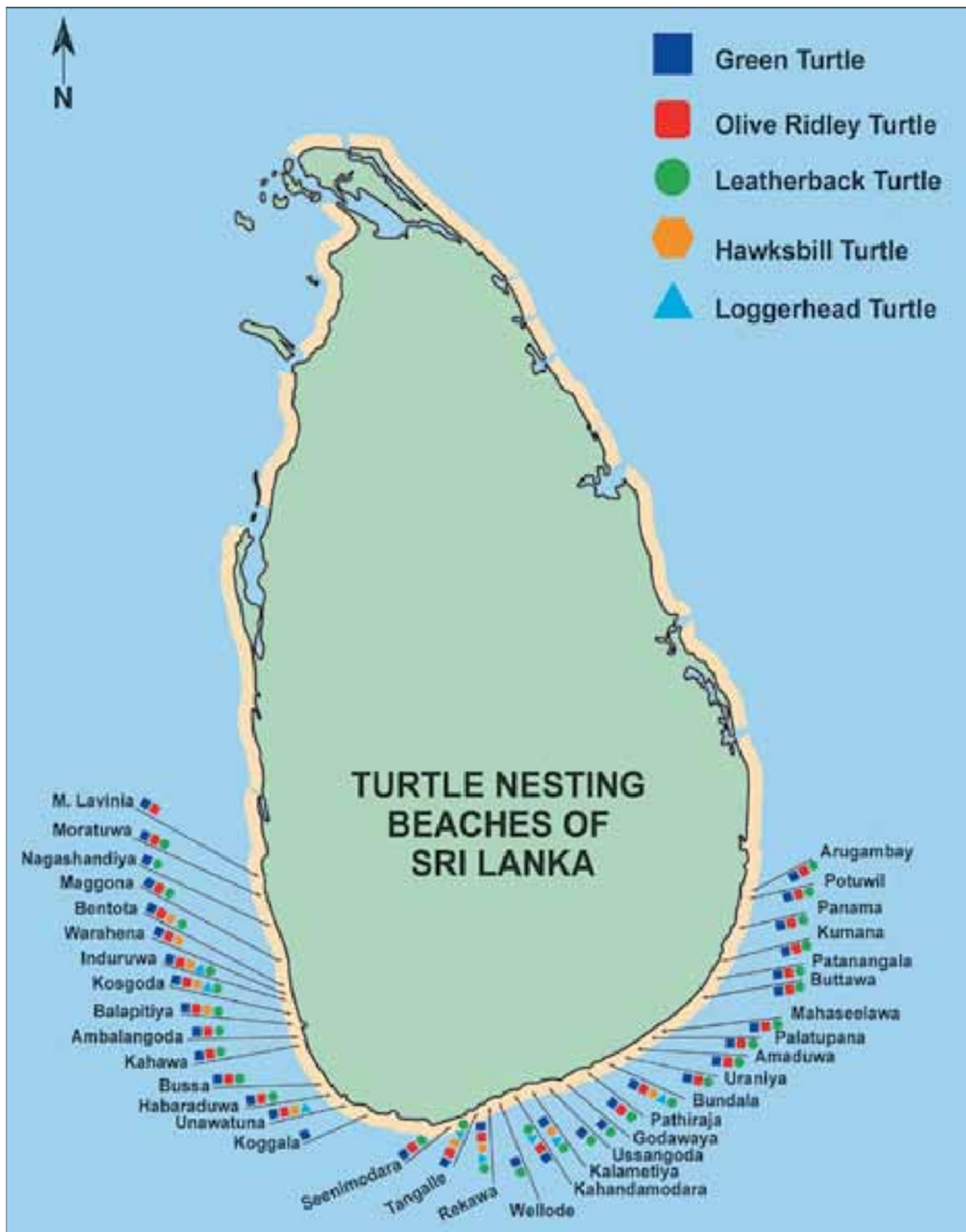


Figure 1 Map showing the nesting beaches of five sea turtle species in Sri Lanka



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# SUDAN

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## Introduction

Five species of sea turtle are recorded in Sudan [11, 12]. Hawksbill turtles (*Eretmochelys imbricata*) are most common, followed by green turtles (*Chelonia mydas*) with both confirmed as nesting in the country and 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 discussed further.

## 1 RMU: *Eretmochelys imbricata*, Northwest Indian Ocean (EI-NWIO)

### 1.1 Distribution, abundance, trends

#### 1.1.1 Nesting sites

Distribution and levels of hawksbill nesting in Sudan have not been reported for over 15 years ([12], Table 1) and need to be updated. Mukkawar (Mesgarsam) Island appears to be the most important nesting location in the country [12, 15] in the Mohammad Gol Dugonab Bay region, but other important areas include several islands, most notably Seil Ada Kebir [2] and Suakin ([12], Table 2).

Nesting on Mukkawar Island was estimated to be up to “several thousand nesting pits on an 8-10km stretch of shore” in 2002 [15], while 42 individual turtles were recorded nesting 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 the Dugonab Bay has been identified as 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

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.

Straight carapace length for nesting females is at least 53.3 cm [2] but is more commonly at least 10 cm longer [2, 12].

No other useful biological data have been reported for hawksbills in Sudan (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 has 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 at least nominally afforded legal protection in Sudan under several international and national regulations (Table 3).

A marine park has been established that covers the most important known nesting and foraging sites for hawksbill turtles [15], but there are no documented or known conservation programs running (Table 1).

### **1.5 Research**

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

## **2 RMU: *Chelonia mydas*, Northwest Indian Ocean (CM-NWIO)**

### **2.1 Distribution, abundance, trends**

#### **2.1.1 Nesting sites**

Very limited information on green turtle nesting in Sudan has been reported [11, 12], however nesting is known to occur at Mukkawar, Payer and Seil Ada Kebir Islands (Table 2) with an estimate of no more than 50 nests annually ([11], Table 1).

#### **2.1.2 Marine areas**

The greater area of the Dunganab Bay has been identified as sea turtle marine habitat with green turtles being particularly widespread and seen across the region. However, particularly large numbers of green turtles were observed in the very extensive areas of shallow reef flat and sand at the northern end of Kukkawar Island, 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**

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

### **2.3.2 Marine areas**

Same as for hawksbill turtles, see section 1.3.2 and Table 1.

## **2.4 Conservation**

See 1.4.

## **2.5 Research**

No current research is reported or known to be in progress (Table 1). There is an acute 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.**

| RMU  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |           | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-----------|------------------------------|-------|
|  | CC-NWIO                | Ref # | CM-NWIO               | Ref # | DC-U                        | Ref # | EI-NWIO                       | Ref #     | LO-WIO                       | Ref # |
| <b>Occurrence</b>  |                        |       |                       |       |                             |       |                               |           |                              |       |
| 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                          |       |
| <b>Key biological data</b>                                 |                        |       |                       |       |                             |       |                               |           |                              |       |
| 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                          |       |

|  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i>                 |       | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|---|-------|------------------------------|-------|
| 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, N= 42 (67.5 CCL, 63 SCL, N = 15,14) | 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) [87-92]                             | 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   |
| <b>Trends</b>  |                        |       |                       |       |                             |       |   |       |                              |       |
| 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                          |       |
| <b>Published studies</b>   |                        |       |                       |       |                             |       |   |       |                              |       |
| 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                            |       |



| RMU   | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |            | <i>Lepidochelys olivacea</i> |       |
|---|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|------------|------------------------------|-------|
|   | CC-NWIO                | Ref # | CM-NWIO               | Ref # | DC-U                        | Ref # | EI-NWIO                       | Ref #      | LO-WIO                       | Ref # |
| <b>Threats</b>  |                        |       |                       |       |                             |       |                               |            |                              |       |
| 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. Egg poaching                                      | 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    |
| <b>Long-term projects (&gt;5yrs)</b>                    |                        |       |                       |       |                             |       |                               |            |                              |       |
| 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                          |       |

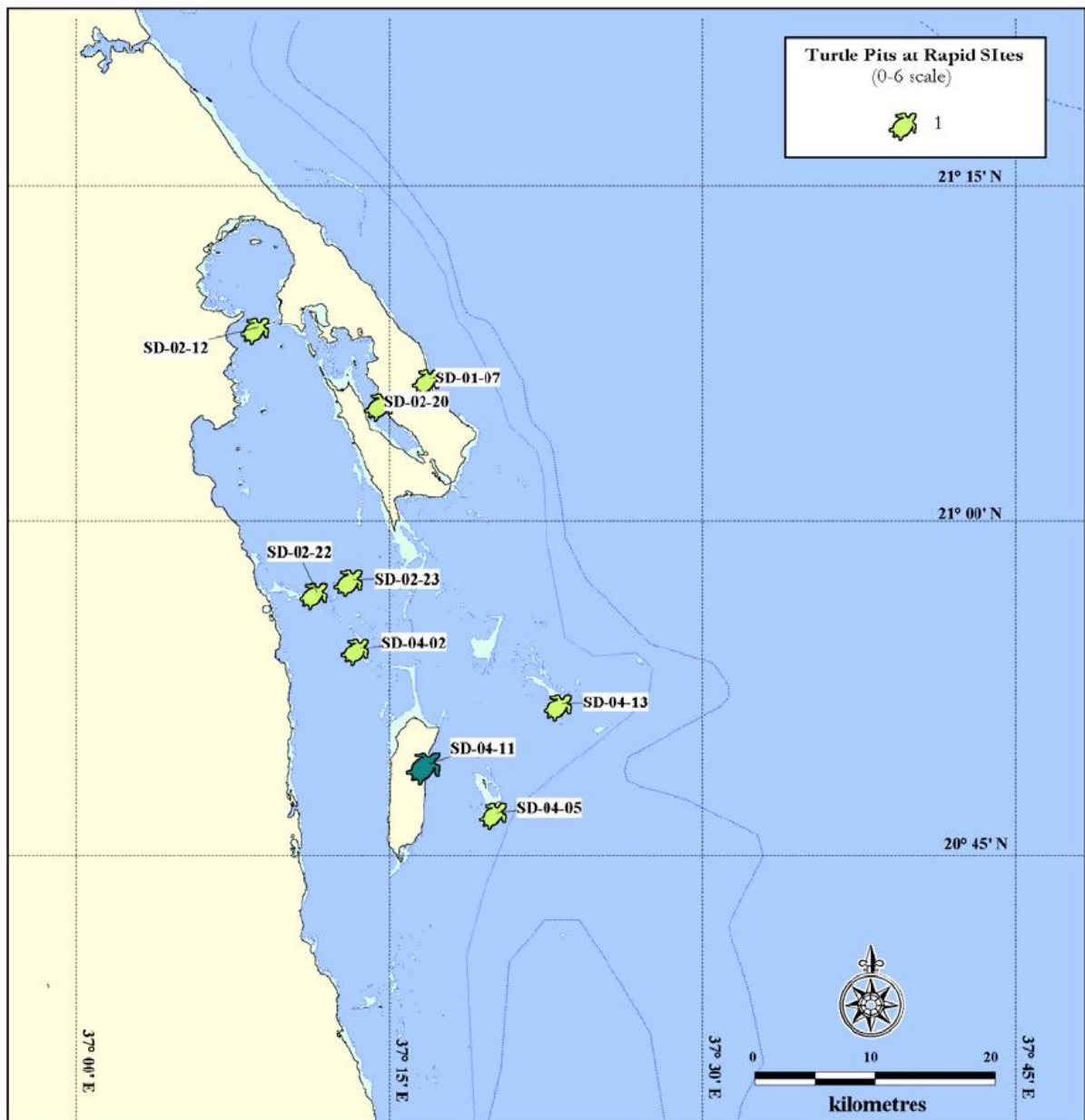
|  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Dermochelys coriacea</i> |       | <i>Eretmochelys imbricata</i> |       | <i>Lepidochelys olivacea</i> |       |
|--|------------------------|-------|-----------------------|-------|-----------------------------|-------|-------------------------------|-------|------------------------------|-------|
| RMU  | CC-NWIO                | Ref # | CM-NWIO               | Ref # | DC-U                        | Ref # | EI-NWIO                       | Ref # | LO-WIO                       | Ref # |
| <b>Conservation</b>  |                        |       |                       |       |                             |       |                               |       |                              |       |
| 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<br>(range of years) | Central point |               | Length<br>(km) | %<br>Monitored | Reference<br># | Monitoring<br>Level (1-2) | Monitoring<br>Protocol (A-<br>F) |
|----------------------------|------------|--|---------------|---------------|----------------|----------------|----------------|---------------------------|----------------------------------|
| <b>Ei NWIO</b>             |            |  |               |               |                |                |                |                           |                                  |
| (Al-)Seil Ada Kebir        | n/a        | n/a  | 19.23333333 N | 37.83333333 E | n/a            | n/a            | L              | 2                         | E                                |
| Hindi Gidir Island         | n/a        | n/a  | 37.91258333 N | 19.38194444 E | n/a            | n/a            | L              | 2                         | E                                |
| Mukkawar (Megarsam) Island | n/a        | n/a  | 37.28969444 N | 20.95666667 E | n/a            | n/a            | L, N           | 2                         | E                                |
| Masamirit Island           | n/a        | n/a  |               |               | n/a            | n/a            | L              |                           |                                  |
| Payer Island               | n/a        | n/a  |               |               | n/a            | n/a            | L              |                           |                                  |
| Arkyay                     | n/a        | n/a  |               |               | n/a            | n/a            | L              |                           |                                  |
| <b>Cm NWIO</b>             |            |  |               |               |                |                |                |                           |                                  |
| Mukkawar (Megarsam) Island | n/a        | n/a  |               |               | n/a            | n/a            | L, N           |                           |                                  |
| Payer Island               | n/a        | n/a  |               |               | n/a            | n/a            | L              |                           |                                  |
| Seil Ada Kebir Island      | n/a        | n/a  | 19.23333333 N | 37.83333333 E | n/a            | n/a            | L              |                           |                                  |

**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                  |   |
| <b>National Convention</b>   |        | 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 Island (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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# YEMEN

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## 1 RMU: *Caretta caretta*, Northwest 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 Island [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 Island, 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 Island 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 Island 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 Socotra 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<sup>2</sup>, including a 550 km<sup>2</sup> 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. Recently (2009), the Ras Isa / Kamaran Island area was declared. 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 1000 nesting turtles annually [9, 19]. Ras Sharma beach appears to be the most important nesting area 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 Island [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<sup>2</sup>, including 550 km<sup>2</sup> 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**

The Republic of Yemen is party to international conventions, agreements and treaties [16, 36, 37] including ones that were signed before unification (Table 3). For example, Yemen is a participant in the 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 a member 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). 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 marine turtles and the regulation of threatening processes. [16, 35]

PERSGA developed a regional action plan for the Red Sea and Gulf of Aden in 2004 [24]. However, because more than a decade has elapsed since the document was produced, it should be reviewed and updated to provide continuing guidance for conservation in Yemen and the Red Sea region.

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

## **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) Island, 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 northwest 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, incidental 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<sup>2</sup> 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 up-dated 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 Island 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 Island in Oman migrated to Yemen territory [64].

**Table 1. Representation and biological characteristics of nesting marine turtle species in Yemen.**

| RMU  | <i>Caretta caretta</i> |        | <i>Chelonia mydas</i> |                        | <i>Eretmochelys imbricata</i> |                |
|--|------------------------|--------|-----------------------|------------------------|-------------------------------|----------------|
|  | CC-NWIO                | Ref #  | CM-NWIO               | Ref #                  | EI-NWIO                       | Ref #          |
| <b>Occurrence</b>  |                        |        |                       |                        |                               |                |
| 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             |
| <b>Key biological data</b>                                 |                        |        |                       |                        |                               |                |
| 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                           |                |

| RMU  | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       |
|--|------------------------|-------|-----------------------|-------|-------------------------------|-------|
|  | CC-NWIO                | Ref # | CM-NWIO               | Ref # | EI-NWIO                       | Ref # |
| 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                           |       |
| <b>Trends</b>  |                        |       |                       |       |                               |       |
| 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                           |       |
| <b>Published studies</b>   |                        |       |                       |       |                               |       |
| 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                           |       |



| RMU   | <i>Caretta caretta</i> |       | <i>Chelonia mydas</i> |       | <i>Eretmochelys imbricata</i> |       |
|---|------------------------|-------|-----------------------|-------|-------------------------------|-------|
|   | CC-NWIO                | Ref # | CM-NWIO               | Ref # | EI-NWIO                       | Ref # |
| 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                           |       |
| <b>Threats</b>  |                        |       |                       |       |                               |       |
| 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. Egg poaching                                      | 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   |                        |       |                       |       |                               |       |

| RMU  | <i>Caretta caretta</i> |        | <i>Chelonia mydas</i> |        | <i>Eretmochelys imbricata</i> |       |
|--|------------------------|--------|-----------------------|--------|-------------------------------|-------|
|  | CC-NWIO                | Ref #  | CM-NWIO               | Ref #  | EI-NWIO                       | Ref # |
| <b>Long-term projects (&gt;5yrs)</b>                               |                        |        |                       |        |                               |       |
| 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                           |       |
| <b>Conservation</b>  |                        |        |                       |        |                               |       |
| 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:<br>recent<br>average<br>(range of<br>years) | Crawls/yr:<br>recent<br>average<br>(range of<br>years) | Western limit |          | Eastern limit |          | Central point |          | Length<br>(km) | %<br>Monitore<br>d | Monitoring<br>Level<br>(1-2) | Monitoring<br>Protocol (A-<br>F) | Ref# |    |
|-------------------------------|---|--|---------------|----------|---------------|----------|---------------|----------|----------------|--------------------|------------------------------|----------------------------------|------|----|
|                               |   |  | Lat           | Lon      | Lat           | Lon      | Lat           | Lon      |                |                    |                              |                                  |      |    |
| <b>CC-NWIO</b>                |   |  |               |          |               |          |               |          |                |                    |                              |                                  |      |    |
| <b>Socotra</b>                |   |  |               |          |               |          |               |          |                |                    |                              |                                  |      |    |
| 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 |

| <b>Mainland</b>                            |                         |       |     |          |          |          |          |          |          |      |  |   |   |            |
|--|-------------------------|-------|-----|----------|----------|----------|----------|----------|----------|------|--|---|---|------------|
| 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         |
| <b>CM-NWIO</b>                             |                         |       |     |          |          |          |          |          |          |      |  |   |   |            |
| 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 Island (= Jazirat Aziz)         | Y                          |     |  |          |          |          |          | 12.73330 | 44.88333 | ~500  | ND | ND | A | 10, 19 |
| Ras Imran and Azizi Island, 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   |
|---|--------|---------|----------------------------------|---------------------|---|--|---|
| <b>International</b>  |        |         |                                  |                     |   |  |   |
| 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, Chairman Environment 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, Chairman Environment 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.<br>To conserve the shared marine environment. | Protects habitat; reduce threats | Dr. Mahomed Saeed Almashjari, President of Environment Protection Authority, Environment Protection Authority (EPA).<br>Postal Address: P.O.Box. 19719 Sana'a<br>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).<br>Postal Address: P.O.Box. 19719 Sana'a<br>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).<br>Postal Address: P.O.Box. 19719 Sana'a<br>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).<br>Postal Address: P.O.Box. 19719 Sana'a<br>Yemen Phone +967 (1) 207817Fax +967 (1) 257549/207327Mobile: 967733761109/967777173372E-mail: environment@yemen.net.ye |

| National <sup>35</sup>   |      |  |  |               |   |   |  |
|--|------|--|--|---------------|---|---|--|
| 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)<br>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)<br>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)<br>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)<br>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)<br>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)<br>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 Socotra         | Environmental Protection Authority (EPA)<br>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)<br>Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816 Fax +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)<br>Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816 Fax +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)<br>Ministry of Water and Environment P.O. Box 19719 Sana'a Republic of Yemen Tel +967 1 207816 Fax +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 Island                        | 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.                                   |   |            |          |
| <b>Leading organisation</b>                   | <b>Public / Private</b> | <b>Collaboration with</b> | <b>Reports / Information material</b> | <b>Current Sponsors</b>                                      | <b>Primary Contact (name and Email)</b> |            |          |
| 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]

| Adults                 |            |        |           |      |            |                                  |                                   |                                 |                                  |                                    |                                     |                                   |                                    |                           |
|------------------------|------------|--------|-----------|------|------------|----------------------------------|-----------------------------------|---------------------------------|----------------------------------|------------------------------------|-------------------------------------|-----------------------------------|------------------------------------|---------------------------|
| Location               | Species    | Source | Year      | Date | 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) |
| 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 Island      | Hawksbill  | 19     | 1966-1967 |      | Adult      | 69.5 (14)                        | 63-72                             |                                 |                                  |                                    |                                     |                                   |                                    |                           |
| Adults                 |            |        |           |      |            |                                  |                                   |                                 |                                  |                                    |                                     |                                   |                                    |                           |
| Location               | Species    | Source | Year      | Date | Life stage | Range Plastron Length (cm)       | Mean Plastron Width (cm)          | Range Plastron Width (cm)       | Mean Head width (cm)             | Range Head width (cm)              | Mean Tail Length (cm)               | Range Tail Length (cm)            | Mean Weight (kg)                   | Range Weight (kg)         |
| Sharmah-Jethmoon Coast | Loggerhead | 22     | 2006      |      | Adult      |                                  |                                   |                                 |                                  |                                    |                                     |                                   |                                    |                           |
| Sharmah-Jethmoon Coast | Green      | 22     | 2006      |      | Adult      | 70-82                            |                                   | 60-7                            |                                  | 13-16                              |                                     | 14-22                             |                                    | 100-152                   |
| Jabul Aziz Island      | Hawksbill  | 19     | 1966-1967 |      | Adult      |                                  |                                   |                                 |                                  |                                    |                                     |                                   |                                    |                           |

| Eggs                   |            |        |           |      |            |                        |                         |                        |                         |                            |                             |                |                          |                           |
|------------------------|------------|--------|-----------|------|------------|------------------------|-------------------------|------------------------|-------------------------|----------------------------|-----------------------------|----------------|--------------------------|---------------------------|
| Location               | Species    | Source | Year      | Date | Life stage | Clutch size (eggs)     | Egg Dia Mean (cm)       | Egg Dia Range (cm)     | Egg Weight (gm)         | Egg Weight Range (gm)      | Number clutches Sampled     | Number sampled | Incubation Period (days) | Renesting interval (days) |
| 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)<br>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)<br>30     | 45.5                    | 41-48                  | 42.3                    | 37.5-47.5                  | 1                           | 50             |                          |                           |
| Sharma Beach           | Green      | 18     | 1972      |      | Egg        | 122.4 (67-179)<br>5    |                         |                        | 44.8                    | 35-55                      | 5                           |                |                          |                           |
| Jabul Aziz Island      | Hawksbill  | 19     | 1966-1967 |      | Egg        | 81.2 (69-99)<br>5      | 40.5                    | 38-45                  |                         |                            | 1                           |                |                          |                           |
| Hatchlings             |            |        |           |      |            |                        |                         |                        |                         |                            |                             |                |                          |                           |
| Location               | Species    | Source | Year      | Date | Life stage | Hatchling CL Mean (cm) | Hatchling CL Range (cm) | Hatchling CW Mean (cm) | Hatchling CW Range (cm) | Hatchling Weight Mean (gm) | Hatchling Weight Range (gm) | Number sampled | Number clutches Sampled  | % Hatching Emergence      |
| 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 Island      | Hawksbill  | 19     |           |      | Hatchling  | 42                     |                         | 32                     |                         |                            |                             |                |                          |                           |

| Nesting season    | Peak nesting period underlined; estimated in parentheses |     |     |     |         |         |         |         |         |         |            |            |            |        |
|-------------------|--|-----|-----|-----|---------|---------|---------|---------|---------|---------|------------|------------|------------|--------|
| 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 Island | 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). |
|               | <b>Age at (years)</b>    | <b>Age at maturity calculation (see original Source)</b> | <b>½ Reproductive Longevity (years)</b> | <b>Generation Length (GL; years)</b>   | <b>3-generation duration ( [= GL * 3]; years)</b> | <b>Calendar year 3 generations back (= 2001- 3GL)</b> |  |                 |                    |  |
|               | 33.3                     | Mean of A,B,C  | ½ (19 yr) = 9.5                         | 33.3 + 9.5 = 42.8                      | 42.8 * 3 = 128.4                                  | 1873  |  |                 |                    |  |
|               | <b>Past</b>              | <b>Present</b>   |   | <b>Subpopulation 3 gen. ago (est.)</b> | <b>Current Subpopulation (est.)</b>               | <b>Estimated 3-generation reduction</b>               | <b>Notes</b>                                     |                 |                    |  |
|               | 1,750                    | 750  |   |  |   |   | Subpopulation declining since at least 1950 (10) |                 |                    |  |
|               | (1972)                   | (1999)   | E=                                      | 5,409                                  | 677   | -87%  |  |                 |                    |  |
|               |                          |  | L=                                      | 2,564                                  | 676   | -74%  |  |                 |                    |  |
|               | <b>Egg Collect</b>       | <b>Female Harvest</b>                                    | <b>Intent. Capture</b>                  | <b>Incident. Capture</b>               | <b>Habitat Loss</b>                               | <b>Cont.</b>  | <b>Dis</b>                                       |                 |                    |  |
|               | 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        |

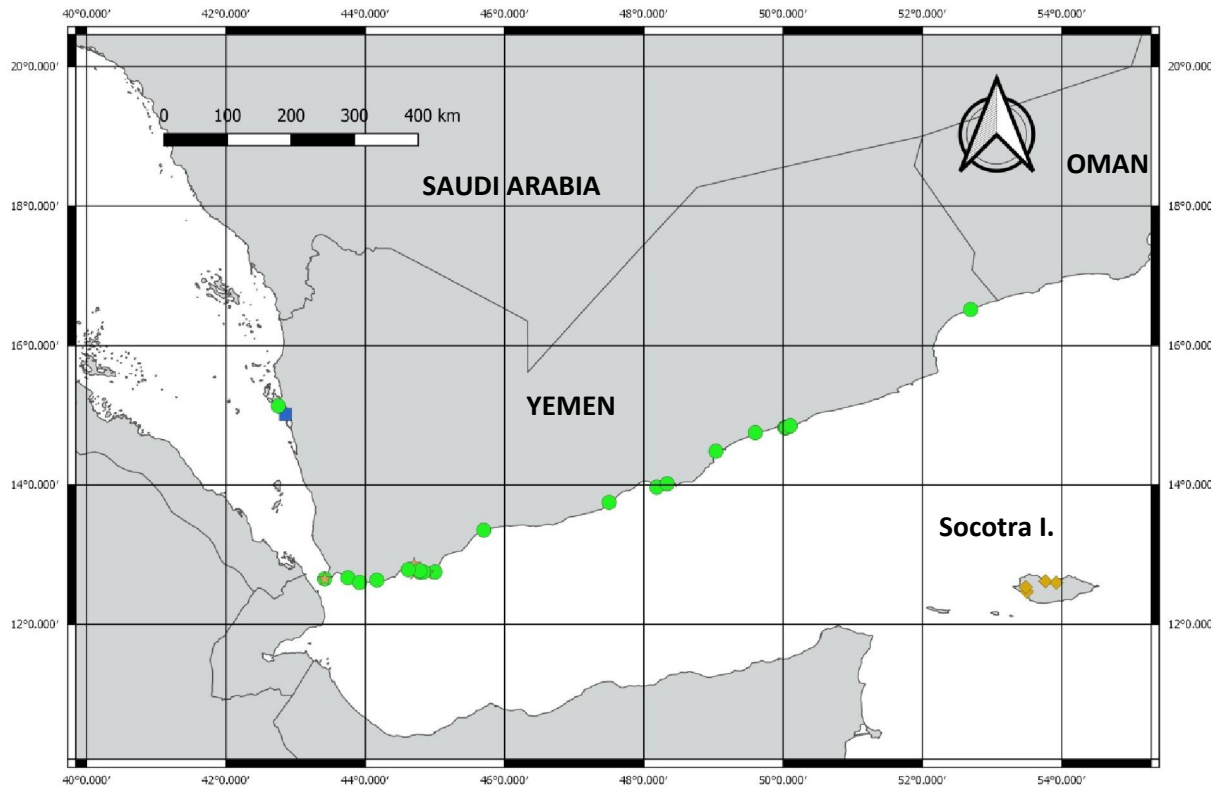
**Table 7. Marine Protected Areas in Yemen.**

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 <sup>2</sup> ) | Major habitats and significant species   | Impacts and conflicts  | Management                              | Global recognition                                    | Ref # |
|--|---------------------------------|-------------------------|-------|-------------|---------------|-------------------------|--|--|---|---|-------|
| <b>SOCOTRA</b>                         | 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    |
| <b>KAMARAN</b>                         | Ras Isa/ Kamaran Island         | 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    |
| <b>BIR ALI AND PELHAF</b>              | 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    |
| <b>SHARMAH AND JATHMON</b>             | 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    |
| <b>KHAWOR UMAYRAH</b>                  | 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    |
| <b>DHOBBAH (SHIHR)</b>                 | Dhobba (Shihr)                  |                         | 2     |             | Proposed      | Not defined             | Sandy beaches, important turtle nesting site   | Turtle egg collecting, possibly slaughtering of turtles  | None                                    | None  | 36    |
| <b>BAB AL MANDABB and Perim Island</b> | Bab-al- Mandab and Perim Island | 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 |



**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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