Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia

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# RECOMMENDATIONS ARISING FROM SPECIES ASSESSMENTS

Following constructive discussions at the Sixth Meeting of Signatory States (Bangkok, January 2012) an updated **Assessment of the Conservation Status of the Leatherback Turtle in the Indian Ocean and South-East Asia**, coordinated by Dr Ronel Nel, was published online in October 2012. This served to refresh the comprehensive species assessment originally published in 2006. The full document is reproduced for the present meeting as MT-IOSEA/SS.7/Inf. 10.

Subsequently, in September 2013, the **Assessment of the Conservation Status of the Loggerhead Turtle in the Indian Ocean and South-East Asia**, compiled by IOSEA Advisory Committee member Dr. Mark Hamman and other co-workers, was published online; and a hard copy version was circulated in early 2014. The Loggerhead Assessment presents a synopsis of the current state of knowledge for the species in the IOSEA region, based on a review of information for six recognised Regional Management Units. The document is reproduced in full for the present meeting as MT-IOSEA/SS.7/Inf. 11.

Both of these reports help to identify important gaps in basic biological information as well management of the species concerned, and both include many helpful recommendations for follow-up conservation action. The updated Leatherback Assessment went one step further by formulating a "Provisional List of Project Concepts" (Annex 1) that could be developed into concrete project proposals and taken forward if sufficient funds were available. The Secretariat is not aware of any progress towards these project activities and circumstances may have changed in some of the countries mentioned.

For ease of reference, the executive summaries (including identification of information and management gaps) and tables of recommendations from each of the original Species Assessments are appended as Annexes 2 and 3.

*Action requested / Expected outcome:*

(1) Leatherback Assessment recommendations:

The Advisory Committee, Signatory States and other interested stakeholders are invited to reconsider the project concepts listed in Annex 1 and to further develop the most promising concepts (in terms of importance, priority and financial viability) to the point where a few of them could be selected and used to solicit external funding and attract consultants interested/capable to carry out the work.

(2) Loggerhead Assessment recommendations:

With reference to Annex 3, in particular the table of recommendations, the Advisory Committee, Signatory States and other interested stakeholders are invited to develop project concepts to fill information/management gaps in relation to Loggerhead turtle conservation, using a procedure similar to that described for the Leatherback turtle.

**Annex 1**

## Provisional list of project concepts resulting from the updated (2012) Leatherback Assessment

**Western Indian Ocean**: Provide partial support or help to leverage funding for a post-graduate study to investigate the hatching success and incubation temperature of leatherback rookeries in Mozambique. This research should be done in conjunction with sub-regional experts (Dr Ronel Nel/South Africa).

**Northern Indian Ocean**: Devise a low-cost monitoring protocol, identify and monitor index sites consistently for a period of 3-5 years in Sri Lankan leatherback rookeries, and collect genetic samples as a contribution to a region-wide assessment. Possible collaborators: local conservation bodies (e.g. Turtle Conservation Project (TCP) – Sri Lanka) and interested experts (e.g. MCS/Dr Peter Richardson).

**Habitat Rehabilitation**: Assess the extent of use of exotic vegetation to stabilize beach/dune systems and the impacts thereof through a questionnaire survey throughout the IOSEA region. If appropriate (based on the survey results), develop a short paper that outlines the problems associated with using for example Cassuarina trees in beach/dune stabilization and provide recommendations and guidelines as to the sensible removal of these trees from beach dune/ecosystems. Commission an expert desktop study to conduct the survey and develop the paper.

**Thailand & Malaysia (+ other programmes):** Review egg relocation and hatchery practices and, where appropriate, suggest and implement management interventions to enhance hatching success and produce balanced sex ratios. Short-term expert consultancy.

**Indonesia (Java/Sumatra):** Engage with local environmental agencies and NGOs (e.g. through a workshop) to document the extent of leatherback nesting, particularly in Java/Sumatra and disseminate education and awareness materials, to stimulate future data collection and the establishment of turtle monitoring programmes, where relevant.

**Papua New Guinea:** Aerial surveys have identified Buang-Buasi and Kamiali as important nesting sites. It has been suggested to establish long-term monitoring to determine nesting abundance trends in PNG (Dutton et al 2007). IOSEA to engage with experts working in the region to identify opportunities for support (e.g. technical training, data management systems, education and awareness) to enable local communities to establish inexpensive monitoring programmes.

**Additional Suggestions:**

The Steering Committee (Bellagio Sea Turtle Conservation Initiative, 2008) highlighted erosion as an expanding issue, along with predation at some to key island rookeries. Targeted support for technical training for egg relocation of “eggs/nests at risk” may assist in enhancing hatching success.

An Action Plan has apparently been developed through a Memorandum of Understanding (MOU) among Indonesia, Solomon Islands, and Papua New Guinea to support field conservation efforts and establish effective institutional and funding mechanisms to implement management activities in a sustainable manner. Implementation of this plan should be a priority.

# Appendix 1: Leatherback turtle synthesis (extracted from Hamann et al, 2006)

**Nesting areas**

This study has confirmed that there are four main areas of leatherback turtle nesting in the Indian Ocean and South East Asian region. These probably represent separate large-scale management units.

*1. Southwest Indian Ocean - South Africa and Mozambique*

The population nesting in South Africa has rarely averaged more than 100 females nesting annually within the index beach (56km of the 200km beach). Data from the index beach shows a rise from 10 to 20 nesting females per year in the 1960s, and up to approximately 100 nesting females per year in the 1990s, but in the last four years it has declined to approximately 20 to 40 nesting females per year visiting the index beach per year. The study in South Africa is one of the longest, continuous studies of leatherback turtle nesting in the world. The numbers nesting in Mozambique are not well documented, but based on data presented in this report from 1994 to 2004 it is likely that approximately 10 females nest per year in southern Mozambique (see Mozambique and South Africa sections). In addition, there does not appear to be an increase in the number of leatherback turtles nesting per year in southern Mozambique to offset the decline in South Africa.

*2. Bay of Bengal and north-eastern Indian Ocean - Sri Lanka, Andaman & Nicobar Islands (India), Thailand and Sumatra – Jave and other islands of southern Indonesia and Arnhem Land (Australia)*

There are few continuous long term data sets at any of these locations. Data from recent years, presented in this report, indicate that the nesting population in Sri Lanka might be in the order of 100 to 200 females per year (based on one year of data), for the Andaman and Nicobar Islands it is approximately 400 to 600 females per year and in Thailand fewer than 10 nests (that is probably not more than 3 or 4 females) are laid per year. An interesting pattern is emerging from two geographically close rookeries in Java. At Meru Betiri the number of leatherback turtles nesting each year has declined from approximately 20 females per year in the early 1980s down to less than five females per year in the early 2000s. In contrast, at a neighbouring beach, Alas Perwo, the very small nesting population may have doubled over the same time period (from approximately 500 eggs laid per year (1 or 2 females) up to 1000 eggs laid per year). Sightings of nesting in Arnhem Land (northern Australia) are irregular but the area has been incompletely surveyed.

*3. Southwestern South China Sea – Malaysia, Viet Nam and other minor nesting out to Japan*

The Malaysian rookeries have undergone a well-documented decline from approximately 5000 nests per year in the 1960s down to less than 10 nests per year in the 2000s. This is one of the best-studied, most dramatic examples of decline in a nesting population of marine turtles. While there are no detailed data from Viet Nam, community surveys reveal that the population has declined from an estimated 500 females per year (equivalent to thousands of nests per year) prior to the 1960s down to less than 10 nests per year in recent years.

*4. Western Pacific – Indonesia (northwest Papua), Papua New Guinea, eastern Australia*

The leatherback turtles nesting along the north coast of New Guinea (Indonesia and Papua New Guinea) are from the same genetic population as females nesting in the Solomon Islands. There are few long term data for either location (see Indonesian and Papua New Guinea sections). Data from recent surveys at both locations indicates that the total nesting population is approximately 1000 females per year. Surveys along the Papua coast are incomplete. The small eastern Australian

population identified in the 1970s is approaching extinction, no nests have been recorded in eastern Australia since 1996, and track sightings in northern Australia are irregular.

**Foraging grounds and migratory corridors (non breeding areas)**

This study has confirmed that there are few data on the foraging grounds and migratory corridors of leatherback turtles in the IOSEA region. The data presented in this report indicates that leatherback turtles have been reported from the waters of 32 of the 44 nations in the Indian Ocean and South East Asian region. However, in most of the countries that have no records of leatherback turtles, the main fisheries are shallow water artisanal fisheries, and in most cases there have been few efforts made to collect fisheries based bycatch information.

The use of satellite telemetry to track post-nesting leatherback turtles has revealed that turtles from nesting beaches within the IOSEA region use the southern Atlantic, Southern and Pacific Oceans (northern and southern). In particular, migration data from post nesting females in South Africa show that the leatherback turtles migrated south into the southern ocean, and in several cases over into the southern Atlantic Ocean. In addition, post nesting leatherback turtles tracked with satellite telemetry from West Papua swam northwards into the northern Pacific Ocean whereas those tracked from Papua New Guinea migrated into the southern Pacific Ocean. Aside from these data, and those collected from tag recoveries from peninisla Malaysia there is little known about the “at sea” components of leatherback turtle life history in the IOSEA region.

**Gaps in the basic biological information**

*Population genetics (*Assessments of marine turtle population genetics are used to determine distinct breeding populations).

There are wide gaps in our understanding of leatherback turtle population genetic profiling within the IOSEA region. To address this gap, and determine the genetic structure of leatherback turtle populations the following rookeries need to be sampled and compared to each other, as well as to published genotypes from Malaysia, Indonesian West Papua and South Africa:

- Australia (northern and eastern)
- Andaman and Nicobar Islands
- Mozambique
- Sri Lanka
- Sumatra
- Java
- Thailand
- Viet Nam

Knowledge of these genotypes will facilitate identification of the origin (by breeding area) of leatherback turtles being captured throughout their dispersed foraging and migratory distribution of the IOSEA region.

*Life history attributes*

*A. Nesting populations*

There are substantial gaps in our knowledge of life history attributes for several of the leatherback turtle nesting sites in the IOSEA region. The specific gaps vary between locations, and details can be found by referring to sections on India, Indonesia, Malaysia, Mozambique, Papua New Guinea, Sri Lanka, South Africa, Thailand and Viet Nam. Data on life history attributes are necessary for the development of accurate population models. It is preferential that life history parameters be collected from at least one rookery per management unit. The gaps in life history attributes include:

- The number of clutches per female per year/nesting season
- The number of years between breeding seasons
- The rate of recruitment into the breeding population
- Nest success and hatchling recruitment
- Internesting areas

Of the 10 nations with current leatherback turtle nesting five have included some of the leatherback turtle rookeries within protected areas.

*B. Non-nesting beach aspects*

Within the IOSEA region there are substantial gaps in our knowledge of leatherback turtle foraging areas, habitat use (oceanic and coastal), internesting area habitats, diet, growth, age and survivorship. While there have been substantial tracking and foraging area studies in eastern Pacific and western Atlantic leatherback turtle populations, few data exist for the Indian Ocean region, with the exception of the South Africa and the Papua region.

**Gaps in management**

*Bycatch and fisheries mortality*

Leatherback turtle fisheries bycatch was reported to occur at varying levels of intensity in 25 of the 44 nations in the IOSEA region, not recorded in 13 nations and undetermined in 6. This bycatch has not been quantified in most countries, and fewer bycatch data exist for the high seas fisheries. There are also gaps in the ecological, social and economical aspects of marine turtle bycatch. Bycatch and fisheries based mortality needs to be addressed by Fisheries and/or Government organizations. This will take a coordinated international effort similar to those undertaken in the Atlantic and Pacific Ocean fisheries.

*Egg take*

The direct take of leatherback turtle eggs occurs in each of the leatherback turtle breeding areas to varying degrees (encompasses both legal and illegal take). However in most cases the level of exploitation in relation to the size of the population and the socio-economic and cultural factors related to the use of eggs are unknown. Improved knowledge of these factors will enable the level of exploitation to be assessed for sustainability and managed accordingly. Every effort must be made not to repeat what has happened at Rantau Abang.

*Hatchling production*

Aside from data collected from the hatchery programme in Malaysia and South Africa, there have been no detailed assessments of the hatchling production at any of the rookeries in the IOSEA region. Without these data it is impossible to conduct meaningful population assessments and design management strategies. While natural (in situ) incubation is the preferred management option for egg incubation, hatcheries are used as a management tool in one nation (plus some of the commercial hatcheries in Sri Lanka occasionally incubate leatherback turtle eggs).

Rising beach temperatures associated with climate change can be expected to negatively impact on population sex ratio and incubation success of leatherback turtle eggs. No adequate monitoring appears to be in place in any of the IOSEA countries to guide rookery management in response to climate change.

*Standard monitoring*

Monitoring of several of the rookeries in the IOSEA region has been initiated relatively recently. There is a need for managers in each location to develop standard monitoring protocols that remain consistent year to year, and complements existing projects. Mostly importantly, if whole season

monitoring is not possible at all rookeries, index beaches and standard monitoring periods need to be determined and used annually. It is also preferable that tagging projects double tag turtles (PIT and flipper) to minimize problems of tag loss. The introduction of standard practices will substantially improve the ability to use the data effectively in the future.

**Additional issues for leatherback turtles in the IOSEA region**

*Direct harvest of turtles*

A traditional harvest of leatherback turtles occurs in the Kei Islands of Indonesia. While research addressing social, economical and cultural aspects of this harvest are underway (see Indonesian section), gaps exist with regard to understanding biological aspects of the harvest (size, age class, sex and maturity). The combination of biological, social, economic and cultural data can be assessed to determine ecological sustainability and help to manage any trade-offs (social, economical, cultural or ecological) that may occur as a result of management.

*Predation of eggs*

Depredation of eggs by pigs and dogs presents a problem in at least several locations (Andman and Nicobar Islands Papua New Guinea and Indonesian West Papua). Turtle conservation groups in these regions would benefit from assistance in management of the problem e.g. by predator removal or nest protection programs.

*Leatherback turtles nesting in South Africa*

The leatherback turtle nesting population in South Africa and Mozambique was rising and has recently undergone a marked decline in annual nesting numbers (based on data from the South African index beach). In addition, an increase in the proportion of recruits (identified as first time nesting turtles) to the nesting population has occured. Therefore, close attention should be paid to the assessment of current and future nesting leatherback turtle data so that management and remedial actions can be quickly taken if needed.

*Incomplete nesting distribution data*

There are gaps in our knowledge of the distribution and size of current and/or historical leatherback turtle rookeries along the Indian Ocean southern margin of Indonesian (Sumatra, Java and out to the east) and the islands on northern Indonesian Papua and southeastern Philippines. These data could be collected from a combination of ground based and aerial surveys in each of the respective areas.

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## Recommendations for leatherback turtle conservation

These three tables of recommendations were developed through plenary and working group discussions held at the IOSEA Memorandum of Understanding's Fourth Meeting of the Signatory States (Muscat, Oman, March 2006).

| Gap | Nations/agencies | Project context/aim | Expected outcomes |
|---|---|---|---|
| **Regional and national fisheries based projects** | | | |
| High seas and within EEZ bycatch (pelagic fisheries) | Nations of the IOSEA region and Nations (outside IOSEA) deploying foreign fishing fleets into the region.<br><br>International fisheries management agencies | Work within national and regional fisheries bodies to develop programs and activities such as onboard observer programs, and bycatch assessment/quantification and mitigation projects (including gear modification and improved fishing practices to reduce bycatch).<br><br>Advocate for regional and national fisheries bodies' policies to incorporate turtle bycatch assessment and mitigation strategies<br><br>Investigate/ advocate for investigation of seasonal and spatial closures as a management tool for reducing bycatch. | National bycatch observer, assessment and quantification programs established.<br><br>National and/or regional bycatch mitigation projects established<br><br>Coordinated regional approaches to bycatch management and illegal fishing established<br><br>Reduced mortality of marine turtles |
| Within territorial waters bycatch (coastal fisheries) | States of the IOSEA region | Determine the spatial and temporal variation in distribution and impact of fishing effort.<br><br>There is a particular need for the development of gear modification and/or use to achieve reduction in turtle mortality in gill nets [c.f. achievements such as TEDs and work in progress with long line fisheries].<br><br>Assess the impact of fisheries to inter-nesting, migrating & foraging turtles<br><br>Assess the impacts of ghost nets and plastics pollution | Improved understanding of bycatch "hotspots" which will aid in fisheries bycatch management.<br><br>National and/or regional bycatch mitigation projects established<br><br>Improved understanding of the impacts that bycatch may have on turtle at particular life history stages<br><br>Reduced mortality of leatherback turtles |
| MPAs | States of the IOSEA region | Protection and adequate management of already identified critical habitats (nesting, inter-nesting, feeding and migratory)<br><br>Identification of further critical habitats – especially inter-nesting, feeding and migratory) | MPA networks (community-based and/or formally gazetted) that provide adequate protection and management across critical leatherback habitats |

| Gap | Relevant nations | Project aim | Expected outcomes |
|---|---|---|---|
| **Regional and national genetic based projects** | | | |
| Population genetics - Leatherback turtle nesting down through the Andaman Sea, southern Indonesia to northern Australia and in Sri Lanka have not been genetically identified. | Sri Lanka, India, Indonesia, Thailand, South Africa, Papua New Guinea, Australia and Mozambique | Determine the genotype of leatherback turtles nesting in Sri Lanka, India Thailand and Indonesia [Sumatra] and compare these with published haplotypes | Understanding of the genetic structure of leatherback turtles to be used as a base for monitoring and management |
| Genetics of bycatch/strandings/direct take [development of an organized collection program] | Countries with leatherback turtle bycatch programs and/or direct take [Australia, Eritrea, Sri Lanka, South Africa (shark nets) & Indonesia (Kei Is.)] | Using genetic markers identified for nesting populations, determine population structure of marine turtle bycatch or stranded turtles | Stock based threat analysis to be used as a base for monitoring and management |
| **Biological data** | | | |
| Quantify key demographic parameters [reproductive output, clutches per season, remigration interval and annual survivorship] | Each nation with nesting leatherback turtles | Conduct annual saturation tagging census at an index rookery within each genetic management unit for a minimum of six consecutive breeding seasons | Improved understanding of the biological structure of leatherback turtle populations to be used as a base for monitoring and management |
| Incomplete mapping of the breeding distribution and census | The priority areas are Sri Lanka, southern Indonesia to north western Australia and Philippines. | Complete the mapping and develop a six year census project at index beaches. | 6 year (& then ongoing) determination of size of nesting population |
| Limited understanding of post nesting distribution of female leatherback turtles | Sri Lanka, India, Indonesia (predominately southern) | Satellite telemetry study to define geographical scale of migration pathways | Improved understanding of the structure of leatherback turtle populations to be used as a base for monitoring and management |
| Limited data on hatchling production including sex ratios and health and survivorship of hatchlings | South Africa, Mozambique, India, Sri Lanka, Indonesia and Papua New Guinea and Thailand | Determine; (1) survivorship of eggs and hatchlings (inc. natural egg loss, predation and human use), (2) clutch size, (3) beach temperatures, (4) temporal and spatial patterns of nest distribution and survivorship (5) socio-economic drivers that | Improved understanding of the biological structure of leatherback turtle populations, in particular aspects related to egg and hatchling mortality to be used as a base for monitoring and management |

# Loggerhead turtle synthesis

## Summary – nesting

Loggerhead turtles nest in 10 nations within the Indian and Pacific Ocean basins. Seven of these nations are Signatory States of the Indian Ocean and South-East Asia Marine Turtle Memorandum of Understanding (IOSEA); one, Japan, is within the range of the IOSEA but is not a signatory; and two, New Caledonia and Vanuatu, are outside of the IOSEA region. There are records from Vanuatu that warrant verification. There were anecdotal records of nesting from Myanmar and Bangladesh; however, they are now believed to have been mis-identified olive ridley sightings. Telemetry of post-nesting turtles has been undertaken from South Africa, Oman, eastern and western Australia, New Caledonia and Japan.

## Summary – foraging

Data from tag recoveries, satellite telemetry (end points), and fisheries bycatch indicate that loggerhead turtles forage within the Exclusive Economic Zones of 23 of the IOSEA Signatory States (and their Territories). In addition, loggerhead turtles have been recorded in six non-signatory range states and four non-range states. Population and biological studies on foraging turtles have only been conducted in two nations (Japan and Australia – for the north and south Pacific Ocean populations respectively. Of the 23 Signatory States in which loggerhead turtles have been recorded, specific threats to loggerhead turtles have been identified in 10.

## Summary – population identification

There are six distinct populations/management units (MU) of loggerhead turtles within the IOSEA region – South-west Indian Ocean, North-west Indian Ocean, North-east Indian Ocean, South-east Indian Ocean, North Pacific Ocean and South Pacific Ocean. These have been classified as distinct based on a combination of genetic data, migration data, home range data, tag recoveries and expert opinion. While the nesting sites are distinct, individuals from more than one population may inhabit particular foraging areas.

The status of each of the populations has recently been assessed by both the United States National Marine Fisheries Service (US NMFS) and as part of the Burning Issues initiative of the Marine Turtle Specialist Group (Figure A; Wallace et al. 2011). In general the two assessments, which were conducted independently but with some experts involved in both processes, derived similar conclusions (Table 1). Two main differences exist between the assessments: (1) US NMFS included the Sri Lankan loggerheads with the North-west Indian Ocean population (Oman and Yemen) whereas Wallace et al. (2010, 2011) considered it to be separate, and classed it as a high risk-high threats population (and one of the 11 most endangered in the world); and (2) US NMFS classed the North-west Indian Ocean population as 'Endangered' whereas Wallace et al. (2011) classed it as low risk-low threats because there is a lack of empirical data on population decline and threats (Figure 1). Clearly, the different opinions expressed in the two assessments raise important questions about the population's status and condition. Of the two assessments, the US NMFS placed more emphasis on expert opinion to fill the empirical knowledge gaps than Wallace et al. (2011), hence their 'Endangered' classification. There is a well-recognised need for both data analysis and continued research and monitoring on this population to improve assessment accuracy.

Table 1. Comparison of outputs from the US NMFS determination and Wallace et al. (2011) for loggerhead turtle populations in the IOSEA region. [1] denoted by Wallace et al. 2011 as a critical knowledge gap; [2] listed as one of 11 of the world's most endangered regional management units (RMUs) (Wallace et al. 2011) and [3] is included in the NW Indian Ocean section.

| Breeding location | Population | NMFS Determination | Wallace et al. 2011 |
|---|---|---|---|
| Japan | North Pacific | Endangered | High Risk-High Threats[2] |
| Eastern Australia and New Caledonia | South Pacific | Endangered | High Risk-High Threats |
| Western Australia | South-east Indian | Threatened | High Risk-Low Threats[1] |
| South-east Africa | South-west Indian | Threatened | High Risk-Low Threats |
| Oman and Yemen | North-west Indian | Endangered | Low Risk-Low Threats[1] |
| Sri Lanka | North-east Indian | Not assessed[3] | High Risk-High Threats[1,2] |

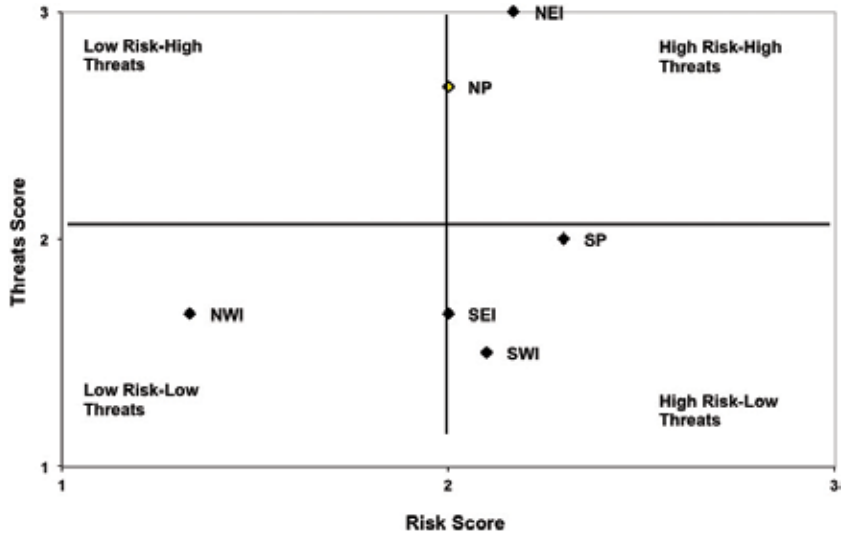


Figure 1. Conservation priority portfolio approach to displaying and interpreting paired risk and threat scores for loggerhead regional management units (RMUs) (adapted from Wallace et al. 2011)

# Gaps in the basic biological information

## Population structure

There are some gaps in our understanding of loggerhead turtle population genetic profiling within the IOSEA region. To address the gaps and determine the genetic structure of loggerhead turtle populations, the following rookeries need to be sampled and compared to each other, as well as to published genotypes: Sri Lanka, Yemen (Socotra) and Somalia. There is also a need to sample turtles from foraging areas, or those that have stranded or been caught in fisheries, to better understand population-specific mortality.

## Life history attributes

### A. Nesting populations

There are substantial gaps in our knowledge of life history attributes for several of the loggerhead turtle nesting sites in the IOSEA region. The specific gaps vary between locations, and details can be found by referring to each population section of this report. Data on life history attributes are necessary

for the development of accurate population models. It is preferential that life history parameters be collected from at least one rookery per management unit. The gaps in life history attributes evident in most management units include:

- the number of clutches per female per year/nesting season
- temperature profile and hatchling sex ratios of nesting populations
- the number of years between breeding seasons
- the rate of recruitment into the breeding population
- nest success and hatchling recruitment
- survivorship of adult females
- inter-nesting areas and habitat use.

**B. Non-nesting beach aspects**

Within the IOSEA region there are substantial gaps in our knowledge of loggerhead turtle foraging areas, habitat use (oceanic and coastal), inter-nesting area habitats, diet, growth, age and survivorship for all except the two Pacific Ocean populations. Additionally, while there have been substantial tracking and foraging area studies in the North and South Pacific, and the South-west and North-west Indian Ocean populations, few data on migration and home range exist for the North-east and South-east Indian Ocean populations.

# Gaps in management

## Reporting gaps

It was evident during the writing of this assessment that much of the threat, mortality and management information contained within the IOSEA website and the Signatory States reports is not species specific. It could be that "species" level information is not collected, or that it is not reported on. In terms of threats such as bycatch it is most likely the former. Improving species-specific data collection about threats and mortality will improve management.

## Bycatch and fisheries-associated mortality

Incidental catch of marine turtles was reported to occur at varying levels of intensity in all nations in the IOSEA region; however, species-specific data is often not available. Bycatch has not been quantified in most countries, and fewer bycatch data exist for the high seas fisheries, especially species-specific data. There are also gaps in the ecological, social and economical aspects of marine turtle bycatch. Bycatch and fisheries-based mortality needs to be addressed by fisheries and/or government organisations. This will take a coordinated international effort similar to those undertaken in the Atlantic and Pacific Ocean fisheries. Recent initiatives have aimed to quantify bycatch from several fisheries: South African longline fisheries (Petersen et al. 2008), gillnet fisheries (Gilman et al. 2010) and a multi-fishery ecological risk assessment (Nel et al. in press). A summary of the previous 15 years of data for the European Union Purse Seine Fisheries sea turtle interactions can be found at http://ioseaturtles.org/pom_detail.php?id=123, and IOSEA reports relevant to Indian Ocean fisheries-turtle interactions can be found at http://ioseaturtles.org/pom_detail.php?id=127.

## Hatchling production

Aside from the South-west Indian Ocean and the two Pacific Ocean populations there have been no detailed assessments of the hatchling production at other rookeries in the IOSEA region. Without these data it is impossible to conduct meaningful population assessments and design management strategies.

### Climate change

Rising beach temperatures associated with climate change can be expected to negatively impact on population sex ratio and incubation success of loggerhead turtle eggs. Sand temperature loggers have been deployed on index beaches for the South-east Indian Ocean and South Pacific Ocean populations; however, no adequate monitoring appears to be in place in any of the other IOSEA countries to guide rookery management in response to climate change.

### Standard monitoring

Monitoring of several of the rookeries in the IOSEA region has been initiated relatively recently. There is a need for managers in each location to develop standard monitoring protocols that remain consistent year to year, and which complement existing projects. Most importantly, if whole season monitoring is not possible at all rookeries, index beaches and standard monitoring periods need to be determined and used annually. The introduction of standard practices will substantially improve the ability to use the data effectively in the future.

## Additional issues for loggerhead turtles in the IOSEA region

### Climate change

Climate change is becoming a ubiquitous issue throughout the world. While marine turtles have coped with changing climates over past millennia, the rate of current and predicted change, coupled with additional threats and pressures (e.g. coastal development, pollution, fisheries etc.), is unprecedented. While it may be a ubiquitous issue, the degree to which various species or populations of marine turtle are exposed, and how they are able to adapt, will vary considerably. For loggerhead turtles, Chaloupka et al. (2008) demonstrate that increased sea surface temperatures could negatively influence the numbers of females breeding each year, and studies from the US indicate that shifts in the nesting season or impact of threats could change with a warming climate (Pike and Stiner 2007). Key research gaps include the conversion of global/ocean-scale climate models down to smaller scales so they are relevant to local scale (e.g. for nesting beaches or foraging areas), understanding sensitivity and thresholds of concern (e.g. pivotal temperatures and sand temperature ranges) and understanding adaptive capacity (see Hamann et al. 2007, 2010).

### Marine debris and plastic pollution

Marine debris, in particular plastic pollution, is emerging as an important and widespread threat to marine turtle populations globally. Although most of the published accounts of impacts on sea turtles come from the Pacific and Atlantic oceans, it is becoming clear that the South-East Asian and Indian Ocean regions contain substantial levels of plastic pollution. The main threats that plastics pose to turtles occur when turtles ingest plastic fragments, become entangled in discarded nets (ghost nets), or have their nesting habitats impacted by them. Key research gaps include quantification of the impact across populations and life stages, the oceanographic features that disperse the pollution, understanding the social and economic drivers behind the pollution, and the barriers and opportunities for management.

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# Recommendations for loggerhead turtle conservation

| Gap | Project context/relevance | Expected outcomes | Nations/agencies targeted |
|---|---|---|---|
| Species-specific bycatch data from fisheries in coastal and oceanic zones of the Indian Ocean. Particularly, but not limited to, Indian Ocean tuna fisheries, longline, gillnet and bottom trawl fisheries<br><br>Mortality data related to bycatch, and skin samples for genetic analysis on stock contributions | Work with national and regional fisheries bodies (e.g. IOTC) to promote programs and activities such as onboard observer programs, and bycatch assessment/ quantification and mitigation projects (including actual implementation of gear modification and improved fishing practices at national level to reduce bycatch)<br><br>There is a particular need for the development of gear modification and/or use to achieve reduction in turtle mortality in gill nets [c.f. achievements such as TEDs and work in progress with long line fisheries]<br><br>Advocate for national fisheries bodies' policies to incorporate turtle bycatch assessment and mitigation strategies, and for monitoring of progress through regional fisheries management organisations<br><br>Investigate/ advocate for investigation of seasonal and spatial closures as a potential management tool for reducing bycatch – especially in coastal fisheries<br><br>Assess the impact of fisheries on inter-nesting, migrating & foraging turtles | National bycatch observer, assessment and quantification programs established<br><br>National and/or regional bycatch mitigation projects established<br><br>Coordinated regional approaches to bycatch management and illegal fishing<br><br>Improved understanding of bycatch "hotspots" which will aid in fisheries bycatch management<br><br>Improved understanding of the impacts that bycatch may have on turtles at particular life history stages.<br><br>Reduced mortality of marine turtles | Nations of the IOSEA region and nations (outside IOSEA) deploying foreign fishing fleets into the region.<br><br>International fisheries management agencies |

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| Understanding of hatchling and post-hatchling dispersal in the Indian Ocean | Compared with the Pacific and Atlantic (esp. northern) little is known about the distribution and migration routes of post-hatchling turtles in the Indian Ocean | Identification of important dispersal mechanisms and routes for hatchlings for each of the Indian Ocean management units | Each nation within the Indian Ocean with nesting loggerhead turtles (e.g. South Africa, Oman, Western Australia). Strategies could include combinations of active tracking, development of oceanographic models and genetic studies. |
| Assessment of the vulnerability of loggerhead turtle management units to climate change | Climate change is a global issue for marine turtles. For most of the management units there is a lack of data on key parameters such as beach temperature, nesting season length, vulnerability to sea level rise and extreme weather, and the influence of climate factors on key biological traits | Baseline data on sand and beach temperatures for index sites for each management unit.<br><br>Improved understanding of the vulnerability of each management unit to climate change (temperature, sea level rise and extreme weather) | Each nation with nesting loggerhead turtles to collect baseline data as a contribution to broader modelling exercises |
| Quantification of abundance and demography of loggerhead turtles in coastal waters | There is a lack of information about non-nesting biological attributes for most of the management units. Understanding growth rates, survivorship, recruitment, and habitat use of foraging turtles will help improve population assessments | Improved understanding of population dynamics and function | Each nation with foraging loggerhead turtles to conduct foraging area surveys. Priority areas: Western Indian Ocean nations, nations of the Northwest Indian Ocean and Western Australia |
| Assessment of the vulnerability of loggerhead turtles to marine debris (in particular plastic pollution) | Marine debris, in particular plastic pollution, is emerging as a global issue for marine turtles. It can impact foraging turtles at all size classes, yet very few data exist to quantify the issue, or determine hotspots. Key research could focus on understanding aspects such as distribution, transport and abundance of marine debris in the Indian Ocean, marine debris ingestion rates, and vulnerability | Improved understanding of the vulnerability of each management unit to marine debris (plastic pollution)<br><br>Improved understanding of the sources and sinks of marine debris in the Indian Ocean | National, regional, international organisations concerned with marine debris (cooperative studies, modelling etc.) |
| Genetics and population identification in Sri Lanka – including national assessment (by sampling/analysis) | It is not known whether the loggerhead turtles breeding in Sri Lanka are a distinct management unit, or part of other Indian Ocean units | Resolution of discrete management units for loggerhead turtles in the IOSEA region | Sri Lanka (Dept. of Wildlife and/or NGOs; and cooperating countries for sample analysis) |
| Analysis of existing data from the Northwest Indian Ocean management unit (acknowledging that significant amounts of annual nesting turtle data exist) | Recent assessments of loggerhead turtles (Wallace et al. 2011) and US NMFS both acknowledge long-term monitoring of loggerhead turtles of Masirah Island. These reports plus the present assessment indicate that the conservation status of loggerhead turtles in Oman is not known | Resolution of the current conservation status of loggerhead turtles in the NW Indian Ocean | Oman (Ministry of Environment and Climate Affairs, cooperating organisations) |