REGIONAL WORKSHOP AND FOURTH MEETING OF THE WESTERN INDIAN OCEAN - MARINE TURTLE TASK FORCE

South Africa 2012

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

REPORT OF THE REGIONAL WORKSHOP AND FOURTH MEETING OF THE WESTERN INDIAN OCEAN - MARINE TURTLE TASK FORCE

Port Elizabeth, South Africa

4 - 7 December 2012

by Linda Harris, Ronel Nel and Douglas Hykle

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Back cover photo credit: Linda Harris

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Executive Summary

Introduction

The Western Indian Ocean - Marine Turtle Task Force (WIO-MTTF) was created in 2008 under two international instruments: the IOSEA Marine Turtle Memorandum of Understanding[1] and the Nairobi Convention[2]. **The WIO-MTTF serves as a scientific and technical advisory committee, providing technical support to governments in the Western Indian Ocean (WIO) through the collection and review of scientific information on sea turtles and their associated habitats.** *The Regional Workshop and Fourth Meeting of the WIO-MTTF* were hosted at the Nelson Mandela Metropolitan University (NMMU), in Port Elizabeth, South Africa, in December 2012, under the auspices of IOSEA.

Ten of the eleven[3] countries in the WIO region have initiated significant efforts to conserve and protect sea turtles and their biodiversity-rich habitats by formally adopting and implementing the IOSEA Marine Turtle MoU and its integral Conservation and Management Plan (CMP). **The first objective of the meeting was to evaluate the progress towards the implementation of the CMP in the WIO** through country presentations and assessment of past and proposed activities in the WIO-MTTF Work Programme.

Recalling that Signatory States to the IOSEA Marine Turtle MoU have resolved to establish a *Network of Sites of Importance for Marine Turtles in the Indian Ocean - South-East Asia Region*[4], **the second objective of the meeting was to identify candidate sites in the Western Indian Ocean for potential inclusion in the IOSEA Site Network.** This exercise provided an opportunity to review and understand the evaluation criteria[5] for nominated sites, and to aggregate and collectively analyse region-wide data sets. The site-evaluation process was undertaken first based on expert opinion, and second as a quantitative spatial analysis. Throughout the meeting there were also several stimulating invited presentations. These were intended to enhance regional technical capacity and raise awareness of potential research opportunities and collaboration in the WIO region.

WIO-MTTF Business Meeting

Each member presented a country report[6] to update the WIO-MTTF on the state of turtle conservation (including turtle-associated habitats), current research and monitoring programmes, and key emerging threats and/or conservation and management initiatives. The Task Force also reviewed the WIO-MTTF work programme, evaluated progress to date, and updated and prioritised actions for the future. With end of the term of office for the WIO-MTTF Chair (Dr Ronel Nel) and Vice-Chair (Stephan Ciccione), new

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

[2] Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region

[3] These countries are: Comoros, France (La Réunion), Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, United Republic of Tanzania, United Kingdom. Somalia is not yet a signatory to the IOSEA MoU nor a member of the WIO-MTTF.

[4] The full text of the relevant resolution is available for download from the IOSEA website (www.ioseaturtles.org).

[5] The Criteria for the Evaluation of Sites for Inclusion in the IOSEA Site Network are available for download from the IOSEA website

[6] Copies of the presentations are available for download from the Electronic Library of the IOSEA website

representatives were elected to these positions: Dr Peter Richardson and Lindsey West (subject to confirmation), respectively.

IOSEA Marine Turtle Site Network: Validation of the Evaluation Criteria

The purpose of the IOSEA Site Network is to facilitate greater synergy of conservation efforts and co-ordination of management actions among ecologically important areas for marine turtles throughout the IOSEA region. Sites may be proposed for inclusion in the IOSEA Site Network by way of formal nomination by the Focal Point of each Signatory State. The IOSEA Advisory Committee is charged with evaluating the nominated sites against 18 agreed criteria. Its recommendations are considered by the Meeting of Signatory States, which ultimately decides whether or not a site merits inclusion in the network. In a parallel process, suggestions of potential candidate sites have been solicited from experts, in order to facilitate the formal nomination process. The WIO-MTTF meeting provided an opportunity to validate the Site Network Evaluation Criteria, and to compile a set of recommendations and suggestions regarding their future application and implementation of the nomination process.

The experts discussed and agreed on the focus area, i.e., sub-regional management units, per species, within the Western Indian Ocean region. Identification of sites of importance within the focus area then proceeded in two sessions. The first session focused on the Ecological and Biological Criteria (EB1-4), and experts identified sites of importance in terms of species/population abundance and distribution, and integrity (resistance and resilience) of the site. The second session focused on the Socio-Economic and Political Criteria (S1-6, excluding S4). Sites that were nominated in the first session were scored under this second suite of criteria as well. In addition, sites that were not identified in the first session as being ecologically and biologically important, but important under the latter criteria, were added to the list and scored.

Nineteen areas (two of which comprised two adjacent sites) were identified as candidates for potential inclusion in the IOSEA Site Network. Listed in alphabetical order they are: Agalega Island; Aldabra Atoll; Amirantes Island Group; Bazaruto Archipelago National Park / São Sebastião MPA; Cosmoledo, Astove, Assomption; Diego Garcia; Europa; Farquhar Atoll and Providence Islands; Glorieuses; Inner Island Group; iSimangaliso Wetland Park; Itsamia; Mayotte; Nosy Iranja; Ponta do Ouro Marine Reserve / Inhaca Island Special Control Zone; Rufiji Delta; Sofala Banks; St. Brandon Island; and Tromelin.

IOSEA Marine Turtle Site Network: Pilot Spatial Analysis using Marxan

Linda Harris introduced the WIO-MTTF to several spatially-explicit, quantitative tools that could be used to support the parallel process of proposing sites for the IOSEA Site Network, namely: systematic conservation planning (SCP) and marine spatial planning (MSP). While these tools are traditionally used to design reserve (protected area) networks, the analyses can be adapted to meet the objectives of the IOSEA Site Network. There were a number of constraints to the analyses, primarily due to the limited timeframes of both the meeting and report preparation. For example, although the best available data were used included in the analyses, some of the features were represented with datasets that are known to be outdated, or with data that are not in the most optimal form for spatially-explicit analyses, which resulted in under-representation of features.

Notwithstanding these constraints, digital maps of: turtle distributions at sea; turtle-associated habitats (nesting beaches, coral reefs, seagrass beds, mangroves, and sea-mounts); and threats (15 different threats ranging from storm impacts to dynamite fishing) were compiled from existing sources or from information collated during the workshop (see Part 2). These digital maps were integrated, and subjected to SCP analyses using Marxan. Three scenarios were considered: 10 % representation of all features; 20 % representation of all features; and 10 % representation of at-sea distributions of turtles, and 20 % representation of the habitat features. To a large extent, the expert-selected sites of importance matched those highlighted in the Marxan analyses. However, the latter selected several additional sites - particularly in the northern Mozambique Channel, and along the Agulhas retroflection. Recommendations for future analyses are proposed, including generation of better data sets, and including more complexities into the Marxan algorithm. It was shown that spatially-explicit analysis can be a valuable tool in the context of the IOSEA Site Network, and it was emphasized that the intent for the products is to guide, not replace, expert judgement.

Invited Presentations

Invited expert, Prof. Marc Girondot, gave two presentations. In the first, he discussed strategies to obtain an index of population status for marine turtles. It was suggested that, if the goal of a monitoring programme is to define a population trend over time, and resources to support the programme are limited, a statistical approach and analysis of track counts can give a very good estimate of what the population trend is. Minimum data requirements and monitoring designs to quantify population trends using both track counts and flipper tagging (capture-mark-recapture method) were also recommended.

In his second presentation, Prof Girondot focused on the analysis and quantification of threats to marine turtles. Given that there is a myriad of threats to all life-history stages of marine turtles, from hatchlings to adults, and that the severity of each threat is assessed in a different metric, it is difficult to rank threats to turtles and/or to quantify cumulative threat effects. Prof Girondot proposed a common metric that the impact of each threat could be converted into, namely: *the equivalent number of adult marine turtles to produce the same effect, in terms of population dynamics, if they were to be removed from the population.* Using this common metric, the relative impact of threats can be measured, and conservation and management interventions can be prioritized.

Dr David Vousden introduced the WIO-MTTF to the activities of the Agulhas and Somali Current Large Marine Ecosystem (ASCLME) Programme. He described some of these activities, and discussed the five important steps that the ASCLME Project is following to achieve more effective management and governance at the ecosystem level. Potential areas for research collaboration for the scientific community working on sea turtles were highlighted.

Acknowledgements

Financial support from the French Ministry of Ecology, by way of IOSEA, is hereby acknowledged, and a vote of thanks is extended to Dr Ronel Nel, Douglas Hykle and students at NMMU (Karien Bezuidenhout, Anje De Wet, Linda Harris, Bernice Mellet, and Jenny Tuček) for organizing a very successful meeting. Task Force members and meeting observers are also thanked for their lively participation in the presentations, workshops, and plenary discussions. Thanks also to the Nelson Mandela Metropolitan University, particularly the Zoology Department, for the use of the facilities during the meeting. Unless otherwise indicated, the photographs used in this report were kindly provided by Dr George Hughes and Jenny Tuček.

Abbreviations

ASCLME	Agulhas and Somali Current Large Marine Ecosystem
COM	Comoros
CMS	Convention on the Conservation of Migratory Species of Wild Animals
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FRA	France
GEF	Global Environment Facility
IOC	Indian Ocean Commission
IOSEA	Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South East Asia
IOTC	Indian Ocean Tuna Commission
IUCN	International Union for the Conservation of Nature
KEN	Kenya
MAD	Madagascar
MPA	Marine Protected Area
MSC	Marine Stewardship Council
MSP	Marine Spatial Planning
MOZ	Mozambique
MUS	Mauritius
NMMU	Nelson Mandela Metropolitan University
NOAA	National Oceanic and Atmospheric Administration
NWIO	North West Indian Ocean
OBIS	Ocean Biogeographic Information System
RMU	Regional Management Unit
SCP	Systematic Conservation Planning
SEY	Seychelles
(S-)RMUs	(Sub-)Regional Management Units
SWIO	South West Indian Ocean
SWIOFC	South West Indian Ocean Fisheries Commission
SWIOFP	South West Indian Ocean Fisheries Project
TZA	United Republic of Tanzania
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WCMC	UNEP/World Conservation Monitoring Centre
WHS	World Heritage Site
WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association
WIO-MTTF	Western Indian Ocean - Marine Turtle Task Force
WWF	World Wide Fund for Nature / World Wildlife Fund
ZAF	South Africa

Meeting Agenda

Regional Workshop and Fourth Meeting of the WIO-MTTF

Port Elizabeth, South Africa, 4-7 December 2012

Agenda Item		**Presentations***
1.	Welcome Ceremony	
	NMMU – Prof Thoko Mayekiso	
	NMMU: Science Faculty – Prof Andrew Leitch	
	DEA: Oceans and Coasts	Herman Oosthuizen
	IOSEA	Douglas Hykle
2.	Adoption of the Agenda	
3.	National Presentations	
	Island States	All Focal Points/Proxies
	Continental States	
4.	Identification of Management Units	Ronel Nel
5.	Review of the IOSEA Site Network Programme	Douglas Hykle
6.	Workshop 1: Population Assessments	Marc Girondot
	Loggerheads	
	Green turtles (Africa, Madagascar, Europa)	
	Green turtles (Other islands)	
	Leatherbacks	
	Hawksbills	
	Olive ridleys	
7.	Opportunities in the ASCLME Programme	David Vousden
8.	Workshop 2: Threat assessments for turtles and their habitats	Linda Harris
		Marc Girondot
	Southern Mozambique Channel: SA, MOZ, Western MAD, Europa	
	North of the Channel: TNZ, KEN, SOM, COM, Mayotte & Glorieuses	
	Eastern MAD: MAU + St Brandon, Reunion & Tromelin, SEY, UK	
9.	Workshop 3: Perceived benefits for the inclusion of sites in the site network	
	EB4 and G4 – Resistance and Resilience; Research and Monitoring (Index sites)	
	S1 and S3 – Cultural and Traditional Importance and Educational Value	
	S5 and S6 – Regional and International Significance and Ancillary Benefits	
	Other benefits (criteria)	
10	Candidate sites for the WIO	
11.	IOSEA International Flipper Tag Recovery Database	
12.	Any other business	
	Priorities for the WIO-MTTF	
	Way forward for the WIO-MTTF	
13.	Closing of the meeting	

* Note that all presentations indicated in the agenda are available for download from the IOSEA website (www.ioseaturtles.org), in the Electronic Library.

WIO-MTTF Business Meeting

Country Reports and Task Force Work Programme

[Agenda Items 3, 11 and 12]

1

Country Reports

Each member presented a country report[7] following a set format (below) to update the WIO-MTTF on the state of turtle conservation in the region (see also Appendix 1).




1. Nesting beach information
    a. Species are present
    b. Sites (how many sites, and where are they)
    c. Size of rookery (number of females)
    d. General population trends across all sites, per species
2. Habitats
    a. Nesting beaches
    b. Foraging grounds
    c. Migration routes (requires satellite tracking information)
3. Satellite tracking information
    a. Species and life history phase of satellite-tagged individuals
    b. Number of tracks available
    c. Areas frequented by satellite-tagged individuals
4. Genetics initiatives (if any)
5. Major threats to habitats
    a. Nesting beaches
    b. Foraging grounds
    c. Migration routes
6. Major threats to species
    a. Direct harvesting
    b. Incidental capture (per fishery)
7. New conservation initiatives or activities; or emerging threats
8. Conclusions

Peter Richardson, in collaboration with the Secretariat, to follow up with OBIS about getting the turtle satellite tracking information in a single map, and aligned with the IOSEA Satellite Tracking Metadatabase.

WIO-MTTF Work Programme

Progress made in implementing the Work Programme adopted by the First Meeting of the WIO-MTTF (Dar es Salaam, February 2008) was evaluated, and areas that still need to be addressed were identified. In addition, the recommended activities in the programme were edited as necessary, and new actions were noted. Note: blue text in the table below highlights important additions to the recommendations, and red text with strikethrough highlights text to be removed from the recommendations. A summary of the discussion points relating to the Work Programme items follows the table below (on p. 10).

[7] Copies of the presentations are available for download from the Electronic Library of the IOSEA website (www.ioseaturtles.org).

Work Programme of the Western Indian Ocean – Marine Turtle Task Force: Evaluation of Progress (2008-2012) and Draft of Future Work (2013-2015)

Work Programme Adopted by the First Meeting of the Task Force (Dar es Salaam, February 2008);
Revised by the Fourth Meeting of the Task Force (Port Elizabeth, 4 - 7 December 2012)

IMPLEMENTATION PREREQUISITES

Recommendation	Lead/Responsible*	Progress (% Implemented)**	Renew	New Actions
1a. Task Force members should establish working relationships with their respective IOSEA Focal Points;	TF Members	COM: N/A, FRA: 100, KEN: 100, MAD: 100, MUS: 100 (same person): UK: 50% (highly variable 0-100), MOZ: 100 (same person), SEY: 0, TZA: 100, UK: 100, ZAF: 10.	Yes	
1b. Provide suggestions to, and assist their respective national Focal Points on strengthening national committees, networks, working groups or other national arrangements, as appropriate;	TF Members	COM: N/A, FRA: 70, KEN: 50, MAD: 100, MUS: 100, MOZ: 0, SEY: 50, TZA: 50, UK: 100, ZAF: 0.	Yes	
1c. Assist respective Focal Points with the updating of IOSEA national reports, including identification of specific resource needs.	TF Members	COM: Acted on behalf of Focal Point, FRA: 100, KEN: 75, MAD: 100, MUS: 100, MOZ: 70, SEY: 50, TZA: 80, UK: 100, ZAF: 50.	Yes	

UNIQUE SOCIAL CUSTOMS AND PRACTICES (Social Aspects)

Recommendation	Lead/Responsible*	Progress (% Implemented)**	Renew	
2. Develop a proposal for a compilation of available, relevant information on social aspects of marine turtle conservation in the region, including a literature review as a form of policy brief (guidelines), perhaps to be funded and made available by WWF or WIOMSA, in preparation for a symposium/ workshop (i.e. studies to understand relevance of turtles to people, and their impacts or value).	TF Chair	COM: 80 (Moheli MP), FRA: 50 (Mayotte), KEN: 0, MAD: 25, MUS: 50 (St Brandon), MOZ: 0, SEY: 25, TZA: 10, UK: NA, ZAF: 0.	Yes	1. Update literature (bibliography); 2. Re-develop proposal in conjunction with the IOSEA Advisory Committee Chair.

ECONOMIC USES

Recommendation	Lead/Responsible*	Progress (% Implemented)**	Renew	
3. Request the support of WIOMSA and other regional funding bodies to conduct a regional workshop to assess the social-economic values of marine turtles and compatibility of ~~socioeconomic~~ conservation approaches, ~~(concept to be drafted by J. Frazier for review by the Task Force).~~ including both exploitation (consumptive use) and sustainable ecotourism (live turtles, non-consumptive use).	TF Chair; IOSEA; Nairobi; Jack Frazier	COM: 80 (2 studies), FRA: 0 (but accessible information), KEN: 0, MAD: 40 (3 studies), MUS: 50 (1 study), MOZ: 10, SEY: 0 (many historic studies - none recent), TZA: 100 (2 studies since 2008 in trade; SWOT analysis on ecotourism), UK: 0, ZAF: 0.	Yes	
4. From the workshop, produce an annotated bibliography, ~~socio-~~economic study guidelines and analysis of conservation approaches from the region.	(To be decided at the workshop)		Yes	

FISHERIES-INTERACTIONS

Recommendation	Lead/Responsible*	Progress (% Implemented)**	Renew	
5. Task Force members are encouraged to work directly with IOSEA Focal Points and relevant stakeholders to complete and improve the quality of data in national reports in relation to fisheries and fisheries interactions, in particular.	TF Members	COM: 100, FRA: 100, MAD: 100 (National Committee), MUS: 100, MOZ: 0, SEY: 20, TNZ: 50, UK: 100, ZAF: 80.	Yes	
6. Engage RFMOs and other bodies not yet participating in the Task Force, including IOTC, ASCLME, IOC, SWIOFP, etc.	IOSEA; Nairobi		Yes	
7. Liaise with the Indian Ocean Tuna Commission (IOTC) and SWIOFC for data on marine turtle bycatch in purse seining and long lining, including the impact of the use of FADs, and other non-tuna fisheries.	IOSEA; Nairobi		Yes	
8. Compile information on the status of on-board observer programmes and the status of marine turtle bycatch recording within those observer programmes in Western Indian Ocean region.	TF Members	Kelonia/IFREMER – training program for observers (spp ID & release); Northern Mozambique Channel Observer Programme cancelled.	Yes	1. National reports (update/info) 2. Find available information
9. Explore opportunities for applying market incentives (eco-labelling, certification etc) and role of international bodies and instruments (EU, FAO, CMS, SWIOFC) to enhance compliance in use of bycatch reduction measures.	TF Chair; TF Members; IOSEA	Consultations with MSC (ZAF/IOSEA).		
Compile information on turtle bycatch and inshore fisheries	TF Members			

MONITORING / MITIGATION / RESEARCH

Recommendation	**Lead/Responsible***	**Progress**	**Renew**	
10. Compile information on existing monitoring protocols and needs within region and submit to IOSEA Secretariat in preparation for a regional training workshop.	TF Chair; TF Members		No	
11. Develop a proposal for a WIO regional technical training workshop(s) to develop minimum standardized protocols for monitoring, for submission to interested donor bodies.	TF Chair; IOSEA; Nairobi		No	
12. Maintain a record of genetic studies conducted in the region and submit the information to IOSEA for posting on the IOSEA website.	S. Ciccione (TF Vice-Chair); TF Members; IOSEA	Ongoing	To be encouraged	
13. Provide up-to-date lists of flipper tag series used in the countries for inclusion in the existing IOSEA online database of tag series.	TF Members; IOSEA	Ongoing	Yes	
14. Submit information on satellite tracking studies in WIO countries to the IOSEA Secretariat ~~TF Chair~~, for inclusion in the Satellite Tracking Metadatabase.	TF Members; TF Chair; IOSEA	Ongoing	Yes	

PROGRESS EVALUATION

Recommendation	**Lead/Responsible***	**Progress**	**Renew**	
15. Review the status of implementation of recommendations made at the first WIO-MTTF meeting (Dar es Salaam, Feb 2008).	TF Members; TF Chair; IOSEA	Completed	Yes	Review status of implement-ation of recommendations made at the Fourth WIO-MTTF meeting.

Explanation of abbreviations used in the text:

TF Members: Members of the WIO-MTTF
TF Chair: Chair of the WIO-MTTF
TF Vice-Chair: Vice-Chair of the WIO-MTTF
IOSEA: Secretariat, IOSEA Marine Turtle Memorandum of Understanding
Nairobi: Secretariat, Nairobi Convention

****Explanation of abbreviations used in the text:***

COM: Comoros
FRA: France
KEN: Kenya
MAD: Madagascar
MUS: Mauritius
MOZ: Mozambique
SEY: Seychelles
TZA: Tanzania
UK: United Kingdom
ZAF: South Africa
MSC: Marine Stewardship Council
NA: Not applicable

Comments on the Recommendations and Implementation Prerequisites

Recommendation 1

- Not having Focal Points appointed in some countries (Comoros, Seychelles) constrains the ability of Task Force members to interact with their respective governments. The Secretariat will try again to encourage the governments concerned to make the necessary appointments.

Unique Social Customs and Practices (Social Aspect)

Recommendation 2

- It is very important to preserve this aspect of the work programme because it is a vital way to gain valuable information for sea turtle conservation. However, the literature review/policy brief (which this meeting interpreted to mean "guidelines") has not yet been drafted.
- Some studies have been conducted in the region, e.g., a PhD thesis exploring how cultural customs and practices can aid conservation of turtles in the French Territories; it was noted that this kind of research would be useful in other countries as well.

All members should advise the Secretariat of publications suitable for inclusion in the IOSEA online Bibliography Resource, particularly those relating to social and cultural (and other) studies on an on-going basis. The proposal listed in Recommendation 2 should be re-developed in consultation with the Chair of the IOSEA Advisory Committee.

(Socio-)Economic Uses

Recommendations 3 & 4

- There has been no progress on this recommendation since the First Meeting of the WIO-MTTF. A few countries have undertaken limited studies at selected sites, but there is no comprehensive analysis of the socio-economic value of turtles for the region. This is still recognised as an important activity for the WIO-MTTF, and it was noted that the analysis should include both consumptive and non-consumptive use of turtles; terms which are deliberately preferred over unsustainable and sustainable use, respectively.

Fisheries-Interactions

Recommendation 5

- Task Force Members noted that it was difficult to achieve this recommendation in cases where there is no Focal Point (refer to Recommendation 1). Nevertheless, collecting and ensuring the accuracy of fisheries data is considered as a priority, and it is important that these data are reflected in the National Reports submitted to IOSEA.

Recommendation 8

- To obtain scientifically-valid data from fisheries observers, at least 5 - 10 % of the fleet must be monitored. The Task Force should try to help to improve observer programmes on fishing vessels; the first step will be to identify and try to acquire the data that are currently being collected. It was noted, though, that piracy in the region is an issue. For example, most fisheries observer programmes in Tanzania were cancelled due to piracy.
- IOSEA National Reports should be updated to include information on bycatch reduction measures that are implemented in the country. For example, France has developed a training programme to educate observers how to identify and safely release turtles caught as bycatch.

Recommendation 9

- Given that there are other bodies (IOTC) and government departments dealing with fisheries bycatch data, this recommendation regarding market incentives was considered unrealistic, and not a current priority. An alternative approach would be to compile information on turtle bycatch for inshore fisheries.
- N.B. Information on fisheries bycatch is often collected without a measure of fishing or monitoring effort; without this information it is difficult to do a full assessment of the impact of the fishery on turtles. Consequently, collection of both bycatch and effort data is recommended.

Monitoring, Mitigation and Research

Recommendations 10 & 11

- These are no longer considered priorities for the WIO-MTTF and have been deleted from the work programme.

Recommendations 12-14

- The value of databases housing information on genetics, flipper tagging and satellite tagging was discussed (see also: Flipper Tag Database and Working Group below).
- The need for an online directory of specialists working on turtle genetics was considered by some to be redundant: tissue samples are collected in almost all turtle programmes; those undertaking genetics studies in the region are aware of other genetics projects should they wish to establish collaborations; and the studies get published in the primary literature (largely because the expense of the analyses warrants publication of the data). Therefore, uploading contact details, and sharing information on samples collected but not analysed (e.g. for lack of resources), and about current/planned genetics projects that might be of interest to others, was not an immediate priority for Task Force members. Those who consider the exchange of such information useful are encouraged to do so, using the available directory.
- Stable isotope analyses were considered in the same light as genetics studies. For interest, stable isotope studies are currently being conducted by France, Seychelles, and South Africa.

All members are encouraged to update the results of tagging, genetic and satellite tracking studies in the IOSEA Online Reporting Facility and other available IOSEA databases before the next WIO-MTTF meeting. Santosh Bachoo to update South Africa's satellite-tagging information.

Progress Evaluation

- The Task Force agreed that the current list of recommended activities is appropriate.

Flipper Tag Database and Working Group

Flipper tagging is currently the best, low-technology tool available for monitoring population size and basic reproductive parameters. Despite all the time invested in tagging turtles, systems for recovering and sharing information about tag recoveries remained rather primitive (e.g. relying on goodwill to mail unspecified information to a post office box in a foreign country). The Secretariat suggested that an International Flipper Tag Recovery Database could help to promote more exchange of information about international tag recoveries and make better use of tag recovery data in the WIO region (and elsewhere). Douglas Hykle presented a brief outline of the contents of a proposed database that would help to connect recovered tags to their point of origin, along with some basic morphometric details. The database would not store information about animals as they were tagged, nor was it meant to collect information from “domestic“ tag returns (assuming that national data gathering systems had these tag returns well in hand). It was recognised that although it would take time to set up and populate with data, a database that included past tag recovery information could be a valuable resource. Several points were raised during discussions.

1. **Existing databases:** An online database already exists in the region (TORSOOI: www.torsooi.com). Given that this is a sub-regional repository, it would not serve the needs of an IOSEA region-wide database.
2. **Data sharing and data-use agreements:** Concern was expressed over sharing data prior to its publication by contributing organisations. It was suggested that the online database could be set up with a dual purpose: to have only basic information available to the public; and to have detailed information for scientists that is accessible only via a log-in and acceptance of a data-use agreement. In this latter case, formal acknowledgement of contributing organisations would be required for any use of their data.
3. **Raising awareness and encouraging reporting of flipper tags:** It was suggested that tag-return information could be mentioned in the IOSEA newsletter. This could facilitate interest and draw attention to tag returns, particularly in the initial stages following the launch of the online database. More broadly, questions were raised on how to incentivize people to report recovered flipper tags, particularly fishermen who (theoretically) recover the majority of tags. It was noted that the cost of mailing a flipper tag to the country of origin (not to mention the special effort involved) can be an issue. Some suggestions were: to proactively send out information leaflets/letters to the fishermen; and to include a long-lasting email address or phone number on the flipper tag.

Peter Richardson, Lindsey West, Jeanne Mortimer and Santosh Bachoo will form a small working group that, together with the Secretariat, will draw up a framework for the flipper tag database. Once the Secretariat has finalised development of the database, Task Force members can play a proactive role in helping to populate it and to promote it among other projects.

Way Forward for the WIO-MTTF

At the close of the meeting, the term of office ended for the Chair (Dr Ronel Nel, South Africa) and Vice-Chair (Stephan Ciccione, France) of the WIO-MTTF. Peter Richardson (United Kingdom) was elected as the new Chair, and Lindsey West (Tanzania) was elected as the Vice Chair (subject to confirmation from Tanzania); Stephan Ciccione agreed to continue translating relevant documents from French into English, as necessary. Ronel and Stephane were thanked for their significant contribution to the WIO-MTTF since 2008.

It was suggested that the WIO-MTTF take advantage of the 8th WIOMSA Symposium (28 October - 2 November 2013) in Maputo, Mozambique, by organising a day-long session immediately before or after. Important dates to be noted for the Symposium are:

26 April 2013	Deadline for submission of abstracts
15 June 2013	Notification of abstract acceptance
31 June 2013	Deadline for application of travel grants
31 August 2013	Deadline for confirmation by institutions wishing to participate in the exhibition opportunities

IOSEA Marine Turtle Site Network

Test of the Nomination Process by the WIO-MTTF

[Agenda Items 4-6, and 8-10]

2

Introduction

At their Sixth Meeting (January 2012, Bangkok), Signatory States to the IOSEA Marine Turtle MoU resolved to establish a *Network of Sites of Importance for Marine Turtles in the Indian Ocean - South-East Asia Region*[8]*,* referred to hereafter as the IOSEA Site Network. The purpose of the network is to facilitate greater synergy of conservation efforts and co-ordination of management actions among ecologically important areas for marine turtles throughout the IOSEA region. Its establishment will contribute to the co-operative, long-term protection of marine turtles and the habitats on which they depend; outcomes which are consistent with the objectives of the IOSEA Marine Turtle MoU. The goal and objectives of the IOSEA Site Network, as defined in the Resolution, are as follows.

(i) Provide a regional mechanism to enhance the conservation of sites of importance to marine turtles;
(ii) Derive ecological and governance benefits that are not possible to achieve by managing individual sites in isolation;
(iii) Contribute, through enhanced regional conservation of marine turtles and their habitats, to more effective maintenance of ecosystem services that support human well-being; and
(iv) Catalyse opportunities for participatory resource management and community development centred on marine turtles, through network-wide information exchange.

The establishment of the IOSEA Site Network is largely dependent on Signatory States (Focal Points) nominating sites for inclusion. Both the nomination and evaluation of the site should take account of a list of 18 clearly-defined criteria that are divided into four categories[9]: (1) Ecological and Biological; (2) Governance; (3) Socio-Economic and Political; and (4) Network-wide Ecological. Signatory States were invited to begin preparing and submitting site nominations from September 2012. Formal adoption of the nominated sites will take place on an on-going basis at Signatory State meetings.

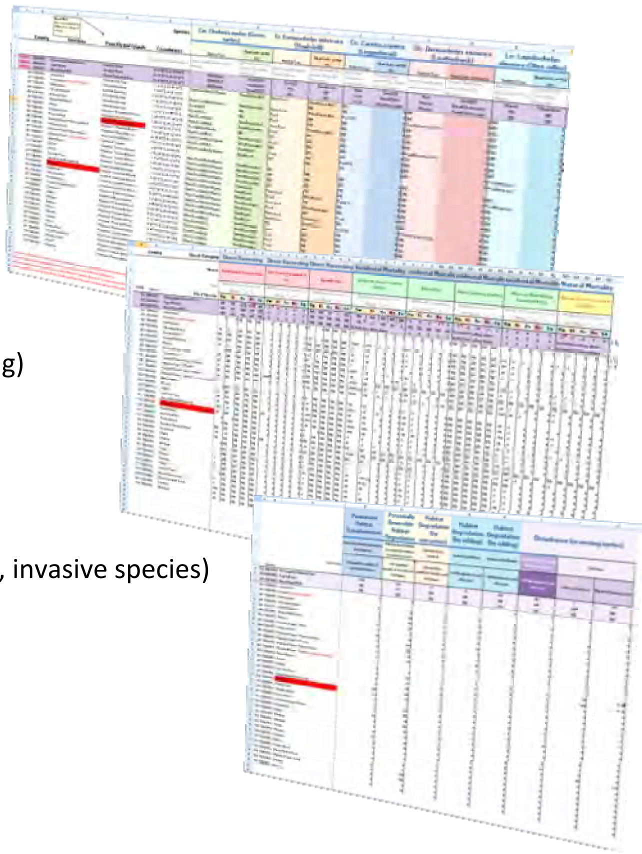
A key objective of the Regional Workshop and Fourth Meeting of the WIO-MTTF was to validate the evaluation criteria that were developed, but had so far not been thoroughly tested, considering sites in the Western Indian Ocean (WIO) for potential inclusion in the IOSEA Site Network. Apart from familiarising Task Force Members with the evaluation process and identifying a preliminary list of candidate sites for the WIO, the intent of the exercise was also to identify any difficulties in using or interpreting the criteria. The subsequent recommendations made by the WIO-MTTF are listed at the end of this section.

[8] The full text of the Resolution is available for download from the Site Network section of the IOSEA website.
[9] The Criteria for the Evaluation of Sites for Inclusion in the IOSEA Site Network is available for download from the Site Network section of the IOSEA website.

Site Data Requested

Prior to the meeting, a list of turtle nesting, foraging and migratory-corridor sites in the WIO region were compiled from the IOSEA Online Reporting Facility (http://www.ioseaturtles.org/report.php). These were entered into a single spreadsheet that was circulated to WIO-MTTF members, along with a guideline document. Task Force Members were requested to: (1) verify each site in the list, removing redundant or invalid sites; and adding missing sites; and (2) populate the spreadsheet with information for all sites under three categories:

1. **Site Data, per species**
   - (a) Type of site (nesting, foraging, migration)
   - (b) Abundance (following a population-size reference table)
2. **Threats to Turtles**
   - (a) Direct Harvesting
     - (i) Exploitation of nesting females
     - (ii) Direct harvest of animals at sea
     - (iii) Egg collection
   - (b) Incidental mortality
     - (i) Incidental capture in coastal fisheries
     - (ii) Boat strikes
     - (iii) Marine debris (e.g., plastics)
     - (iv) Other (e.g., Ghost fishing, dynamite fishing)
   - (c) Natural Mortality
     - (i) Disease, excessive natural predation
3. **Threats to Turtle-Associated Habitats**
   - (a) Potentially reversible habitat destruction
     - (i) Habitat degradation (e.g., coastal erosion, invasive species)
   - (b) Habitat degradation (by extraction)
     - (i) Sand mining or removal
   - (c) Habitat degradation (by addition)
     - (i) Industrial effluent
     - (ii) Inshore oil pollution
   - (d) Disturbance (to nesting turtles)
     - (i) Artificial lighting (on land or near shore)
     - (ii) Vehicles



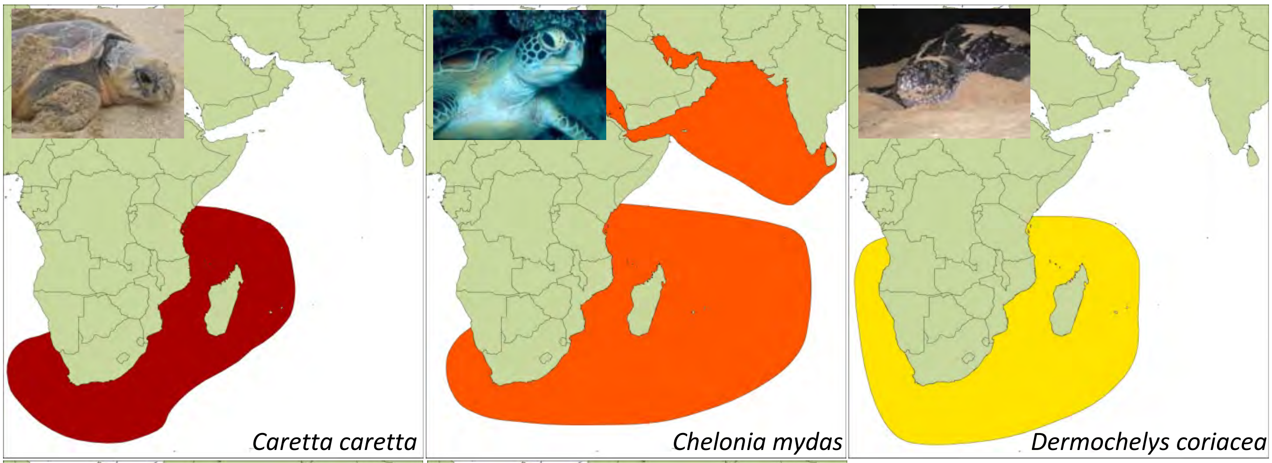
Given that this information would be used to compare and evaluate sites across the WIO, data were solicited in quantitative metrics, *e.g.*, percentage of the longshore beach affected by artificial lighting, rather than as a subjective, qualitative ranking of high, medium or low. The data for each country were compiled into a single spreadsheet in advance and verified, in plenary, prior to their use.

(Sub-)Regional Management Units

At the outset of the meeting, WIO-MTTF Chair, Dr Ronel Nel, presented background information and led a plenary discussion to identify the sub-regional management units (S-RMUs) in the WIO, per species. This followed from an IUCN Marine Turtle Specialist Group exercise that had identified regional management units (RMUs) for marine turtles, globally[10], shown for the WIO in Fig. 2.1.

The WIO-MTTF's first task was to identify the areas within which candidate sites ought to be considered for potential inclusion in the Site Network, for each of the five species present in the region. Dr Nel posed three questions for discussion, which were addressed as follows.

[10] See: Wallace et al. (2010) Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. PLoS One 12, e15465.



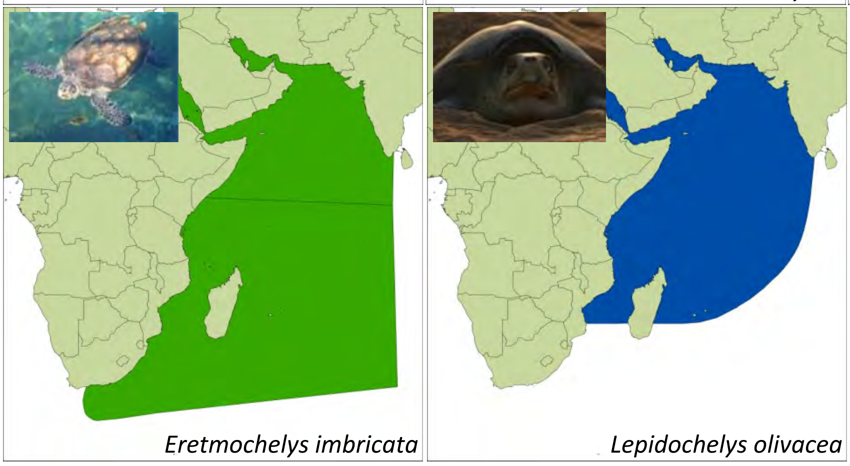


Figure 2.1. *Regional Management Units (RMUs) for marine turtles in the Western Indian Ocean region, following Wallace et al. (2010).*

Photo credits: Cc: Jenny Tuček; Cm: Jerome Bourjea; Dc and Ei: Linda Harris; Lo: Kartik Shanker

1. Are there spatially and biologically distinct S-RMUs?

It was agreed that there are no S-RMUs and that the existing RMUs are sufficient.

2. What are the boundaries of the RMUs?

It was agreed that the RMU boundaries should be determined by the turtles' biology rather than by political boundaries. Notwithstanding this consensus, it was noted that political boundaries are important in the context of implementing management actions within the RMU.

Overall, the existing boundaries of RMUs were considered acceptable. However, two key points were raised.

(a) The boundaries of the two green turtle RMUs need to be addressed. Green turtles nest in Somalia, but it is unknown whether these individuals should be included in the North-West Indian Ocean (NWIO) RMU, or in the South-West Indian Ocean (SWIO) RMU. It was suggested that any revision to the RMU boundaries should be based on nesting and satellite-tracking information, and genetics studies. In the interim, the Somali green turtles were considered to be part of the SWIO-RMU until better information is available.

Follow up with contacts in Somalia to determine whether the Somali green turtles should fall under the NWIO or SWIO RMU, or shared between the RMUS. If data are lacking to inform this decision, make recommendations for data and tissue-sample (for genetics) collection.

(b) The RMU boundaries are based on our knowledge of adult female turtles, rather than the entire population demographic. It was suggested that a supplementary boundary should be delineated for the remainder of the population demographic (i.e., juveniles and adult males), per species. Notwithstanding the importance of this supplementary boundary, it was recognised that the distribution of juveniles is very difficult to identify because they do not necessarily follow passive-drift models.

3. How many stocks are there per RMU?

The large data gap concerning genetic stocks within RMUs was highlighted during discussions. It was consequently proposed and agreed that the meeting should proceed by recognising only one genetic stock per RMU, except for green turtles where there are three recognised genetic stocks. However, it was suggested that decision-making in this regard is adaptive; for example, current work on hawksbills in Seychelles may reveal distinct genetic stocks.

A question was raised whether or not splits in genetic stocks should be used to define S-RMUs. It was decided that delineations need to be practical otherwise S-RMUs will ultimately be defined by individual rookeries. Although some species do appear to have several genetic stocks, there is overlap in their spatial distribution, justifying a single RMU per species.

IOSEA Marine Turtle Site Nomination and Evaluation Process

Douglas Hykle presented an overview of the IOSEA Marine Turtle Site Network, including the purpose, goal and objectives; expected benefits; funding opportunities and limitations; nomination process; and evaluation criteria. Following this introduction and clarification of key points, Task Force Members divided into two groups to examine candidate sites for potential inclusion in the Site Network using two sets of criteria (1. Ecological and biological; 2. Socio-economic and political).

Evaluation of Sites under the Ecological and Biological Criteria

The four Ecological and Biological Criteria are defined as:

EB1. Turtle abundance (at nesting sites)
The number of marine turtles constituting a management unit, the size of which is considered to be of regional importance, which the associated nesting site regularly supports

EB2. Species or management unit richness
The number of species or marine turtle management units (if known) regularly using a site's nesting habitat or foraging habitat (for which abundance data are generally lacking)

EB3. Presence of rare marine turtle species
Presence of a marine turtle species that is considered rare in the IOSEA region

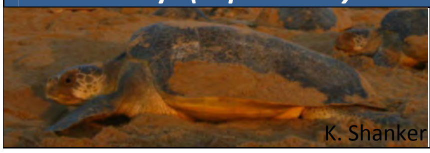
EB4. Resistance and resilience
A site containing habitat of importance to marine turtles that is likely to be relatively resistant and/or resilient to disturbance

This group selected and evaluated the three or four most important sites in the WIO region for each turtle species, under the four criteria above. These sites were then presented and discussed in plenary (see Table 2.1). In addition to the sites below, **St Brandon Island (17)** and **Agalega Island (18)**, Mauritius, were recommended for consideration as potential network sites because they are important feeding grounds for green turtles and hawksbills. Later in the meeting, scores were assigned to all candidate sites as per the criteria guidelines, based on the evaluation descriptions in Table 2.1.

Table 2.1. Key nesting and foraging sites for marine turtles in the WIO, with justifications for their inclusion in the Site Network under the ecological and biological criteria. (Table continues on the next page).

Loggerheads *(Caretta caretta)*		
1 iSimangaliso Wetland Park (South Africa) This site supports the largest number of nesting logger-heads in the WIO, although the population is still considered small. There are also nesting leatherbacks, and resident green turtles, hawksbills, and olive ridleys in the nearshore. Resistance and resilience is high because the whole site is protected in marine and terrestrial reserves (including some sanctuary areas), and as a World Heritage Site. The greatest proportion of nesting is in the northern section of iSimangaliso, which could accommodate a potential south-ward shift in nesting in response to warming ocean currents.	**2 Ponto d'Ouro Marine Partial Reserve (2.1) and Inhaca Island Special Control Zone (2.2; Mozambique)** This site supports a small population of nesting loggerhead (shared with iSimangaliso). There are also nesting leatherbacks, and resident green turtles, hawksbills, and olive ridleys in the nearshore. Resilience is fairly low; although the region is partly protected by the Maputo Elephant Reserve and Inhaca Island Special Control Zone, and there is an active turtle monitoring programme in the area. However, there are several eminent threats (e.g., a proposed deep water port).	**3 Bazaruto Archipelago National Park (3.1) and São Sebastião MPA (3.2; Mozambique)** A small population of loggerheads nest and forage at this site. A few leatherbacks and green turtles also nest here, and hawksbills and green turtles forage in the nearshore. Resistance and resilience is high because the area is protected, and there is monitoring by the private sector on some of the islands on the São Sebastião peninsula. 
Green turtles *(Chelonia mydas)*		
4 Aldabra Atoll (Seychelles) An important nesting site, supporting a large population of green turtles. It also represents feeding grounds for green turtles and hawksbills, the latter of which also nests on Aldabra. Resistance and resilience is high because the atoll is a World Heritage Site.	**5 Cosmoledo, Astove and Assomption Islands (Seychelles)** An important nesting site, supporting a medium-sized population of green turtles. It also represents feeding grounds for green turtles and hawksbills. Moderate resistance and resilience because the islands are remote and mostly uninhabited; there is a mixture of surveillance and poaching.	**6 Farquhar Atoll and Providence Island (Seychelles)** An important nesting site, supporting a medium-sized population of green turtles. The surrounding waters and reef flats are important feeding grounds for green turtles and hawksbills. Good resistance and resilience because Farquhar is earmarked for protection and long-term monitoring; Providence is currently uninhabited (but no surveillance).
7 Glorieuses (France) An important nesting site, supporting a medium-sized population of green turtles. It also represents feeding grounds for green turtles and hawksbills. Strong resistance and resilience because the site is an isolated, protected island.	**8 Tromelin (France)** An important nesting site, supporting a medium-sized population of green turtles. It also represents feeding grounds for green turtles and hawksbills. Strong resistance and resilience because the site is an isolated, protected island.	**9 Itsamia 1 (Comoros)** An important nesting site, supporting a medium-sized population of green turtles. It also represents feeding grounds for green turtles (adults and juveniles) and hawksbills.
	**10 Mayotte (France)** An important nesting site, supporting a medium-sized population of green turtles. It also represents feeding grounds for green turtles (adults and juveniles) and hawksbills. Part of this site is in a protected state.	**11 Europa (France)** An important nesting site, supporting a very large population of green turtles. It also represents feeding grounds for juvenile green turtles and hawksbills. Strong resistance and resilience because the site is an isolated, protected island.

Table 2.1 continued

Leatherbacks *(Dermochelys coriacea)*		
1-2 **iSimangaliso Wetland Park (1), Ponto d'Ouro Marine Partial Reserve (2.1) and Inhaca Island Special Control Zone (2.2; South Africa - Mozambique)** The largest and only known leatherback nesting site in the area. It is a shared nesting site with loggerheads; also supports foraging hawksbills, green turtles and olive ridleys. Resistance and resilience is high in the South African sector (marine and terrestrial reserves, and a World Heritage Site); but poor in the Mozambican sector. It was suggested that the World Heritage Site be extended into Mozambique.	3 **Bazaruto Archipelago National Park (3.1) and São Sebastião MPA (3.2; Mozambique)** A small population of leatherback use this site for incidental nesting, although the site may be of greater relative importance than it is currently perceived to be. All five species of turtles are present in the area. 13 **Nosy Iranja (Madagascar)** This site was noted as being data deficient, but was flagged as a research priority area for leatherbacks.	12 **Sofala banks (Mozambique)** This area is an important foraging ground for leatherbacks, but also loggerheads and other megafauna. However, it is an important site for prawn trawling - so the threats to turtles here are high.  L. Harris
Hawksbills *(Eretmochelys imbricata)*		
14 **Diego Garcia (United Kingdom)** There is a medium-sized population of hawksbills nesting and foraging at this site, both inside and outside of the lagoon, and particularly around turtle cove (a dense feeding area for hawksbills). Green turtles also nest at this site. Resistance and resilience is high because the whole Chagos Archipelago falls in a protected area.	15 **Amirantes Island Group (Seychelles)** This site supports a medium-sized population of nesting hawksbills, and represents significant foraging grounds for both hawksbills and green turtles. In addition, these islands are significant nesting grounds for green turtles. This site has also been suggested to be proclaimed as a protected area.	16 **Inner Island Group (Seychelles)** Collectively, this is the most important site for hawksbills in the WIO, supporting a medium to large nesting population. Resistance and resilience is high because the islands are protected areas, nature reserves, or privately owned and managed as nature reserves.  G. Spiby
Olive ridleys *(Lepidochelys olivacea)*		
 K. Shanker	There are insufficient data to support the inclusion of any nesting or foraging sites for olive ridleys in the IOSEA Site Network.	

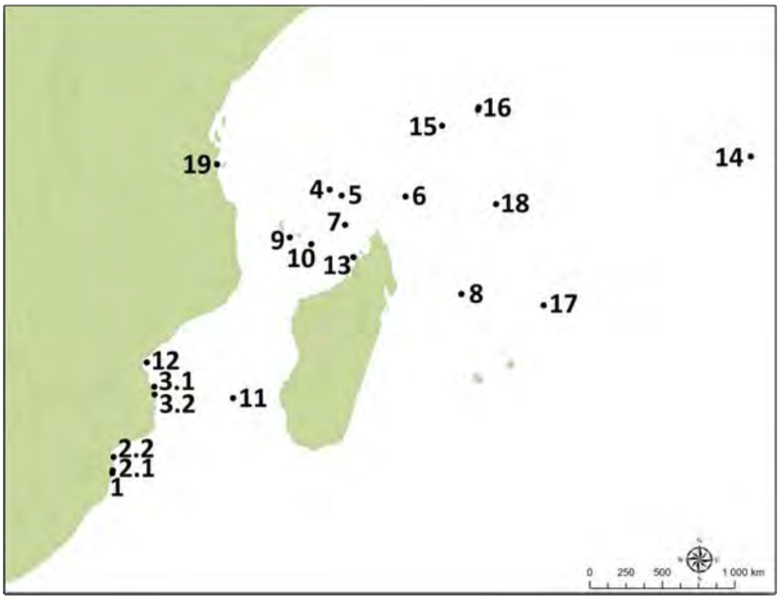


Figure 2.2. *Sites of importance identified by the WIO-MTTF (site numbers correspond to those in Table 2.1 and in the text). 1 = iSimangaliso; 2.1 = Ponto d'Ouro Marine Partial Reserve; 2.2 = Inhaca Island Special Control Zone; 3.1 = Bazaruto Archipelago National Park; 3.2 = São Sebastião MPA; 4 = Aldabra Atoll; 5 = Cosmoledo, Astove and Assomption Islands; 6 = Farquhar Atoll and Providence Island; 7 = Glorieuses; 8 = Tromelin; 9 = Itsamia 1; 10 = Mayotte; 11 = Europa; 12 = Sofala Banks; 13 = Nosy Iranja; 14 = Diego Garcia; 15 = Amirantes Island Group; 16 = Inner Island Group; 17 = St Brandon Island; 18 = Agalega Island; 19 = Rufiji Delta.*

Evaluation of Sites under the Socio-Economic and Political Criteria

The Secretariat introduced the six Socio-Economic and Political Criteria, which are defined as:

S1. Cultural and traditional importance
Site contains prehistoric, historic, and/or contemporary resources of cultural and traditional significance

S2. Compatible activities
Activities occurring within the site that are compatible with the conservation of marine turtles and their habitats

S3. Educational value
Existence of actual, or future opportunities for, educational and outreach activities, by virtue of the site's location and other inherent characteristics.

S4. Existing recognition
Length of existing protected status or other national, regional or international recognition for the site's value to marine turtles

S5. National and international significance
Significance of the site in a national context, relative to other sites

S6. Perceived ancillary benefits as a consequence of the site's inclusion in the network
Perception of ancillary conservation benefit (e.g. for other biodiversity/local communities associated with the site, or other related conservation initiatives), that would be achieved through the site's inclusion in the network

Task Force Members scored the ecologically-important sites, listed above, following the socio-economic criteria (except S4) for evaluation for nominations to the IOSEA Site Network. Scoring drew, in part, from the data collated per site. Following this task, any sites that were not listed as ecologically important, but with high socio-economic/cultural importance, were also to be identified and scored.

Incidentally, only one site met these latter criteria and was added to the list of important sites in the WIO Region: **Rufiji Delta (19; Tanzania)**. This site is strongly linked to the development of the coastal Swahili culture. In addition, there are close links between the wetlands and cultural identity (e.g., there are numerous taboos on harvesting and/or complex harvesting rituals for certain species). A number of compatible activities are on-going in the area, including: a dugong conservation initiative with objectives that are consistent with turtle conservation; and several management initiatives, some of which may incorporate natural resource conservation measures that support sea turtles and their habitats. In addition, education and outreach programme are being implemented by Sea Sense NGO. Rufiji Delta was proclaimed a Ramsar site in 2003, and contains the largest estuarine mangrove forest on the eastern seaboard of the African continent, and the most extensive seagrass beds in Tanzania. Consequently, it is of national significance as a foraging ground for green turtles, and supports the last known population of dugongs in Tanzania. Additional benefits of including Rufiji Delta in the Site Network are far-reaching, because it is an area of high biodiversity (including its role in supporting migratory birds), and because the Delta is part of the Rufiji-Mafia-Kilwa Seascape, within which, extensive coral reefs support the livelihoods of local communities through prawn, finfish and invertebrate fisheries.

Adding Rufiji Delta to the list of important sites primarily on the basis of the socio-economic and political criteria was considered a positive outcome from the meeting. It suggests that the criteria function as they were intended to: sites can (and will) be included in the network for their significance in aspects other than those pertaining to ecological and biological importance.

Synthesis: Proposed Sites for Inclusion in the Site Network

The scores for the nominated sites (see also Fig. 2.2) were compiled into a single table (Table 2.2) and ranked according to the sum of all scores. This outcome was discussed in plenary. Note that the intent of the ranking was not to suggest that any site is more important than another, and also that Sofala Banks (Site 12) was not evaluated.

Table 2.2. *Key sites in the WIO, as identified by the WIO-MTTF, that are recommended for inclusion in the Site Network on the basis of their ecological and biological (EB) and/or socio-economic and political (S) importance.*

	EB1	EB2	EB3	EB4	∑ EB	S1	S2	S3	S5	S6	∑ S	∑ (EB+S)
Aldabra Atoll (4)	12	12	0	7	31	6	6	6	6	6	30	61
Itsamia (9)	9	15	0	6	30	6	3	6	6	6	27	57
Tromelin (8)	12	12	0	7	31	3	6	6	1	6	22	53
iSimangaliso Wetland Park (1)	6	15	6	6	31	1	6	3	6	6	22	53
Ponta do Ouro Marine Reserve (2.1)	6	15	6	4	31	1	6	3	6	6	22	53
Amirantes Island Group (15)	15	12	0	6	33	3	3	6	1	3	16	49
Inner Island Group (16)	12	9	0	6	27	3	6	3	6	3	21	48
Nosy Iranja (13)	15	15	0	3	33	1	3	6	1	3	14	47
Glorieuses (7)	9	15	0	4	28	1	6	1	6	4	18	46
Cosmoledo, Astove, Assomption (5)	9	9	0	8	26	3	6	6	1	3	19	45
Mayotte (10)	9	6	0	6	21	6	3	6	3	6	24	45
St. Brandon (17)	6	6	0	6	18	6	6	6	1	6	25	43
Diego Garcia (14)	9	9	0	4	22	6	3	6	1	3	19	41
Agalega (18)	6	6	0	6	18	6	6	6	1	3	22	40
Farquhar Atoll / Providence Islands (6)	9	12	0	3	24	3	3	6	1	3	16	40
São Sebastião MPA (3.2)	3	15	0	7	25	1	1	1	6	6	15	40
Inhaca Island Spec. Control Zone (2.2)	3	12	0	7	22	1	3	1	6	6	17	39
Europa (11)	15	15	0	7	37	dd	dd	dd	dd	dd	dd	37
Bazaruto Archipelago Nat'l Park (3.1)	3	15	0	2	20	1	1	1	6	6	15	35
Strict Nature Reserves: Aride Island and Cousin Island	9	12	0	6	27	1	1	1	1	1	5	32
Rufiji Delta (19)	dd		0	4	4	6	1	6	6	6	25	29
*Sofala Banks (12)												

*This site was not scored, but was noted because new information suggests it is a foraging area for leatherbacks.

Suggestions and Recommendations for the Site Nomination Criteria and Nomination Process

Note: In this section, key discussion points are reported in black, bullet text; specific suggestions and recommendations for the Site Network Criteria arising from these discussions are highlighted in green, boxed text.

Ecological and Biological Criteria

Criterion EB1

- Quantifying abundance of turtles at foraging grounds arose as a point of discussion, not only in relation to the data sheets, but in terms of the Site Network Criteria. First, while guidelines are available for quantification and concomitant scoring of turtle abundance at nesting sites[11], similar guidelines are not available for foraging grounds. Second, Criterion EB1 deals explicitly with turtle abundance at nesting sites, and does not consider abundance at foraging grounds.
- The same issues apply to turtle abundance along migratory corridors.
- It is recognised that quantifying turtle abundance at foraging grounds and along migratory corridors is difficult owing to the dependence on data from satellite-tracking and in-water surveys, which may be biased by effort and/or are not always available. It was noted that bycatch data could be used as an indirect method to support quantifying turtle abundance at these sites.

> ***It is suggested that Criterion EB1 be re-formulated to consider turtle abundance in a broader sense, with separate guidelines to aid scoring in the case of nesting sites, foraging grounds, and migratory corridors. Draft text to address this point has been submitted to the Secretariat, and is currently being evaluated.***

- When applying the scoring criteria under EB1, it was not clear how the scoring table should be applied in cases where several species nest at the site.

> ***Clarify that, where several species nest at a single site, the score for the most abundant species is to be used. It is not the sum of scores for of all species present. Species or management unit richness is evaluated under a separate criterion (EB2).***

Criterion S1

- It was noted that it is hard to distinguish cultural importance from cultural-specific importance (*i.e.*, to separate between consumptive importance, and religious significance/importance). Also, cultural importance cannot always be attributed to one specific site; rather, all sites may be important as a whole. This point is particularly relevant for uninhabited islands, complicated further in that their significance may not be specific to one group of local people.
- All agreed that the description and motivation provided by the proponent will need to be very good for this criterion; if there is good motivation for the cultural significance of the site, it will stand out. It was also recognised that scoring Criterion S1 will become easier when there are some sites which have been scored that can serve as benchmarks for comparison.

> ***Turtles are not part of the evaluation description of Criterion S1 specifically; it was suggested that this is amended for clarification.***

[11] See: Wallace et al. (2010) Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. PLoS One 12, e15465.

It was also suggested that "traditional" be excluded from this criterion on the grounds that it may relate to turtle consumption; the sentiment of the criterion should rather reflect the significance of cultural, religious and spiritual beliefs associated with turtles. Other aspects of the cultural importance of turtles (including both consumptive and non-consumptive use) should be included under Criterion S2: Compatible Activities.

Criterion S2

- As for Criterion S1, it was agreed that the proponents' description of this criterion will be especially important so that the evaluators can be guided in their decision making. Seychelles, for example, have good examples where hotel development (generally an incompatible activity) is proceeding in a way that is compatible with turtle conservation.
- There was debate over how far seaward a site extends. It was ultimately decided that an activity must *interact* with whatever the site is being scored for, and that this will require guidance in the criterion description rather than strict delineations.

It is suggested that the wording of Criterion S2 be modified to say "within reasonable proximity to" or "within the vicinity of" rather than "at the site".

- When defining the site for inclusion in the Site Network (refer to the Site Information Sheet, item 6 and/or 25, see also point 17), it was recommended that the proponent includes a zoning scheme (if applicable). The purpose would be to indicate areas where certain activities (that might be incompatible with turtle conservation) are permitted, buffer zones, and areas where the activities are not permitted (sanctuary areas).

Criterion S3

- The following metrics could be used to guide scoring Criterion S3:
  - Permanence of the educational value (*e.g.,* Mon Repos in Australia; Sea Turtle Conservation Center of the Royal Thai Navy in Thailand; Kelonia in Reunion)
  - Accessibility of the site/education facilities and integrity of the access infrastructure
  - Number of people influenced by the site/education facilities

Criterion S5

- Scale and proximity arose as an issue in Criterion S5. For example, how does one measure the national significance of Itsamia (one beach on three islands), versus Mayotte (one island among very many overseas territories)?

It was difficult to score national and international significance as a single criterion, and it is recommended that this is separated into two separate criteria: national significance (within the region - in cases where there are other overseas territories), and international significance. National significance is suggested to be measured by its uniqueness for turtles in relation to other sites in the country.

General issues

Multi-site semantics: pairing versus twinning

- *Paired sites* are those that are contiguous in the Site Network, which may or may not span more than one country; *twinned sites* are spatially separated in the Site Network, but a species uses both directly. It is possible to have a single, multi-site nomination within a country; but this may be difficult among countries.

Scoring ***Scoring-scales for the Site Network criteria should allow for zeros to indicate when the criterion is not important at the site, or the relevant elements are absent.***

Grouping/splitting sites for a single nomination

- Sites should be grouped into clusters that are relevant in terms of turtle ecology and biology, but also management/governance. Having sites too finely split or too coarsely grouped becomes similarly irrelevant in the context of the Site Network.

Additional recommendations

Modifications to the data sheet

- Score sites for nesting and feeding in separate rows in the data sheet.
- Plastic pollution is fairly sporadic and only important in extreme cases; it should be moved to *Other threats* rather than being listed as a separate criterion. Seismic activity should also be included under *Other threats*.
- Data-deficient threats: a distinction may be made between cases where a threat is known to be present but is not quantified, and cases where it is unknown whether the threat is present.
- Clarification under threats to sites: the unit *percentage of the coastline modified/affected* refers to the percentage of the coastline *of the nesting site* that has been/is modified/affected by a particular threat.
- Erratum under threats to turtles: the unit for *Direct harvesting: egg collection* needs to be changed to *Number of nests, per species, per year*.

IOSEA Marine Turtle Site Network

Pilot Spatial Analysis using Marxan

[Agenda Item 10]

3

Introduction

The formal process of nominating sites for inclusion in the IOSEA Marine Turtle Site Network has been described earlier in this report. A parallel process has been initiated to facilitate, support and guide the formal process. Sites perceived by experts to be merit inclusion in the IOSEA Site Network may be suggested as candidate sites. The aim of Part 3 of this report is to introduce systematic conservation planning (SCP) and marine spatial planning (MSP) as empirical tools to support this parallel process, as presented to the workshop by Linda Harris.

SCP is a widely-used, efficient and spatially-explicit tool to identify sites of ecological importance, usually in the context of reserve-network design. It is under-pinned by two over-arching objectives: representativeness and persistence (Margules and Pressey, 2000). Biodiversity features must be sufficiently represented in protected areas across the land- or seascape that their long-term persistence is secured (or at least makes a strong contribution to securing their persistence). These objectives are achieved by the two key features of SCP: complementarity and irreplaceability (Margules and Pressey, 2000). In terms of complementarity, sites are iteratively considered as protected areas based on the biodiversity features already represented in the reserve network. This differs from the hot-spot approach to selecting important areas for biodiversity conservation because SCP does not necessarily target all sites with the greatest diversity; rather, it selects sites to achieve adequate representation of all biodiversity features. Irreplaceable sites are those that cannot afford to be lost because they are the only sites where particular biodiversity features are found. Importantly, SCP is underpinned by constrained optimisation algorithms. This means that the algorithm seeks to achieve user-defined targets[12] for each biodiversity feature efficiently; reserve networks are designed in configurations that require the least area, and avoid competing activities or threats as far as possible (Sarkar et al., 2006). (The technical details and mathematical explanations of SCP are not considered important for the purposes of this report; interested readers are rather referred to two classic texts: Margules and Pressey, 2000 and Moilanen et al., 2009).

Traditionally, MSP is defined as, *"a practical way to create and establish a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect marine ecosystems, and to achieve social and economic objectives in an open and planned way"* (DEFRA 2008, cited in Ehler and Douvere, 2009). An alternative definition of MSP is that it is *"a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process*" (Ehler and Douvere, 2009). In other words, MSP is concerned primarily with zoning activities, either spatially or temporally, to reduce conflicts - either between competing users, or between users and the environment. In zoning activities, MSP could also aim to minimize the overall impact of threats to ecosystems at any one site by separating threats (in space and/or time) that may interact to have an impact that is far worse than either threat on its own. MSP is, therefore, a spatially-

[12] Targets are amounts of a feature that are required to be included in the reserve network, often based on critical ecological thresholds; for example, the minimum percentage area of a species' distribution required to ensure its persistence; or a minimum number of breeding pairs to maintain a population in an endangered state (see *Representation targets and scenarios* below (pg. 30), and Rondinini and Chiozza, 2010 for further details).

explicit tool used to support ecosystem-based management that takes into account biodiversity, supporting ecological processes, ecosystem goods and services, and human use of natural resources. It has been suggested that products from SCP analyses are incorporated into MSPs to secure the biodiversity underpinning the provision of ecosystem goods and services on the premise that this will contribute to ensuring sustainability.

Recalling that there are no legal conservation or management obligations for a site that is accepted into the IOSEA Site Network, it is recognised that the SCP and MSP tools would not be used in the traditional sense. Consequently, it would be more appropriate to refer to the process followed here as *spatially-explicit identification of important sites* rather than SCP or MSP proper. It is also emphasized that these spatial analyses are not proposed or designed to replace expert judgement; rather, they are intended to inform the decision-making process. In particular, they will (more than likely) identify important sites for turtles in the region that are not nominated through the formal process, both inside and outside of territorial waters. Part 3 of this report is a worked example of the *spatially-explicit identification of important sites* process to illustrate the kind of inputs required and outputs created, and showcase the benefits of this approach. **Note that due to numerous data limitations (largely driven by the timeframes of this report), it is not suggested that the sites chosen here are the final selection, and it is strongly suggested that this analysis is refined in the future.**

Methodology

Digital maps of: turtle distributions at sea; turtle-associated habitats (nesting beaches, coral reefs, seagrass beds, mangroves, and sea-mounts); and threats (15 different threats ranging from storm impacts to dynamite fishing) were compiled from existing sources or from information collated during the workshop (see Part 2, and Appendix 1). These digital maps were integrated, and subjected to SCP analyses using Marxan. Three scenarios were considered: 10 % representation of all features; 20 % representation of all features; and 10 % representation of at-sea distributions of turtles, and 20 % representation of the habitat features. Details of the data compilation, input maps, and analyses are presented in Appendix 1.

Comparison of Selected Sites

To a large extent there is a good match between the sites of importance suggested by the WIO-MTTF and the Marxan analyses (Fig. 3.9). However, as was the intention of the exercise, the Marxan analyses also identified a number of supplementary sites that were not captured in the expert-based nominations, both inside and outside of territorial waters. First, **the spatial analyses highlighted the importance of the northern Mozambique Channel as key foraging grounds** (which very likely serve as key developmental grounds as well). This is because much of the turtle-associated habitats, particularly coral reefs, mangroves and seagrass beds, are located in this area. While the presence and selection of these habitats in the analyses suggest key foraging areas, it was anticipated that the at-sea distributions of the turtles would serve the same purpose. However, the majority of satellite tags are applied to nesting females when they come ashore. Given that the satellite tracks have been simply coded to and summed per 2.5° grid squares, it means there is a bias in the data: in Scenario 1 (10 % representation), the near- and offshore areas adjacent to nesting beaches where satellite tagging regularly take place are the sites that get selected (e.g., iSimangaliso in South Africa). It is only in Scenario 2 (20 % representation) where it becomes evident that the at-sea distributions (very likely representing aggregations at foraging sites) are most important in the northern Mozambique Chanel (detectable by the 2.5° blocks of selected areas). While experts did select sites of importance in this area, northern

Mozambique, Tanzania[13], Kenya and southern Somalia are particularly under-represented. This raises an additional point that it is important to get better information on turtle distributions from Somalia (both nesting sites and at-sea distributions) because of how strongly the coastal habitats were selected in the analyses.

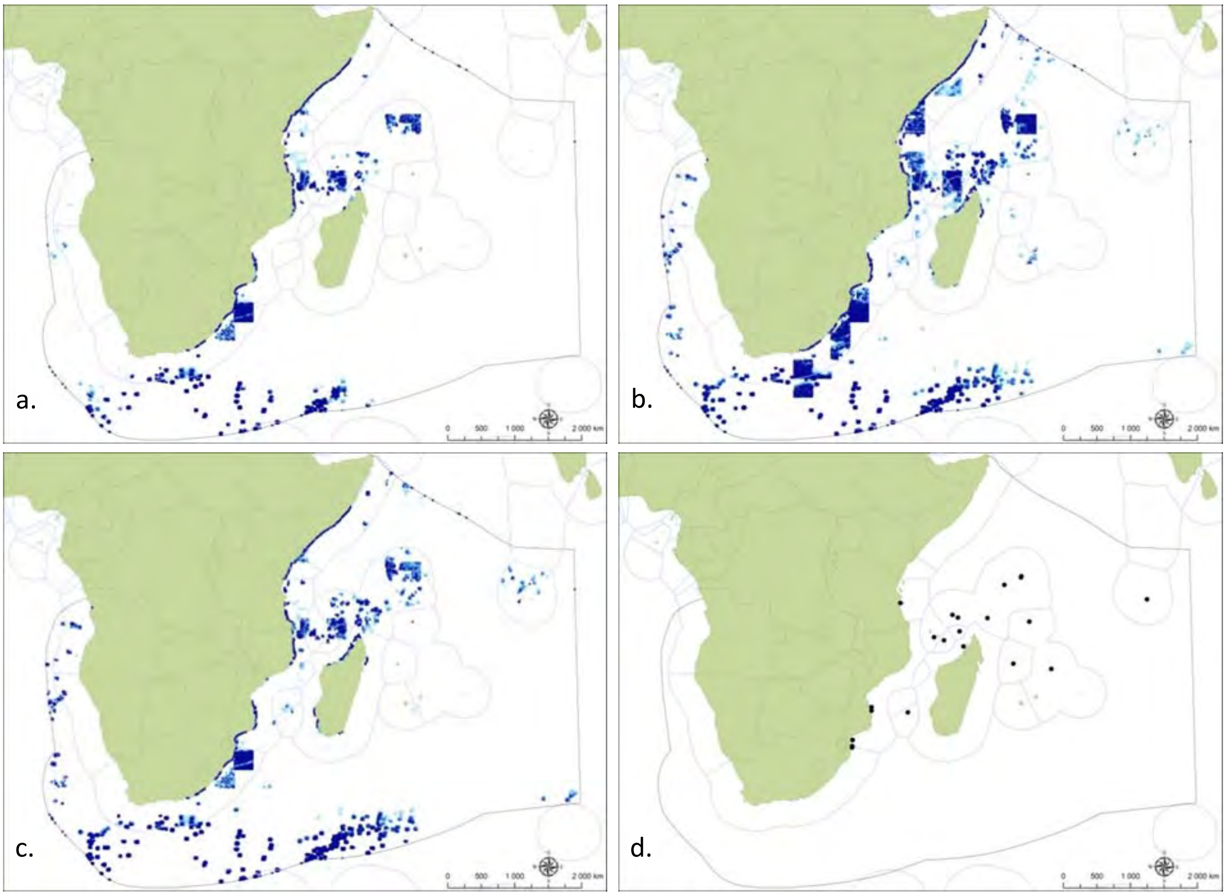


Figure 3.9. *Maps of the Marxan outputs for (a) Scenario 1: 10 % representation of all features; (b) Scenario 2: 20 % of all features; (c) Scenario 3: 10 % representation of the at-sea distribution of turtles and 20 % representation of their habitats; compared to (d) the expert-selected sites (note that this excludes Sofala Banks).*

Second, **the Tugela and Agulhas Banks (South Africa) also come out as key foraging grounds and migratory routes**. In addition, it is interesting to note the strong selection for seamounts along the southern section of the planning domain. While oceanography is not taken into account, the route from iSimangaliso, south-westward past the Tugela Banks, Agulhas banks and then eastward along the selection of seamounts matches the pathway of the Agulhas retroflection. Leatherback turtles are known to migrate along this route, which probably serves as an important route for hatchlings as well, presuming at least some of them drift passively in this current. These offshore sites were not captured in the sites of importance identified by the WIO-MTTF.

Recommendations

The spatial analyses proved to be very useful. They provided a number of key insights, and highlighted sites of importance for turtles that were not captured in the expert workshops. This showcases the value

[13] Recall, the site selected in Tanzania, Rufiji Delta, was selected primarily for its socio-economic and cultural importance more than its ecological and biological importance.

of Marxan products in the site-nomination process: the maps can be used to guide expert judgement and ensure that there is sufficient representation (redundancy) in the selected sites across the IOSEA Site Network, and that no key sites of importance are overlooked. Note that while this was an informative exercise, there are several ways in which the analyses can be strengthened.

First, the algorithm used in this pilot study was Marxan in its simplest form; there are a number of complexities that can be considered in future analyses. For example, Marxan can be run including terms for:

1. **Budgetary constraints and implementation schedules:** if only a certain amount of money is available for land acquisition and/or implementation costs, and if not all identified reserves (sites) can be proclaimed at once, an implementation schedule can be determined to guide which reserves (sites) should be implemented first, and which sites should be implemented in the future.
2. **Threat probabilities:** Sites can be selected for inclusion in the reserve network (Site Network) only if they have more than a user-defined probability of persistence in the future; note that legislation and governance could be used analogously to “threat probabilities” where sites are required to have a particular level of legislation and governance.
3. **Zoning of activities and varying protection levels:** Marxan with Zones can be used to determine appropriate configurations of recommended sanctuary, buffer, and use zones within sites of importance.
4. **Socio-economic, cultural and traditional importance:** These factors can be included as features, with a target and particular area selected to meet their specific objectives; or alternatively, could be integrated into the cost layer, where features with detrimental (to turtles and their habitats) attributes (e.g., festivals or customs that require harvesting or killing turtles) could be included among the threats, and features with positive (to turtles and their habitats) attributes (e.g., opportunities for environmental education and awareness-raising) could be used to discount the threat score in a planning unit.

Second, even though the data used here are not entirely optimal (either outdated or in a sub-optimal format for the spatially-explicit analyses), Marxan still produced some informative outputs. It is recommended, however, that better data are generated and the process repeated to get a more robust product to guide decision making. Included here, in particular, is better representation of the at-sea distribution of turtles using spatial modelling techniques rather than simply coding satellite tracks to a coarse-scale grid. It is suggested that Marxan will serve as a valuable tool to support the identification of sites of importance in the WIO region (and potentially broader) in the parallel site-nomination process, again emphasizing that its purpose is to supplement expert judgement and not to replace it.

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4 Invited Presentations

[Agenda Items 6-8]

Strategies to obtain an index of population status for marine turtles *Prof Marc Girondot*

While any turtle monitoring programme must have a goal, these goals and the resources to achieve them vary among programmes. In his first presentation, Prof Girondot suggested that if the goal of a monitoring programme is to define a population trend over time, and resources to support the programme are limited, a statistical approach can give a very good estimate of what the population trend is. He presented three alternative metrics to get an index of turtle population status: number of nesting females; number of nests; and number of tracks. After challenging the validity of the former two, Prof Girondot proposed the latter as the statistically-preferred metric. He also presented a methodology to determine population trends using track counts as an alternative to saturation tagging, including sampling strategies designed to acquire the fewest data necessary to complete the analysis reliably. Most importantly, monitors must record zero counts on patrols, otherwise there is no way to distinguish between nights when no turtles encountered, and no patrols were undertaken.

The following are presented as the minimum data required if the goal of the monitoring programme is to determine a population trend:

Tracks:

- Within season: Count the number of tracks for 50 % of the number of nights per year (with reasonable coverage across all nesting sites)
- Among seasons (long-term trend): Count the number of tracks for at least 20-30 % of nights (with reasonable coverage across all nesting sites)

Females:

- >20 % of the females must be tagged
- At least 6 years of data using the capture-mark-recapture method

Analysis and quantification of threats for marine turtles *Prof Marc Girondot*

All life-history stages of marine turtles are subject to a myriad of threats. A threat is defined as any influence that lowers the probability of survival and of population persistence, and in the context of

turtles, threats range from direct harvesting to magnetic pollution. Quantifying or ranking threats to turtles is thus a multi-factorial problem, further complicated by the fact that each threat is measured in different metrics. Prof Girondot presented a standard metric that each threat could be converted to: *the equivalent number of adult marine turtles to produce the same effect, in terms of population dynamics, if they were to be removed from the population.* Using this common metric, the relative impact of threats can be measured, and conservation and management interventions can be prioritized.

For example: presuming an average marine turtle reproduces for 10 nesting seasons, each comprising 5 clutches of 100 eggs, she will produce 5000 eggs during her lifetime. The effect of removing a single median-aged turtle out of the population roughly halves her potential for reproduction, i.e., equivalent to 2500 eggs. Therefore, a single clutch (of 100 eggs) is equivalent to 100/2500 = 0.04 of a median aged adult female; and a single egg is equivalent 1/2500 = 0.0004 of a median aged adult female. From this information it can be determined that poaching 25 nests of 100 eggs has an equivalent impact on the population as poaching a single adult female turtle:

$$25 \text{ nests} * 100 \text{ eggs} * 0.0004 \text{ equivalent adult turtles} = 1 \text{ adult turtle}$$

Using a cost-benefit analysis, local authorities could then determine whether it is more beneficial to target poaching of eggs or adult females.

Developing a Strategic Action Programme for the Sustainable Management of the Large Marine Ecosystems of the Western Indian Ocean

Dr David Vousden

The United Nations / Global Environment Facility (GEF) Large Marine Ecosystems Programme in the WIO consists of three partner projects funded by the GEF: WIOLaB (UNEP); SWIOFP (World Bank); and the ASCLME Project (UNDP). Dr David Vousden presented the latter project. He described some of the activities undertaken, including various aspects of: oceanography; coastal artisanal and subsistence fisheries; larval transport; critical habitat mapping; marine pollution; and invasive species. Currently, the participating countries are: Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa, and Tanzania.

Dr Vousden discussed the five important steps that the ASCLME Project is following to achieve more effective management and governance at the ecosystem level: (1) collection of baseline data; (2) identification of key threats to ecosystems and their associated biota, and of the communities who depend on these natural resources to prioritize areas warranting concern and monitoring; (3) establishment of monitoring programmes and identification of ecosystem indicators; (4) translation of scientific outputs to products that can inform governance; and (5) establishment of a WIO Alliance of partners to achieve co-operative management. Within this framework, he highlighted potential areas for research collaborations for the scientific community working on sea turtles. Further information can be found on the ASCLME website: www.asclme.org.

Appendix 1: Marxan Methodology

Details of the methodology underlying the Marxan analysis

Planning domain

The planning domain was delineated as an outline of the largest extent of each of the RMUs, per species (Wallace et al., 2010), excluding olive ridleys. The RMU for this turtle species was excluded because there is very little information available for them in the WIO region, and because their inclusion would have meant an extension of the planning domain across the entire North West Indian Ocean (see Fig 2.1 above), which was considered inappropriate for the purposes of the current analysis. A five-minute grid was constructed in ArcGIS 10 (ESRI) for the planning domain, where each block in the grid will be referred to hereafter as planning units (Fig. 3.1).

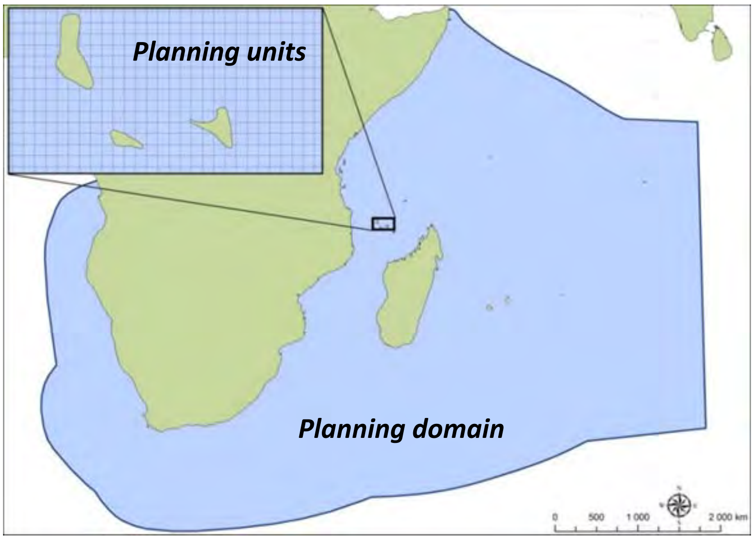


Figure 3.1. *Map of the planning domain (blue), comprising the RMUs for loggerheads, leatherbacks, green turtles, and hawksbills. The insert is a zoomed section of the planning domain (Comoros islands in green) to show a sample of the planning units (blocks outlined in grey).*

Input data: species

A recent project (Nel et al., 2012) compiled all turtle satellite tracking information within the jurisdiction of the Indian Ocean Tuna Commission (IOTC). The satellite tracks were coded to a 2.5° grid, and the number of tracks, per species, per grid block was summed. Currently, and within the timeframes of this meeting report, this is the best dataset available to represent the at-sea distribution of marine turtles across the planning domain. These data were used in preference to sites identified as feeding grounds or migratory corridors by experts from the IOSEA database.

Recalling, however, that the eastern boundary of the IOTC region is at Cape Agulhas (20° E), there was a large data gap up the east coast of southern Africa. To our knowledge, the only satellite tracks showing turtles migrating around Cape Point are from South Africa; these were coded to an extension of the IOTC 2.5° grid following the methods in Nel et al. (2012) to fill the data gap. Note that turtles migrating into the planning domain from adjacent RMUs were accounted for, and were also coded to the planning units - e.g., Leatherbacks from South East Asia migrating into the BIOT (cluster of coded planning units in the upper right of Fig. 3.2).

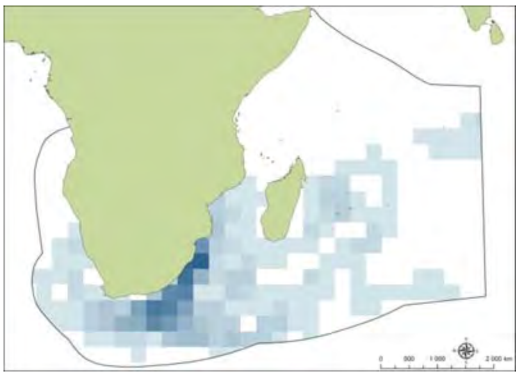


Figure 3.2. *Distribution of leatherbacks in the SWIO. Blue shading in the planning units reflects relative abundance; light to dark blue indicates 1-25 tracks.*

Input data: habitats

Digital maps of most of the turtle-associated habitats were downloaded as global datasets and coded to the planning units on a presence-absence basis (Fig. 3.3). These habitats include: coral reefs (UNEP-WCMC, W.C., WRI and TNC., 2010[14]); seagrass beds (UNEP-WCMC 2005); mangroves (UNEP-WCMC and USGS, 2011) and seamounts (Yesson et al., 2011).

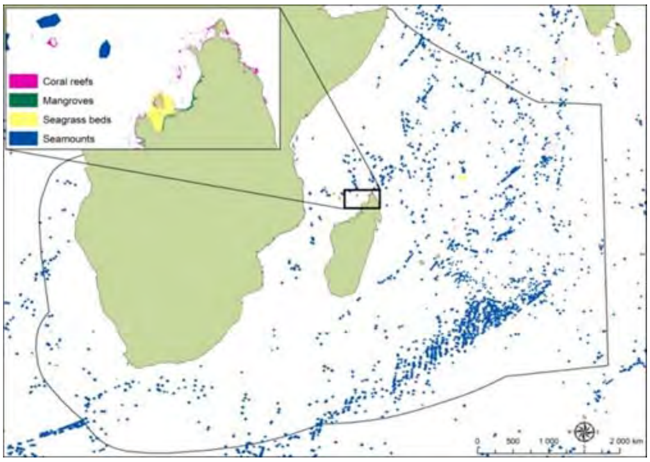
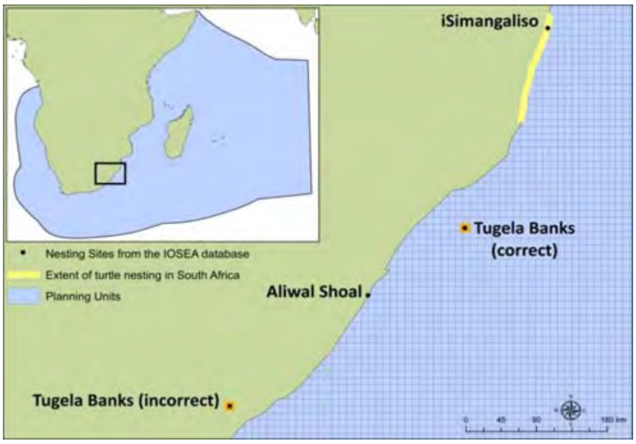


Figure 3.3. *Turtle-associated habitats in the WIO, with an inset showing northern Madagascar, Mayotte and eastern Comoros.*

Ideally, a similar digital map representing turtle nesting beaches is required (e.g., extent of turtle nesting in South Africa shown as a yellow line in Fig. 3.4), but this data layer currently does not exist and could not be created within the timeframes of the project. Therefore, the known nesting sites from the IOSEA database (www.ioseaturtles.org) and SWOT database (http://seamap.env.duke.edu/swot) were used as the best available data, and were coded to the planning units (detailed below), recognising, that using single GPS points (and thus a single planning unit) to represent a site generally does not provide sufficient representation of nesting beach area. In South Africa, for example, the extent of the nesting grounds spans more than 100 km. When the data point (iSimangaliso) is coded to the planning unit grid, only one planning unit is selected. In reality, 21 planning units should be selected. Similarly, only one GPS point is provided in the IOSEA database for clusters of islands that are considered to be a single nesting site, which means that the planning unit corresponding to each individual island did not necessarily get coded as a nesting beach. Note also that the GPS co-ordinates of the sites (from both the IOSEA and SWOT databases) were verified before they were coded to the planning units (see Tugela Banks in Fig. 3.4 as an example, noting however that this is a turtle feeding ground and was not included in the nesting beach habitat map; it is shown here for illustrative purposes only).

Figure 3.4. *First, turtle nesting grounds are under-represented in the habitat maps because the best available data are single GPS points per site from the IOSEA database, which does not sufficiently capture the full extent of the nesting grounds at each site. Second, prior to coding the nesting grounds information to the planning unit grid, the GPS points were verified. The example above shows the incorrectly-placed Tugela Banks site (an offshore turtle feeding ground just south of iSimangaliso), that was repositioned into the correct location.*



[14] This is dataset is an amalgamation of information, comprising three main components: (1) Millennium Coral Reef Mapping Project validated maps provided by the Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF) and Institut de Recherche pour le Développement (IRD, Centre de Nouméa), with support from NASA. (2) Millennium Coral Reef Mapping Project unvalidated maps provided by the Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF), with support from NASA. Unvalidated maps were further interpreted by UNEP-WCMC. Institut de Recherche pour le Développement (IRD, Centre de Nouméa) do not endorse these products. (3) Other data have been compiled from multiple sources by UNEP-WCMC.

Some coding errors were detected in the IOSEA nest-site data; for example, some sites were listed as supporting very large populations of nesting leatherbacks in countries where it is known that leatherbacks do not nest. Recognising that these seeming erroneous sites could well represent areas of incidental nesting, they were retained as nesting sites in the database. Given that the SWOT data are quantitative (recorded as the number of nesting females, per site), it was proposed that these data would better represent turtle abundance at (and thus, relative importance of) each nesting beach, at this stage. Interestingly, although the IOSEA and SWOT databases are both recognised as being comprehensive, the nesting sites listed in each do not align entirely. Therefore, in an attempt to capture as much of the nesting habitat available, sites from both databases were coded to the planning units (Fig. 3.5) in the following way (see also, Table 3.1). First, all IOSEA-listed nesting sites were coded to the planning units, and assigned a relative abundance value of 1. Second, SWOT-listed sites were superimposed on the map, coded to the planning units, and assigned a relative abundance score (ranging 2-6), based on a fixed scale (from Table S1 in Wallace et al., 2011; Table 3.1). In cases where the IOSEA- and SWOT-listed sites overlapped (which was most often the case), the score for relative abundance from the SWOT-listed site took precedence (*i.e.*, the higher value was used); the assumption is thus that true nesting sites are assigned greater relative importance compared to incidental nesting sites. Also, where turtle abundance at a nesting site was recorded as data deficient in the SWOT database it was coded with a rank abundance of 1. Note that: if nest-site co-ordinates were not precisely the same in each of the two databases, but it was clear that both points referred to the same nesting site, the SWOT relative-abundance score was assigned to both points/planning units.

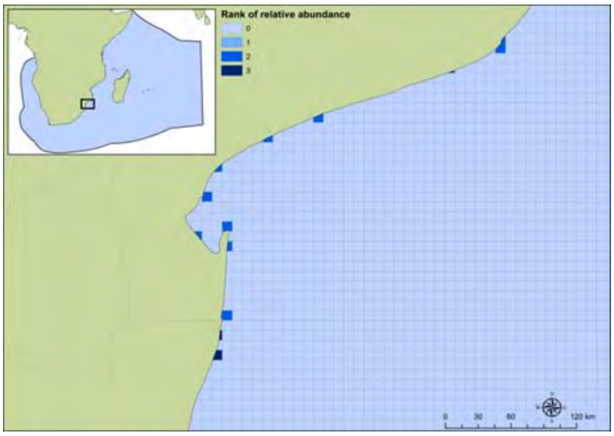


Figure 3.5. *Relative importance of nesting beaches for loggerhead turtles in South Africa and southern Mozambique, based on the rank of relative abundance of nesting females at each site, per annum.*

Table 3.1. *Scores applied to rank turtle abundance at (and thus, relative importance of) each nesting beach (see Wallace et al., 2011). First, all sites listed in the IOSEA database were treated as "data deficient" ("DD"), i.e., to represent the incidental nesting sites. Second, sites from the SWOT database were scored as per the turtle abundance recorded at the site, following the rankings below. The score for each rank (Very Low, Low, Medium...) is given in brackets after the column heading; data in the table represent the number of nesting females, per annum, for each of the species. Note that the SWOT score replaced the IOSEA site score where they coincided.*

Species	"DD" (1)	Very Low (2)	Low (3)	Medium (4)	High (5)	Very High (6)
Caretta caretta	IOSEA site	<100	101-1000	1001-5000	5001-10000	>10000
Chelonia mydas	IOSEA site	<100	101-1000	1001-5000	5001-10000	>10000
Dermochelys coriacea	IOSEA site	<10	11-100	101-500	501-1000	>1000
Eretmochelys imbricata	IOSEA site	<10	11-100	101-500	501-1000	>1000
Lepidochelys olivacea	IOSEA site	<100	101-1000	1001-10000	10001-100000	>100000

Input data: threats

Threats to turtles and their habitats was determined to be a good "cost" layer for the Marxan analysis: the algorithm should select sites of importance that are affected by the least threat (in agreement with criteria EB4 and S2). The threats data used here mostly comprised constituent shapefiles from a global analysis of threats to oceans by Halpern et al. (2008; Fig. 3.6b-m). Recognising that many of these data

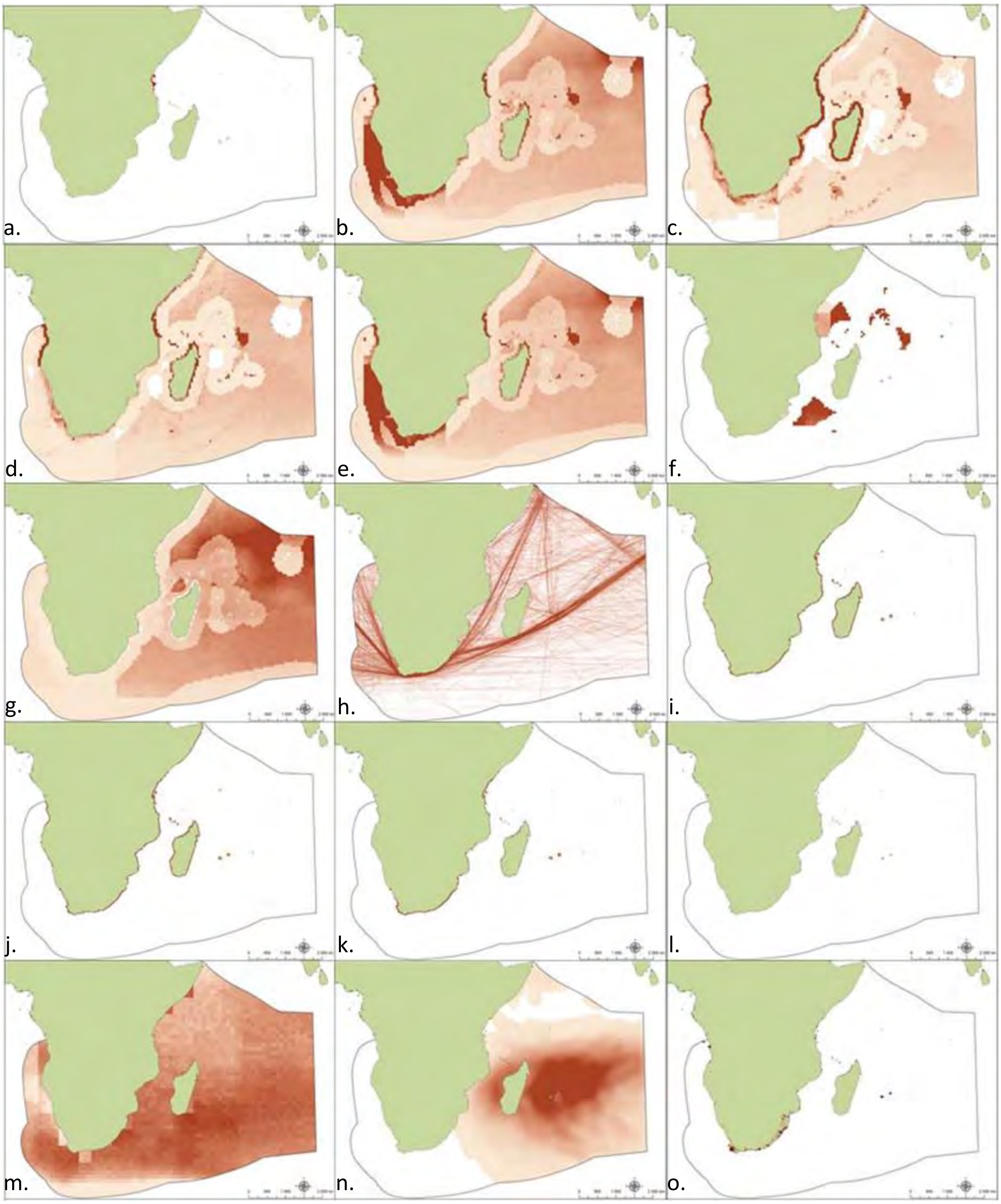


Figure 3.6. *Maps of threats to turtles and their associated habitats in the WIO region (see text for data references). (a) dynamite fishing; (b) artisanal fishing; (c) destructive demersal trawling; (d) non-destructive demersal trawling - high bycatch; (e) non-destructive demersal trawling - low bycatch; (f) pelagic fishing - high bycatch; (g) pelagic fishing - low bycatch; (h) shipping lanes; (i) inorganic pollution; (j) organic pollution; (k) nutrients; (l) coastal population; (m) ocean acidification; (n) storm tracks; (o) artificial lights.*

are outdated and need revision (particularly those relating to fisheries and bycatch), they are the best available, standardized datasets given the timeframes of this project. In addition, night-time lights (NGDC-NOAA 2010; Fig. 3.6o) and storm tracks (Knapp et al., 2010; Fig 3.6n) were downloaded from online databases, with only the latter data requiring further processing (a line-density analysis to transform the data from vector to raster). Finally, a digital map of dynamite fishing areas was created (Fig. 3.6a). A Google Earth map of this threat was obtained from SeaSense (forming part of the *Reefs at*

Risk Revised project: Burke et al., 2011), the image was georeferenced (in QGIS) and the dynamite fishing areas were digitized (in ArcGIS 10). The intensity of dynamite fishing was scored (on a 0-1 scale, see below) as: low = 0.2; moderate = 0.5; and severe = 1.0.

The cost layer required by the Marxan analysis, however, must comprise a single map. The implication is that the maps on individual threats described above need to be integrated into a map of cumulative threats to turtles and their habitats. This was done following methods described in Halpern et al. (2007), again recognising that this process will need to be refined for future analyses. First, data values *(i)* in the planning units describing the relative intensity of threat *t* across the planning domain were normalised *(j_t)* 0-1. This was repeated for *n=15* threats. Second, it would be incorrect to judge that all threats have an equal impact; for example, the effect of organic pollution is not the same as that of pelagic fisheries with high levels of bycatch. Therefore, each threat *t* was weighted *(T)*, depending on whether it had a high, medium, or low impact (Table 3.2).

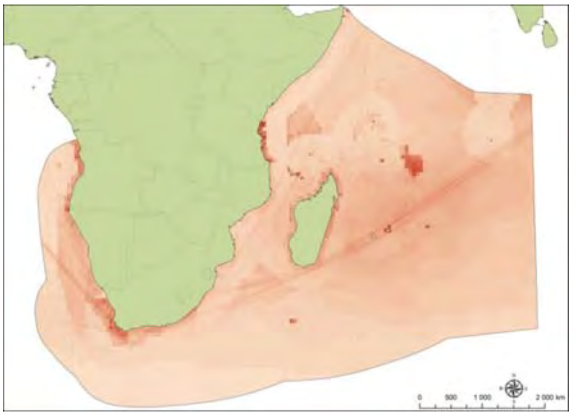


Figure 3.7. *Cumulative threats to turtles and their habitats, with darker red indicating greater overall threat.*

Table 3.2. Weighting among threats to turtles and their habitats used in the cumulative threat assessment

Threat	Weighting	*T*	Justification
Artisanal fishing	Very high	4	
Dynamite fishing	High	3	
Pelagic fishing (high bycatch)	High	3	
Night-time lights	High	3	Destroys nesting habitat
Destructive demersal fishing	Medium	2	Habitat impact
Non-destructive demersal fishing (high bycatch)	Medium	2	Direct Turtle impact
Shipping lanes	Medium	2	
Storms	Medium	2	Although a short-lived impact (recovery within 4 years)
Pelagic fishing (low bycatch)	Low	1	
Non-destructive demersal fishing (low bycatch)	Low	1	
Human coastal population	Low	1	Provided night-time lights are managed
Ocean acidification	Low	1	
Inorganic pollution	Low	1	
Organic pollution	Low	1	
Nutrients	Low	1	

Third, each normalised intensity value *(j_t)* was multiplied by *T,* the weight of threat *t*. Finally, the values from step three were summed per planning unit to give a cumulative threat score *(I_C)* in each planning unit, the map of which (Fig. 3.6) represents the cost layer. This process is expressed mathematically as:

$$I_C = \sum_{t=1}^{n} j_t * T$$

Existing (marine) protected areas and internationally-accredited sites

The Marxan algorithm includes a term that can permanently or temporarily lock planning units into the solutions. This is traditionally used in reserve-network designs where some protected areas exist in the planning domain and the purpose of the analysis is to identify supplementary reserves rather than an entirely new selection of sites. In these cases, the exiting reserves are locked into the solutions, and the algorithm searches for appropriate sites to add. In the case of the analyses used here for the IOSEA Site Network, existing protected areas and World Heritage Sites were temporarily locked into the solutions. In other words, these sites were locked into the initial, randomly-assigned selection of sites, but could be iteratively dropped out of the selection during the annealing routine if that improved the score of the solution.

A global map of protected areas (both terrestrial and marine) is available from the World Database on Protected Areas (IUCN and UNEP-WCMC, 2013); two modifications were made as updates. First, the Chagos MPA is conspicuous by its absence in the 2010 version of the global map, but it is available as a single-site map. Consequently, it was downloaded separately and added to the global layer. Second, one MPA was removed from the global map: a large proposed MPA on the South African west coast, which is no longer being considered for proclamation. The global map of World Heritage Sites (WHS) was also downloaded[15] (UNESCO, 2013), and overlaid on the protected areas map (Fig. 3.8). The data are provided as single points per site, which results in under-representation of the WHS areas when coded to the planning units in the same way that the IOSEA nesting site data points under-represent nesting habitat area (see Fig. 3.4 above). However, the majority of the WHSs are protected in (marine) protected areas, which largely mitigated the under-representation effect.

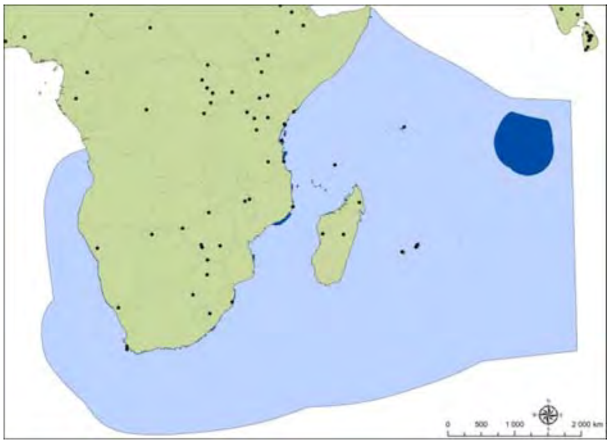


Figure 3.8. *Protected areas (dark blue) and World Heritage Sites (black dots) in the planning domain.*

Representation targets and scenarios

Conservation targets are usually set to ensure that protection is afforded to an amount of a feature that exceeds a critical ecological threshold (Rondinini and Chiozza, 2010). Because data are generally unavailable to compute population viability analyses, targets tend to be set for biodiversity surroagtes either using quantitative methods or expert-based heuristic principles. However**, the IOSEA Site Network is not a network of protected areas; and thus the intent of the spatial analyses is rather to determine a representative selection of important sites for turtles**. Targets were set for 13 features: at-sea distributions, per species to represent feeding grounds and migration routes (note that there are no satellite tracks for olive ridleys recorded in the planning domain); nesting sites, per species; coral reefs;

Table 3.3. *Scenarios of representation targets for turtles and their associated habitats that were used in this analysis*

Feature	Scenario 1	Scenario 2	Scenario 3
At-sea distribution, per species	10 %	20 %	10 %
Nesting beaches, per species	10 %	20 %	20 %
Coral reefs	10 %	20 %	20 %
Seagrass beds	10 %	20 %	20 %
Mangroves	10 %	20 %	20 %
Seamounts	10 %	20 %	20 %

[15] UNESCO WHSs were downloaded as a kml file, which was converted to a shapefile in ArcGIS 10.

seagrass beds; mangroves; and seamounts. Thee scenarios were run where the top 10 % and top 20 % of sites were selected, and finally a combination of the two (Table 3.3). Note that these representation targets are based on heuristic decisions, and can easily be modified in future analyses if necessary.

Site selection using Marxan

Marxan is the most widely-used SCP software globally (Ball et al., 2009; Watts et al., 2009). Marxan stands for *"marine reserve design using spatially explicit annealing",* although it is also frequently used in terrestrial reserve design (Ball et al., 2009). The minimum set problem formulation, in its simplest form, is defined in Equations 3.1 - 3.3 (from Possingham et al., 2009):

$$\min \sum_{i=1}^{N_s} c_i x_i \qquad \text{(Eqn. 3.1)}$$

given the constraints that

$$\sum_{i=1}^{N_s} x_i r_{ij} \geq T_j \quad \text{for all features } j \qquad \text{(Eqn. 3.2)}$$

$$\text{and} \quad x_i \in \{0,1\} \quad \text{for all sites } i \qquad \text{(Eqn. 3.3)}$$

where N_s is the number of sites, c_i is the cost of site i, r_{ij} is the occurrence level of feature j in site i, and T_j is the target level for each feature j. The Boolean control variable x_i has value 1 for selected sites, and value 0 for sites not selected.

Marxan is based on the simulated annealing heuristic (see Moilanen and Ball, 2009 for a mathematical explanation, and also Ball et al., 2009), and proceeds as follows. Initially, a user-defined proportion of sites are randomly selected, representing an initial, theoretical reserve network. Sites are then iteratively added to and removed from the initial reserve network at random, retaining "good moves" (iterations that lower the value calculated in Eqn. 3.1), and rejecting "bad moves" (iterations that raise the value calculated in Eqn. 3.1). However, some bad moves are allowed during computation to prevent the algorithm from falling into a local minimum (false end-point) early on in the routine. As the annealing temperature decreases (during the course of the routine), fewer and fewer bad moves are allowed, until a solution is achieved that cannot be improved. The algorithm runs through this routine a user-defined number of times; and site irreplaceability can be calculated based on the number of times it is selected for inclusion in the reserve network across all of the runs.

The input parameters and input data files were created following recommendations in the Marxan user manual (Game and Grantham, 2008). Included among these data inputs is the boundary file, created using the Marxan Boundary Tool for ESRI ArcGIS 10.x (ABP Marine Environmental Research Limited). The first batches of solutions were run to calibrate the boundary length modifier (following the methods described in the Marxan manual). Thereafter, Marxan was run with the relevant input parameters for each of the scenarios defined in Table 3.3.

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Appendix 2: Statements

Statement by Mauritius

With regards to the National presentation of United Kingdom on Marine Turtles, Mauritius states the following:

a. Mauritius does not recognize the so-called British Indian Ocean Territory. The Chagos Archipelago was illegally excised from the territory of Mauritius prior to its independence in violation of UN General Assembly resolutions 1514 (XV) of 14 December 1960 and 2066 (XX) of 16 December 1965.

b. Under both Mauritian law and International law, the Chagos Archipelago including Diego Garcia and Tromelin are under the sovereignty of Mauritius. Mauritius objects to any reference of any islets of Chagos Archipelago as UK or Great Britain or BIOT and Tromelin as France.

c. The Government of Mauritius has initiated proceedings on 20 December 2010 against the British Government under Article 287 and Annex VII of the United Nations Convention on the Laws of the Sea to challenge the legality of the ʻʻ Marine Protected Areaʼʼ which the UK has purported to establish around the Chagos Archipelago.

Statement by the United Kingdom

The UK has no doubt about its sovereignty over the British Indian Ocean Territory which was ceded to Britain in 1814 and has been a British dependency ever since.

Appendix 3: List of participants

Name	Country	Affiliation
Nassir Amiyo	Kenya	WWF, WIO-MTTF proxy
Darrell Anders	South Africa	DEA Oceans and Coast: Marine Research Technician
Santosh Bachoo	South Africa	Ezemvelo KZNW
Karien Bezuidenhout	South Africa	NMMU - Local Organizing Committee
Stephane Ciccione	France	WIO-MTTF Vice Chair (France, Kelonia)
Anje De Wet	South Africa	Student, NMMU
Terry Furguson	South Africa	Ezemvelo KZN Wildlife, Marine Manager - iSimangaliso Wetland Park
Dr Marc Girondot	France	Invited expert, Université Paris Sud
Nerosha Govender	South Africa	iSimangaliso Authority, Manager: Research and Projects
Linda Harris	South Africa	NMMU - Local Organizing Committee
Dr George Hughes	South Africa	Regional Expert (IUCN MTSG)
Douglas Hykle	Thailand	Coordinator, IOSEA Secretariat
Prof Andrew Leitch	South Africa	NMMU DEAN of Science
Cristina Louro	Mozambique	Centro Terra Viva, WIO-MTTF proxy
Prof Thoko Mayekiso	South Africa	NMMU Deputy Vice Chancellor
Bernice Mellet	South Africa	Student, NMMU
Dr Jeanne Mortimer	Seychelles	WIO-MTTF Member
Anfani Msoili	Comoros	WIO-MTTF Member
Dr Ronel Nel	South Africa	WIO-MTTF Chair (NMMU Zoology)
Devanand Norungee	Mauritius	WIO-MTTF Member (Ministry of Fisheries)
Herman Oosthuizen	South Africa	DEA Oceans and Coast: Scientific Manager
Marguerite Rasolofo	Madagascar	WIO-MTTF Member (Centre National de Recherches sur l'Environnement)
Dr Peter Richardson	United Kingdom	WIO-MTTF Member (United Kingdom, Marine Conservation Society)
Nathan Robinson	United States of America	Student, Purdue University
Lucy Scott	South Africa	ASCLME
Jenny Tucek	South Africa	NMMU - Local Organizing Committee
Dr David Vousden	South Africa	ASCLME
Patrick Vrancken	South Africa	NMMU Law
Lindsey West	United Republic of Tanzania	SeaSense, WIO-MTTF proxy
Jess Williams	Australia	Lead scientist- Sea turtles Marine Megafauna Foundation / Student, James Cook University

Nelson Mandela Metropolitan University

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