



**Australian Government**  
**Department of the  
Environment and Heritage**



**Thai Government**  
**Department of Marine  
and Coastal Resources**

**First Meeting on Dugong Conservation  
in the Indian Ocean and South-east Asia Region**

**23-25 August 2005  
Chaophya Park Hotel  
Bangkok, Thailand**

**MEETING REPORT**

**Introduction**

1. The First Meeting on dugong conservation in the Indian Ocean and South-east Asian region under the auspices of the Convention on Migratory Species (CMS) was held at the Chaophya Park Hotel, Bangkok, Thailand from the 23-25 August 2005, co-hosted by the Governments of Thailand and Australia. The Annotated Agenda for the meeting is Annex 1. The List of Participants is Annex 2.

**Welcoming remarks**

2. The meeting was formally opened by the representative of the Secretariat of the Convention on Migratory Species (CMS), Mr Douglas Hykle. The representatives of the Governments of Australia and Thailand, Mr Andrew McNee and Dr Maitree Duangsawasdi, were appointed by the participants as co-chairs of the meeting. The co-chairs welcomed participants and noted the high level attendance of countries within the dugong's range. They stated they looked forward to the cooperation among countries at the meeting, with the aim to develop a draft text for regional dugong conservation.

**Meeting Agenda**

3. The agenda was adopted without amendments.

**Dugong biology, ecology, populations and behaviour (see Annex 7):**

4. Professor Helene Marsh, as an invited expert, delivered a presentation on dugong biology, ecology, populations and behaviour. The presentation showed that dugongs occupy a wide range, and due to their life characteristics (long lived, late sexual maturity between, having few young with high parental investment, and dependent on seagrass) are affected by human related mortality. There followed a general discussion and information sharing on circumstances within their countries jurisdiction.

5. The key points from Professor Marsh's presentation are:
- Dugongs have a huge range spanning some 140,000 km of coastline of almost 50 coastal and island states between East Africa and Vanuatu and the latitudes of about 27 degrees north and south of the equator.
  - The dugong has high conservation value as the only herbivorous mammal that is strictly marine, the only extant species in the family Dugongidae and one of only four extant species in the order Sirenia.
  - The dugong has extremely high cultural and dietary values throughout much of its range and is a flagship species for the conservation of coastal habitats throughout much of its range.
  - Dugongs are listed as vulnerable to extinction by the IUCN. Populations are believed to be depleted throughout much of the range; there is considerable uncertainty about their status in most of the remainder of their range.
  - Critical dugong habitats include seagrass beds, particularly seagrass occurring at depths of less than 10m deep and especially less than 3m deep, plus movement corridors which may span deeper waters including ocean trenches.
  - If dugongs become locally extinct in an area they may be slow to recolonise and the quality of the seagrass community may decline during the period of recolonisation.
  - Dugong habitats are subject to large scale diebacks associated with extreme weather events. If habitat is lost, dugongs postpone breeding or move.
  - Because dugongs are long-lived slow breeding animals, adult mortality is the most serious human impact.
  - Monitoring population trends is an insensitive trigger for management intervention, except over very long time frames, but estimates of population size are required to estimate sustainable levels of human mortality from all causes.
  - Sustainable dugong anthropogenic mortality targets must recognize variability in the size and potential rate of increase of target population and be calculated at ecologically relevant spatial (hundreds of kilometres) and temporal scales (decades)
  - In areas with small dugong populations (hundreds or less), management actions should aim to eliminate human mortality and conserve habitats.
  - As individual dugongs can move hundreds of kilometres in a few days, management needs to be implemented at regional scales if it is to be ecologically relevant to dugongs.
6. The meeting noted that dugong were known to move between jurisdictions and that any action to conserve and manage dugong populations would need to require cooperation at a regional scale.

### **Threats to dugong:**

7. Professor Helene Marsh gave a presentation on threats to dugong in the Indian Ocean and South-East Asian region. Delegates then discussed these threats, and began to identify a detailed list of threats to dugong populations in the Indian Ocean and South-East Asian region, as well as opportunities for mitigation and prevention. The meeting recognised that regional cooperation was needed to address threats to dugongs.

8. Professor Marsh provided the following information on threats: The anthropogenic threats to dugong populations are widespread and their relative importance differs in different regions. Causes of dugong mortality include legal subsistence harvest for food, medicine and materials, poaching, incidental capture in artisanal and commercial fisheries especially net and dynamite fisheries, and vessel strike. Threats to dugong habitats include coastal development, agricultural pollution exacerbated by poor catchment management and extreme weather events, damage to seagrass beds from fishing activities, oil spills, disturbance to dugongs from vessels including tourist vessels, and climate change.

### **Key elements and possible framework for regional cooperation**

9. The CMS representative, Mr Douglas Hykle, provided information on the CMS and conservation frameworks made under it, including legally binding agreements and non-legally binding Memoranda of Understanding (MoUs). The presentation included information on experience from the development and implementation of the Indian Ocean and South-East Asian Marine (IOSEA) Turtle MoU and the development of legally binding agreements and the positives and negatives of both approaches.
10. The meeting noted that regional frameworks provide an opportunity to cooperate to conserve species, to share information, and to seek financial and technical resources.
11. The meeting discussed which framework appeared to be the most appropriate, and agreed to begin work on a preliminary framework for the region. It was recognised that the IOSEA Turtle MoU was already operational in the region and provided an example of how regional cooperation under the CMS could be achieved through a regional conservation instrument.
12. The meeting identified and discussed the key objectives and elements for a regional dugong conservation arrangement, and requested the technical experts to examine the extent to which the approach to conservation and management actions under the IOSEA Turtle MoU which could inform the development of a regional conservation and management arrangement for dugong.
13. The meeting considered the nature of actions that could be pursued at a regional level and viewed a non-legally binding MoU framework as the most suitable approach to promote regional cooperation. The meeting identified the appropriate structure and format for a draft MoU.
14. The meeting divided into 3 working groups to discuss and identify priorities for conservation and management action under a regional arrangement. The outcome of those discussions is Annex 3.
15. Working groups reconvened to identify mechanisms to promote the conservation status and need of conservation actions in states, and to generate funding and capacity. The outcome of those discussions is Annex 4.

## Progressing Regional Dugong Conservation

16. The meeting invited comments on the sample draft text of a memorandum of understanding. It was agreed that all references in the text to “arrangement” would be amended to read “memorandum of understanding”, and that consideration be given to including some background information on the species, perhaps as an annex.
17. Questions were raised about the definition of the term “Range State” which, it was noted, had also arisen in the context of the IOSEA Marine Turtle MoU. It was pointed out that as there were only passing references in the text to the term “Range State” -- none of them substantive -- the term need not be defined explicitly in the text, and any existing references could be amended.
18. It was agreed to insert a reference to responsible fisheries in the sixth preambular paragraph of the draft MoU text.
19. There was a general discussion of the issue of subsistence and sustainable levels of harvest of dugong, and any references to this issue in the draft MoU. Concerns were raised about the implications of such references in relation to existing national legislation, which in some countries, prohibited any harvest of dugong. It was agreed that the text in 3a) could be clarified by adding, at the end, the words: “in those States where it is allowed”. The same clarification would be added after “management of subsistence harvesting” in 3b (and elsewhere in the text, where relevant).
20. The meeting sought to clarify the potential geographic scope of the memorandum of understanding, noting the importance of involving countries throughout the range of the species, as well as other countries that are relevant (eg. in terms of possible impacts). In particular, justification was given for extending the coverage eastward to include relevant Pacific Island States, whilst taking account of other initiatives being undertaken through SPREP. The representative of Papua New Guinea indicated that his country would be comfortable working through both instruments. Without wishing to preclude further discussion of the geographic scope, in the absence of some interested countries, two possible formulations for the geographic scope were suggested:
  - “Region means all of the waters and coastal States of the Indian Ocean, East Asia, Pacific Ocean, as well as their adjacent seas, [within the range of dugong] or [bounded by latitudes 27 degrees north and south of the equator].” (This issue remained unresolved and will require further consideration at the next meeting).
21. Questions were raised as to the implications for possible amendments needed to domestic legislation and regulations to be able to implement the MoU. It was noted that the draft MoU text provided for review, formulate, revise and harmonise national legislation, as necessary. In the course of the discussion, it was suggested that the Conservation and Management Plan reflect regional differences that clearly exist.

22. The question was raised as to whether a Memorandum of Understanding should be developed with a view to stimulating national capacity and activities where few or none currently exist, or whether the starting point should be that countries first develop capacity at sub-regional levels. Views in favour of both approaches were expressed. Cambodia suggested that national representatives be called on to present their national perspectives, and that regional bodies be invited to future meetings to contribute their expertise and share valuable experience.
23. It was noted that various gatherings over the past three decades had not yielded much progress for dugong conservation in terms of international collaboration, and that a formal MoU might stimulate greater cooperation where other initiatives had not succeeded to date. It was noted also that resource limitations may lead to disappointment over differences between the aspirations of any instrument and delivery, in terms of actions on the ground. Nevertheless, it was pointed out that for any international instrument, a certain number of years are needed before they become fully operational.
24. It was recognised that MoUs reflect the aspirations of Signatory States. The meeting noted that sometimes these aspirations do not translate to effective on-ground actions. The meeting was of the view that there needed to be a strong focus on ensuring that MoUs deliver on-ground conservation actions.
25. The future status of the Memorandum of Understanding was raised, with reference to paragraph 4d) of the basic principles; with reservations raised about the possibility of the instrument being transformed at some point into a legally-binding instrument. It was agreed that the reference to possible replacement of the MoU by a legally-binding treaty be deleted.

### **Conservation and Management Actions**

26. The technical experts provided a summary of actions identified in the working groups, and developed a document which could provide guidance to potential signatories to an MOU and future meetings, on the nature and scope of potential conservation and management actions.
27. This document, *Analysis of elements from IOSEA Turtle MoU possibly relevant to dugong conservation* is as a non-paper as an aid to future discussions on conservation and management actions. In future it would be useful to undertake work and discussion to target actions that are high priority and remove unnecessary duplication.

### **Next Steps**

28. Thailand/Australia offered to disseminate outcomes of the meeting and to coordinate intercessional activity:
  - Identify relevant experts;
  - Seek support for process and for States (NGOs and IGOs).
  - Provide contact point to provide comments on future activities.

29. Participants were requested to provide to Australia and Thailand their views on the non-paper draft MoU text and on the document *Analysis Of Elements From IOSEA Turtle MoU Conservation Management Plan Possibly Relevant To Dugong Conservation* to serve as a basis for future negotiation.
30. The meeting expressed the view that it would be important to undertake research to provide additional information to fill in knowledge gaps. Participants requested that scientific and cultural information be shared among States within the dugong's range and to undertake joint research and provide some funding assistance.
31. It was proposed that a second meeting be held in 2006. The meeting agreed to undertake intersessional discussion with a view to identify a host for the meeting and agree on timing. Professor Marsh indicated that there may be a technical workshop on dugongs in United Arab Emirates in early 2006 which could be linked to the a future meeting.
32. The meeting expressed a benefit that, at future meetings, each delegation should comprise two delegates (one policy and one technical) to bring greater expertise to discussions. In addition, at future meetings, the agenda could provide an opportunity to discuss national actions and information on dugongs. There was also a request that the cultural value of dugongs be discussed.
33. Participants representing Contracting Parties of the CMS were requested to provide a report to the CMS Conference of the Parties on action to work toward implementation of Resolution 7.7 and Recommendation 7.5.
34. If participants are seeking information, they may contact Dr Hines who offered to provide the link to two listserves: Serinian listserv and Asian Marine Mammal listserv to provide an opportunity for States to seek information from dugong experts. The meeting expressed a desire for web- or email-based communication to increase knowledge among States where dugong occur.



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**ANNEX 1. First Meeting on Dugong Conservation in the Indian Ocean and  
 South-east Asian Region  
 Annotated Provisional Agenda**

**23-25 August 2005  
 Chaophya Park Hotel, Bangkok, Thailand**

Tuesday 23 August 2005

Schedule	Items
08.00-09.00	<b>Registration</b>
09.00-9.30	<b>Welcoming remarks</b> The meeting will be formally opened by the representative of the Secretariat of the Convention on Migratory Species (CMS), Mr Douglas Hykle. Mr Hykle will invite the meeting to appoint co-Chairs, who will then also deliver opening statements.
09.30-09.40	<b>Adopting the draft provisional agenda</b> The meeting will be asked to review and, if satisfied, adopt the provisional agenda.
9.40-10.30	<b>Dugong biology, ecology, populations and behaviour</b> A technical expert, Prof. Helene Marsh will deliver a short 30-minute presentation on dugong biology, ecology, populations and behaviour. The remainder of the session will then be opened for general discussion. All delegates could consider sharing information on circumstances within their countries jurisdiction, including information on management actions or research underway. (CMS/DUGONG/INFO1)
10.30-11.00	<b>Morning tea</b>
11.00-12.30	<b>Threats to dugong</b> Prof. Helene Marsh will give a short presentation on threats to dugong in the Indian Ocean and South-East Asian region. Delegates will then be invited to discuss and develop a detailed list of threats to dugong populations in the Indian Ocean and South-East Asian region. (CMS/DUGONG/INFO1)
12.30-2.00	<b>Lunch</b>
2.00-3.30	<b>Key elements and possible framework for regional cooperation</b> The CMS representative will be invited to provide information on the CMS and information on conservation frameworks made under it – both legally binding agreements and Memorandums of Understanding (MoU). The presentation will include information on lessons learnt from the development and implementation of the Indian Ocean and South-East Asian Marine Turtle Memorandum of Understanding and a legally binding agreement. The CMS representative will provide advice on key elements to both legally binding agreements and MoU arrangements. The meeting will then discuss which framework appears to be the most appropriate, discuss the positives and negatives of both approaches and agree on a preliminary framework for development.
3.30-4.00	<b>Afternoon tea</b>

<b>4.00-5.00</b>	<b>Key elements and possible framework for regional cooperation - continued</b> The meeting will be invited to discuss and agree on a list of key elements for a regional dugong conservation MOU arrangement or legally binding agreement.
<b>5.00</b>	<b>Close of meeting for day 1</b>
	<b>Welcome Diner</b> Co-hosted by the Governments of Australia and Thailand at Rachavipha, 2nd Floor TarnTip Building, Chaophya Park Hotel. The start time for the dinner will be announced during Day 1.

Wednesday 24 August 2005

Schedule	Items
<b>09.00-10.30</b>	<b>Progressing regional dugong conservation</b> The meeting will be invited to develop draft text for a regional dugong conservation MOU arrangement or legally binding agreement to take back to capitals for consideration for making.
<b>10.30-11.00</b>	<b>Morning tea</b>
<b>11.00-12.30</b>	<b>Progressing regional dugong conservation - continued</b>
<b>12.30-2.00</b>	<b>Lunch</b>
<b>2.00-3.30</b>	<b>Progressing regional dugong conservation - continued</b>
<b>3.30-4.00</b>	<b>Afternoon tea</b>
<b>4.00-5.00</b>	<b>Progressing regional dugong conservation - continued</b>
<b>5.00</b>	<b>Close of meeting for day 2</b>

Thursday 25 August 2005

Schedule	Items
<b>9.00-10.00</b>	<b>Progressing regional dugong conservation - continued</b> The meeting will be invited to agree on draft text for a regional dugong conservation arrangement/agreement to take back to capitals for consideration for making
<b>10.00-10.30</b>	<b>Conservation and Management Actions</b> The meeting will be invited to list conservation and management actions to address threats to dugongs which may form part of a Conservation and Management Plan.
<b>10.30-11.00</b>	<b>Morning tea</b>
<b>11.00-12.30</b>	<b>Conservation and Management Actions - continue</b>
<b>12.30-2.00</b>	<b>Lunch</b>
<b>2.00-3:30</b>	<b>Preparation of meeting statement</b> The meeting will be invited to develop a short meeting statement.
<b>3:30-4:00</b>	<b>Afternoon tea</b>
<b>4:00-4:30</b>	<b>Preparation of meeting statement – continued</b> The meeting will be invited to finalise and adopt the meeting statement.
<b>4:30-5:00</b>	<b>Other business</b> – future meeting, venue and timing.
<b>5:00</b>	<b>Meeting close</b>

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**ANNEX 2. Participants of First Meeting on Dugong Conservation in the Indian  
Ocean and South-east Asia Region Chaophyapark Hotel, Thailand  
23-25 August 2005**

Number of Participants	Name	Country	Contact details
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## **ANNEX 4. SUMMARY WORKING GROUP – OUTCOME FROM SESSION #2**

24 August 2005

200-330 pm

Three Working Groups were formed to consider a number of key questions that emerged from the Meeting yesterday (23 August 2005). The last two questions were:

### **Question 1.**

#### **What's a Dugong?**

In the development of an MOU between countries on the conservation of dugong how can we:

- Raise the consciousness about how special dugong are;
- generate a greater commitment to action;
- assist countries where dugong are cryptic (not seen);
- lift the policy priority; and
- access funding and other resources?

### **Question 2.**

#### **Resources to support the implementation of the MOU?**

Consider the following approaches to obtaining resources to support implementation of a dugong MOU and identify those that could be a priority in the short term and those to be pursued in the longer-term.

- a) Prioritise conservation and management actions for funding
- b) Explore funding options with Governments and other donors such as the Asian Development Bank, World Bank, UNDP, European Union, UNEP, GEF
- c) Solicit funding and other contributions from industries that have impacts on dugong and their habitats
- d) Explore the use of economic instruments
- e) Approach the private sector, foundations and NGOs that may have an interest in funding activities
- f) Generate funding through self supporting schemes, eg ecotourism
- g) Seek synergies (with other regional global convention secretariats)
- h) Explore international funding support and other incentives for signatory states that effectively manage marine turtle populations.

In considering the questions each Group appointed a rapporteur who reported back to the Plenary on the considerations of the Group. A summary of the three presentations is provided below.

## **SUMMARY**

### **Question 1. What's a dugong?**

There was recognition amongst delegates at the meeting that in some countries, there was very little knowledge or recognition of dugong conservation issues within their jurisdictions. This could be for a variety of reason including very low numbers of dugongs inhabiting the waters within a particular jurisdiction. As such, delegates were asked to discuss what information about dugongs, the species' conservation status and/or significance would be useful to have disseminated to states that are within the range of the dugong.

Delegates were in agreement that:

- there was a need for a coordination point for dissemination of information, in culturally appropriate ways (e.g. translate into language) to describe key aspects of dugong biology and the cultural significance of dugongs where this was known;
- messages should be delivered relevant to the target audience (e.g. raising the profile of dugongs with government departments would necessitate a different message to one for a local coastal community);
- a variety of products (e.g. television documentaries, posters, books, stuffed toys) and local identities (e.g. idols, champions) would assist with spreading information about the need for dugong conservation; and
- linking to the next question, thinking laterally with respect to funding such information campaigns by seeking funding from arts-orientated organisations.

#### Question 2. Resources to support the implementation of the MOU?

The following list was endorsed as a basis upon which future resources could be accessed to support actions identified under an MOU for Dugong Conservation:

- a) Prioritise conservation and management actions for funding
- b) Explore funding options with Governments and other donors such as the Asian Development Bank, World Bank, UNDP, European Union, UNEP, GEF
- c) Solicit funding and other contributions from industries that have impacts on dugong and their habitats
- d) Explore the use of economic instruments
- e) Approach the private sector, foundations and NGOs that may have an interest in funding activities
- f) Generate funding through self supporting schemes, eg ecotourism
- g) Seek synergies (with other regional global convention secretariats)
- h) Explore international funding support and other incentives for signatory states that effectively manage marine turtle populations.

However, there was also a recognition that

- some of the above-mentioned sources may be better separated into short term and longer term basis of resources;
- resources could also mean technical expertise and other non-monetary forms of support mechanisms;
- links with other programs (e.g. fisheries, seagrass, marine turtles) need to be made as the results of such programs could also benefit dugongs; and
- examining alternative sources such as education and arts-related organisations and to broader ecosystem sources (e.g. coral reefs, mangroves).

This draft MoU is not an agreed endorsement by the First Meeting on Dugong Conservation in the Indian Ocean and South-east Asia. It presents a starting point for discussion at the second meeting.

## **Regional Dugong Conservation MoU**

## ***Example text for the background***

### **Background**

The Parties to this Memorandum of Understanding (MoU), in light of the following:

The international responsibilities to conserve, protect and manage dugong populations, across their range, pursuant to the Convention on Migratory Species of Wild Animals (CMS);

Coastal states, pursuant to the 1982 United National Convention on the Law of the Sea, have a sovereign right to explore and exploit, conserve and manage the natural resources within their Exclusive Economic Zones;

The Convention on Migratory Species 7<sup>th</sup> Conference of the Parties' recommendation that states in the range of dugongs cooperate among themselves, as appropriate, and participate actively to develop and conclude a memorandum of understanding and an action plan for the conservation and management of dugongs throughout the species' range;

Dugongs are listed on Appendix I of the Conservation on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which bans international trade.

Knowledge of the biology, ecology, and population dynamics of dugongs, and information on their cultural, social and economic values is deficient, and that cooperation will facilitate research and monitoring of dugongs in order to develop and implement relevant protection measures;

Some populations of dugongs and their habitats are seriously threatened from a range of human activities such as habitat degradation and destruction, fishing pressure, unsustainable levels of hunting and poaching in some areas, vessel strikes, ecotourism, pollution, and disease;

Many maritime activities in the dugongs' range, such as fishing and tourism, are socially and economically important and should be conducted in an ecologically sustainable and responsible manner;

In some states of the dugong's range, the subsistence harvest of dugongs is an important economic, spiritual, social and cultural activity;

The dugongs' range covers a vast area, which crosses territorial borders and encroaches on Exclusive Economic Zones;

Their desire to establish through this MoU co-operative measures for the protection and management of dugongs and their habitats throughout the region, including involving all the states in the region, as well as relevant inter-governmental, non-governmental and private sector organisations, in co-operative conservation and management of dugongs and their habitat;

The desirability of involving other states whose nationals or vessels conduct activities that may affect dugongs of the region, as well as states that may be in a position to contribute resources or expertise that may promote the implementation of this MoU;

Concerted and coordinated action must be taken immediately in order to meet the threats posed to dugong populations and their habitats;

Have reached the following understandings to pursue the actions set forth in this MoU, individually and collectively, to improve the conservation status of dugongs and their habitats.

### **Example text for Definitions and Interpretation**

#### **1. Definitions and Interpretation**

- a) "Dugongs" means the species *Dugong dugon*.
- b) "Habitat" means all those aquatic environments which dugongs use at any stage of their life cycles.
- c) "Region" means all the water in and coastal states of the Indian Ocean, East Asia and Pacific Ocean within the ecological range of the dugong.
- d) "Range" means all the areas of water that the dugong inhabits, stays in temporarily, or crosses at any time during its life cycle.
- e) "Conservation status of dugongs" means the sum of the influences acting on the dugong species that may affect its long-term distribution and abundance [Article I(b) of the CMS];
- f) Conservation status will be taken as favorable when:
  - i) population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its ecosystems;
  - ii) the range of the species is neither currently being reduced, nor is likely to be reduced, on a long-term basis;
  - iii) there is, and will be in the foreseeable future, sufficient habitat to maintain the population of the species on a long-term basis;
  - iv) the distribution and abundance of the species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management; and
  - v) levels of direct and indirect anthropogenic mortality on the species, from all causes, are low enough to allow dugong populations to recover.
- g) "Convention" means the Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 23 June 1979);

- h) "Secretariat" means, unless the context otherwise indicates, the Secretariat to this MoU;
- i) "Signatory State" means a state which has signed this MoU;
- j) This MoU will be considered as an agreement within the meaning of Article IV, paragraph 4, of the Convention.
- k) The annexes to this MoU are an integral part of it. Any reference to the MoU includes a reference to its annexes.

### **Example text for Objective**

#### **2. Objective**

The objective of this MoU is, based on the best available scientific evidence, to conserve, protect and manage, dugongs and their habitat, in order to regenerate dugong populations in the region, while taking into account the environmental, socio-economic and cultural characteristics of the Signatory States.

### **Example text for Actions**

#### **3. Desired Actions**

To achieve the objective of this MoU, in a spirit of mutual understanding and co-operation the Signatory States will, wherever possible:

- a) Co-operate closely in order to restore, or where appropriate maintain, a favourable conservation status for dugongs and the habitats on which they depend, including where appropriate, taking into account subsistence harvest of dugongs in those States where it is allowed;
- b) Implement, subject to availability of necessary resources, the provisions of the Conservation and Management Plan, which are annexed to this MoU. The Conservation and Management Plan addresses such things as: species conservation and protection, habitat protection and management, management of subsistence harvesting (in those States where it occurs), reduction of threats, research and education, information exchange and capacity building;
- c) As necessary, review, formulate, revise and harmonise national legislation relevant to the conservation of dugongs and their habitats, and make every effort to implement such legislation effectively;
- d) Consider ratifying or acceding to those international instruments most relevant to the conservation of dugongs and their habitat, in order to enhance the legal protection of the species in the region;

- e) Establish and fund a secretariat, which will assist communication, encourage reporting and facilitate activities between and among Signatory States, sub-regional institutions created pursuant to sub-paragraphs (e) and (f) of the Basic Principles (Title 4), and other interested states and organisations. The Secretariat will transmit to all of the Signatory States and to each of the sub-regional institutions, all of the national reports it receives, prepare a periodic review of progress in implementation of the Conservation and Management Plan annexed to this MoU, and perform such other functions as may be assigned by the Signatory States. The Secretariat will be based in the office of an appropriate national, regional or international organization, as decided by the consensus of the Signatory States at their first meeting, after consideration of all offers received;
- f) Establish an Advisory Committee to provide scientific, technical and legal advice to the Signatory States, individually and collectively, on the conservation, protection and management of dugongs and their habitats in the region. The Signatory States may nominate individuals for membership on the Committee who have expertise in the fields of dugong biology, dugong management, coastal development, socio-economics, law, fisheries technology, indigenous rights and other relevant disciplines. The size, composition and terms of appointment of the Advisory Committee will be determined by the Signatory States at their first Meeting.
- g) Designate a competent National Authority to serve as a focal point for communication among Signatory States and activities under this MoU, and communicate the complete contact details of this authority (and any changes thereto) to the Secretariat;
- h) Provide to the Secretariat a regular report on their implementation of this MoU, the periodicity of which will be determined at the first meeting of the Signatory States;
- i) Assess at their first meeting, the extent of the need for and possibilities of obtaining financial resources, including the establishment of a special fund for purposes such as:
  - i) meeting the expenses required for the operation of the Secretariat, [the Advisory Committee] and activities carried out under this MoU; and
  - ii) assisting the Signatory States to carry out their responsibilities under this MoU.

## **Example text for Basic Principles**

### **4. Basic Principles**

- a) Each Signatory State will aim to implement, within the limits of its jurisdiction, the MoU with respect to:
  - i) its land territory adjacent to the range;
  - ii) marine areas in the region under its national jurisdiction; and
  - iii) vessels operating in the region under its flag.

- b) Implementation of this MoU, including the Conservation and Management Plan, should be assessed at regular meetings of the Signatory States to be attended by representatives of each of the Signatory States and persons or organisations technically qualified in, or relevant to, the conservation of dugongs and their habitat. Such meetings will be convened by the Secretariat and hosted by, and organized in collaboration with, one of the Signatory States. Such meetings should be held annually, at least initially. The periodicity of these meetings may be reviewed and revised by consensus of the Signatory States at any of their regular meetings.
- c) This MoU, including the Conservation and Management Plan, may be amended by a consensus resolution signed on behalf of all the Signatory States.
- d) The Signatory States acknowledge that this MoU is not legally binding.
- e) Signatory States may establish, by mutual arrangement, bilateral, sub-regional or regional management plans that are consistent with this MoU.
- f) Actions under this MoU will be coordinated with Signatory States, as well as with sub-regional institutions in the region.
- g) The original text of this MoU, in the English language, will be deposited with the UNEP Convention Secretariat, which is the Depositary of the Convention ('the Depositary'). The text so deposited with the Depositary will be considered definitive.
- h) Nothing in this MoU will preclude Signatory States from implementing stronger national measures than those specified in the Conservation and Management plan annexed to this MoU, in accordance with rules of international law.

## **5. Resolution of disputes**

Disputes arising about the terms of this MoU will not be referred to international arbitration or adjudication. Without limiting the generality of the foregoing, none of the Signatory States will invoke Article XIII of the Convention to settle any dispute concerning the terms of this MoU. Instead, the Signatory States will endeavour to solve such disputes by amicable consultations and negotiation.

## **6. Open for Signature, Commencement and Termination**

- a) This MoU is open for signature by all states that exercise jurisdiction over any part of the dugong's range, or a state whose flag vessels, outside national jurisdictional limits but within the area of the MoU, are engaged in operations affecting dugongs.
- b) This MoU takes effect on the first day of the third month following the month in which it is signed by the Xth Signatory State. It remains open for signature

- indefinitely for subsequent states, and will come into effect for those states on the first day of the third month after the month in which they sign this MoU.
- c) Any party may withdraw from this MoU by giving one year's notice of its intention to withdraw to the Depositary and that withdrawal will take effect on the anniversary of the date that the Depositary receives that notice.

[SIGNATURE BLOCK]

Signed in X copies in the English language.

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**Australian Government**

**Department of the  
Environment and Heritage**



**Thai Government**

**Department of Marine  
and Coastal Resources**

**ANNEX 6. ANALYSIS OF ELEMENTS FROM IOSEA TURTLE MOU CONSERVATION  
MANAGEMENT PLAN POSSIBLY RELEVANT TO DUGONG CONSERVATION**

Programme	Activity
<b>Objective 1. Reduce direct and indirect causes of dugong mortality</b>	
1.1 Identify and document the threats to dugong populations and their habitats	<ul style="list-style-type: none"> <li>a) Regularly update existing data on threats to dugong populations and their habitats</li> <li>b) Establish baseline data collection and monitoring programmes to gather information on the nature and magnitude of threats</li> <li>c) Determine those populations affected by subsistence harvest, incidental capture in fisheries, and other sources of mortality</li> </ul>
1.2 Determine and apply best practice approaches to minimising those threats to dugong populations and their habitats	<ul style="list-style-type: none"> <li>a) Identify and document best practice protocols for conserving and managing dugong populations</li> <li>b) Adapt and adopt the best conservation and management practices for dugong populations</li> </ul>
1.3 Implement programmes to correct adverse social and economic incentives that threaten dugong populations	<ul style="list-style-type: none"> <li>a) Conduct socio-economic studies among communities that interact with dugongs and their habitats</li> <li>b) Identify desired modifications to the social and economic incentives in order to reduce threats and mortality, and develop programmes to implement the modifications</li> <li>c) Facilitate the development of alternative livelihoods to minimise resultant adverse social and economic impacts</li> <li>d) Identify resources and sources of funding for the programmes</li> </ul>
1.4 Reduce to the greatest extent practicable the incidental capture and mortality of dugongs in the course of fishing activities	<ul style="list-style-type: none"> <li>a) Develop and use gear, devices and techniques to minimise incidental capture of dugongs in artisanal and commercial fisheries, such as the use of alternative gears and spatial closures</li> <li>b) Develop procedures and training programmes to promote implementation of these measures</li> <li>c) Exchange information and, upon request, provide technical assistance to other signatory States to promote these activities</li> <li>d) Liaise and coordinate with fisheries industries, fisheries management organisations and community groups to develop and implement these activities</li> <li>e) Support the UN General Assembly resolution 46/215 concerning the moratorium on the use of large-scale driftnets on the high seas</li> <li>f) Develop and implement net retention and recycling schemes to minimise the disposal of fishing gear at sea and on beaches</li> <li>g) Provide and ensure the use of port facilities for the disposal of ship-borne waste</li> </ul>
1.5 Ensure that subsistence harvest is sustainable in areas where it is allowed	<ul style="list-style-type: none"> <li>a) Assess the level and impact of subsistence harvest on dugongs at ecologically relevant scales</li> <li>b) Reduce as much as possible all other human impacts on dugongs and their habitats in areas that sustain subsistence harvest</li> </ul>

Programme	Activity
	<ul style="list-style-type: none"> <li>c) Determine the cultural and subsistence values and uses of dugongs (both consumptive and non-consumptive)</li> <li>d) Establish culturally appropriate management programmes to ensure that subsistence harvest is sustainable taking account of the temporal and spatial variability of dugong reproductive rates and other impacts on the species in a precautionary manner</li> <li>e) Ensure that such programs do not have adverse unintended consequences e.g. increase harvest of other threatened species such as marine turtles</li> <li>f) Facilitate the development of alternative livelihoods in areas where the management of the subsistence harvest of dugongs has adverse cultural, social and economic impacts</li> <li>g) Negotiate, where appropriate, management agreements on the sustainable level of subsistence harvest, in consultation with other concerned States, to ensure that such harvest does not undermine conservation efforts</li> <li>h) Ensure that the management of other species (including fisheries) does not have adverse unintended consequences on the subsistence harvest of dugongs</li> </ul>
<p>1.6 Prohibit the direct harvest (capture or killing) of, and domestic trade in, dugongs, their parts or products, whilst allowing exceptions for subsistence harvest as outlined in 1.5</p>	<ul style="list-style-type: none"> <li>a) Enact, where not already in place, legislation to prohibit direct harvest and domestic trade other than subsistence harvest under 1.5</li> <li>b) Establish management programmes to enforce such legislation</li> <li>c) Negotiate, where appropriate, management agreements in consultation with other concerned States</li> </ul>
<b>Objective 2. Protect, conserve and rehabilitate dugong habitats</b>	
<p>2.1 Establish necessary measures to protect and conserve dugong habitats</p>	<ul style="list-style-type: none"> <li>a) Identify areas of critical habitat such as seagrass beds and migratory corridors, using rapid assessment techniques where appropriate</li> <li>b) Designate and manage protected/conservation areas, sanctuaries or temporary exclusion zones in areas of critical habitat, or take other measures (e.g. modification of fishing gear, banning destructive fishing practices, restrictions on vessel traffic) to remove threats to such areas, involving the local community as much as possible</li> <li>c) Consider protecting dugong habits as part of ecosystem based management e.g. networks of marine protected areas</li> <li>d) Develop incentives for adequate protection of areas of critical habitat outside protected areas</li> <li>e) Assess the environmental impact of marine and coastal development and other human activities on dugong populations and their habitats at a catchment scale</li> <li>f) Monitor and promote the protection of water quality from land-based and maritime pollution, including marine debris, that may adversely affect dugongs</li> <li>g) Strengthen the application of existing bans on the use of poisonous chemicals and explosives in the exploitation of marine resources</li> </ul>
<p>2.2 Rehabilitate degraded dugong habitats</p>	<ul style="list-style-type: none"> <li>a) Enhance recovery of degraded seagrass, mangrove and coral reef habitats used by dugongs</li> </ul>

<b>Objective 3. Improve understanding of dugong ecology and populations through research, monitoring and information exchange</b>	
3.1 Conduct studies on dugongs and their habitats targeted to their conservation and management	<ul style="list-style-type: none"> <li>a) Conduct baseline studies or gather secondary information on dugong populations and their habitats using cost effective techniques, including community-based monitoring</li> <li>b) Initiate and/or continue long-term monitoring of priority dugong populations at appropriate spatial scales in order to assess conservation status, using a combination of traditional, community-based and western science techniques where appropriate</li> <li>c) Characterise the genetic identity of dugong populations</li> <li>d) Identify migratory routes through the use of techniques such as genetic studies and/or satellite tracking</li> <li>e) Carry out studies on dugong population dynamics and survival rates</li> <li>f) Conduct research on the frequency and pathology of diseases of dugongs</li> <li>g) Promote the use of traditional ecological knowledge in research and management studies</li> <li>h) Involve local communities at all stages of the research and monitoring programs with training as required</li> <li>i) Review periodically and evaluate research and monitoring activities</li> </ul>
3.2 Conduct collaborative research and monitoring	<ul style="list-style-type: none"> <li>a) Identify and include priority research and monitoring needs in regional and sub-regional action plans</li> <li>b) Conduct collaborative studies and monitoring on genetic identity, conservation status, migrations, and other biological and ecological aspects of dugongs</li> </ul>
3.3 Analyse data to support mitigation of threats and to assess and improve conservation practices	<ul style="list-style-type: none"> <li>a) Prioritise populations for conservation actions</li> <li>b) Identify population trends using local information where appropriate</li> <li>c) Use research results to improve management, mitigate threats and assess the efficacy of conservation activities (e.g. habitat loss, etc.)</li> </ul>
3.4 Exchange information	<ul style="list-style-type: none"> <li>a) Standardise methods and levels of data collection and adopt or develop agreed protocols for <i>inter alia</i> monitoring of dugong populations and their habitats, genetic sampling, and collection of mortality data</li> <li>b) Determine the most appropriate methods for information dissemination e.g. internet and community fora</li> <li>c) Exchange at regular intervals scientific and technical information and expertise among nations, scientific institutions, non-governmental and international organisations, in order to develop and implement best practice approaches to conservation of dugongs and their habitats</li> <li>d) Disseminate traditional knowledge on dugongs, their habitats and traditional practices for conservation and management in a culturally appropriate manner</li> <li>e) Update on a regular basis data on dugong populations of regional interest e.g. country status reports</li> </ul>
<b>Objective 4. Increase public awareness of the threats to dugongs and their habitats, and enhance public participation in conservation activities</b>	
4.1 Establish public education, awareness and information programmes	<ul style="list-style-type: none"> <li>a) Collect, develop, co-ordinate and disseminate education materials e.g. dedicated regional web site</li> <li>b) Establish community learning / information centres</li> <li>c) Develop and implement accurate mass media information programmes</li> <li>d) Develop and conduct focused education and awareness programmes for target groups (e.g. policy makers, teachers, schools, fishing communities, subsistence hunters, media)</li> </ul>

	<ul style="list-style-type: none"> <li>e) Identify champions to help disseminate messages about the need to conserve dugongs and their habitats</li> <li>f) Encourage the incorporation of dugong biology and conservation issues into school curricula</li> <li>g) Organise special events related to dugong conservation and biology (e.g. Dugong Day, Year of the Dugong, symposia, community education workshops)</li> </ul>
4.2 Develop alternative livelihood opportunities for local communities to encourage their active participation in conservation efforts	<ul style="list-style-type: none"> <li>a) Identify and facilitate alternative livelihoods (including income generating activities) that are not detrimental to dugongs and their habitats, and are sustainable in nearshore regions, in consultation with local communities and other stakeholders</li> </ul>
4.3 Promote public participation	<ul style="list-style-type: none"> <li>a) Involve stakeholders, including key policymakers, subsistence hunters, and local communities in particular, in planning and implementation of conservation and management measures</li> <li>b) Encourage the participation of Government institutions, non-governmental organisations, the private sector and the general community (e.g. students, volunteers, fishing communities, local communities) in research, conservation and management efforts</li> <li>c) Implement, where appropriate, incentive schemes to encourage public participation (e.g. T-shirts, public acknowledgement, certificates)</li> </ul>
<b>Objective 5. Enhance national, regional and international cooperation</b>	
5.1 Collaborate with and assist signatory and non-signatory States to regulate and share information on trade, to combat illegal trade, and to cooperate in enforcement activities relating to dugong products	<ul style="list-style-type: none"> <li>a) Encourage signatory States that have not already done so to become Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)</li> <li>b) Review at a national level compliance with obligations under CITES relating to trade in dugong parts or products</li> <li>c) Facilitate better compliance with CITES through training of relevant authorities in cooperation with other signatory States, the CITES Secretariat and other relevant organisations</li> <li>d) Identify routes of international illegal trade through monitoring, and seek cooperation to take action to prevent, deter and, where possible, eliminate illegal trade</li> <li>e) Exchange and discuss information on compliance and trade issues at regular intervals, such as through annual reporting to the MoU Secretariat and at meetings of the signatory States</li> <li>f) Identify, prevent, deter and, where possible, eliminate domestic illegal trade through monitoring, implementation of legislation, identification of gaps in enforcement capabilities in each country, and training of enforcement officers</li> </ul>
5.2 Assist signatory and non-signatory States, upon request, to develop and implement national, sub-regional and regional action plans for the conservation and management of dugongs and their habitats	<ul style="list-style-type: none"> <li>a) Develop a set of key management measures that could be used as a basis for action plans, through consultation with concerned Government authorities, research institutions, NGOs, local communities and other stakeholders</li> <li>b) Identify existing action plans that could be used as models</li> <li>c) Identify specific local management issues where cooperation among States is required for successful conservation and management</li> <li>d) Review action plans at regular intervals to take into account recent advances in skills and knowledge regarding dugong conservation and management, as well as changes in conservation status of dugong populations</li> </ul>

<p>5.3 Enhance mechanisms for cooperation and promote information exchange</p>	<ul style="list-style-type: none"> <li>a) Identify and strengthen existing mechanisms for cooperation at the sub-regional level</li> <li>b) Develop a website and/or newsletter to facilitate networking and exchange of information</li> <li>c) Develop a web-based information resource for dugong conservation (including data on populations, nesting, migration, on-going projects)</li> <li>d) Regularly update a directory of experts and organisations concerned with dugong conservation</li> <li>e) Develop networks for cooperative management of shared populations, within or across sub-regions, and, where appropriate, formalise cooperative management arrangements</li> <li>f) Cooperate where possible in the establishment of transboundary marine protected areas using ecological rather than political boundaries</li> <li>g) Develop a streamlined format for reporting and exchanging information (through the MoU Secretariat and among signatory States) on the state of dugong conservation at the national level</li> <li>h) Encourage MoU signatory States that have not already done so to become Parties to the Convention on Migratory Species (CMS)</li> <li>i) Encourage signatory States to become Parties to global fisheries agreements such as the UN Fish Stocks Agreement (1995) and the FAO Compliance Agreement (1993) and implement the FAO Code of Conduct for Responsible Fisheries (1995)</li> <li>j) Establish relationships with regional fisheries bodies with a view to obtaining data on incidental capture and encourage them to adopt dugong conservation measures within EEZs and territorial waters</li> </ul>
<p>5.4 Build capacity to strengthen conservation measures</p>	<ul style="list-style-type: none"> <li>a) Identify needs for capacity-building in terms of human resources, knowledge and facilities</li> <li>b) Provide training (e.g. through workshops) in conservation and management techniques for dugongs and their habitats to relevant agencies, individuals and local communities</li> <li>c) Coordinate training programmes and workshops</li> <li>d) Develop partnerships with universities, research institutions, NGOs, training bodies and other relevant organizations</li> </ul>
<p>5.5 Strengthen and improve enforcement of conservation legislation</p>	<ul style="list-style-type: none"> <li>a) Encourage and guide the establishment of legislation to protect dugongs and their habitats.</li> <li>b) Review domestic policies and laws to address gaps or impediments to dugong conservation</li> <li>c) Cooperate in law enforcement to ensure compatible application of laws across and between jurisdictions (including through bilateral/multilateral agreements and intelligence sharing)</li> </ul>

<b>Objective 6. Promote implementation of the MoU including the Conservation and Management Plan</b>	
6.1 Broaden membership in the MoU, and ensure continuity of MoU activities	<ul style="list-style-type: none"> <li>a) Encourage non-signatory States to sign the MoU</li> <li>b) Arrange sub-regional workshops involving non-signatory States to raise awareness of the MoU</li> <li>c) Consider at the first meeting of the signatory States the development of a timetable for regular revision of the MoU</li> </ul>
6.2 Promote the role of the Secretariat and the Advisory Committee of the MoU in ensuring the objectives of the Conservation and Management Plan are met	<ul style="list-style-type: none"> <li>a) Secure reliable sources of funding to support the MoU Secretariat</li> <li>b) Appoint at the first meeting of the signatory States the members of the Advisory Committee</li> <li>c) Establish lines of communication between the MoU Secretariat and the Advisory Committee to facilitate advice to the signatory States</li> </ul>
6.3 Seek resources to support the implementation of the MoU	<ul style="list-style-type: none"> <li>a) Prioritise conservation and management activities for funding</li> <li>b) Explore funding options with Governments and other donors such as the Asian Development Bank, World Bank, UNDP, European Union, UNEP, GEF, etc.</li> <li>c) Solicit funding and other contributions from industries that have impacts on dugongs and their habitats (e.g. fisheries, tourism, oil industry, real estate)</li> <li>d) Explore the use of economic instruments for the conservation of dugongs and their habitats by integrating with instruments to conserve coral reefs, seagrass and other marine wildlife</li> <li>e) Approach the private sector, foundations and NGOs that may have an interest in funding activities in particular countries to catalyse the creation of a small grants fund</li> <li>f) Generate funding for conservation and management activities through managed ecotourism and other self-supporting schemes (while benefiting local communities)</li> <li>g) Seek synergies (with respect to fund-raising, provision of institutional support, etc.) with other regional/global convention secretariats</li> <li>h) Explore international funding support and other incentives for signatory States that effectively manage populations.</li> </ul>
6.4 Improve coordination among government and non-government sectors in the conservation of dugongs and their habitats	<ul style="list-style-type: none"> <li>a) Review the roles and responsibilities of government agencies related to the conservation and management of dugongs and their habitats</li> <li>b) Designate a lead agency responsible for coordinating national dugong conservation and management policy</li> <li>c) Encourage cooperation within and among government and non-government sectors, including through the development and/or strengthening of national networks</li> </ul>
6.5 Create links to the marine turtle MoU	<ul style="list-style-type: none"> <li>a) Seek synergies with other regional global convention secretariats (the MoU for marine turtles especially)</li> </ul> <p>Explore collaborative international funding support and other incentives for signatory states that also are involved with management of marine turtle populations.</p>

The Ecology and Conservation of the Dugong  
(*Dugong dugon*)

## 1.0 Introduction

The dugong (*Dugong dugon*), is a seagrass-dependant marine mammal of tropical and subtropical coastal waters, with high genetic biodiversity value. It is the sole member of the genus *Dugong*, which is the only extant member of the Family Dugongidae (UNEP, 2002; Bryden *et al.* 1998). The Dugongidae shares the Order Sirenia with just three species of manatee. Hence, the dugong's genes are more unique than those of most species, which, more typically, have genera and Family-level relatives. The dugong is also one of a suite of large, long-lived marine vertebrates, including turtles and inshore cetaceans, which are under pressure from human activities (Preen, 1998). Dugong conservation therefore represents the opportunity and responsibility, to contribute significantly to the conservation of ocean biodiversity.

Currently dugongs are classified as vulnerable to extinction under the 1996 World Conservation Union (IUCN) Red List of Threatened Species. This classification describes taxon that face a high-risk of extinction in the wild in the medium-term future. In the case of the dugong, it is deemed A1: Population reduction in the form of the following: an observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer [Bryden *et al.* 1998, IUCN].

The long-term survival of the dugong will depend on adequate conservation and management throughout its extensive range. For further information on regional arrangements see "The Conservation of the Dugong Across its Range – A Framework Paper". Protection, conservation and management must be based upon the best available scientific literature. The purpose of this paper is to take a step in that direction by providing a brief outline of dugong biology, and threats to its survival.

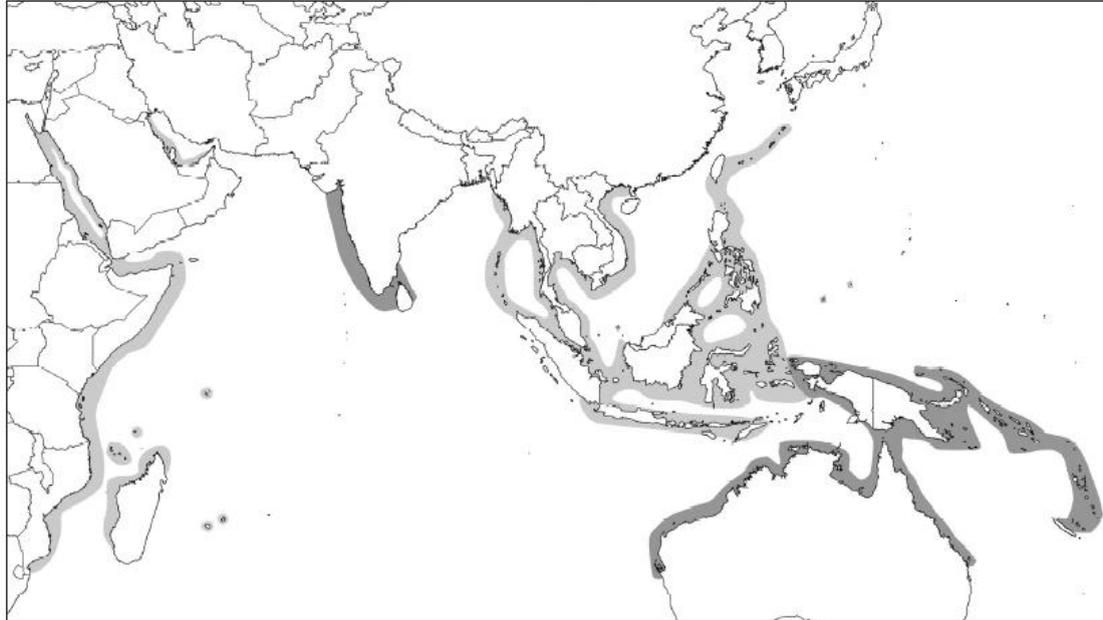
## 2.0 Biology of the Dugong

### 2.1 Distribution and Abundance

The dugong has a large range that spans at least 37 countries and territories and includes tropical and subtropical coastal and inland waters from east Africa to Vanuatu to Japan (Figure 1). The UNEP published the *Dugong Status Report and Action Plans for Countries and Territories* in 2002. It states that 'throughout much of its range, the dugong is represented by relict populations separated by large areas where its numbers have been greatly reduced or it is already extirpated. The dugong is still present at the historical limits of its global range, although there is evidence of a reduction in its area of occupancy within its range. In most parts of its range, the anecdotal evidence suggests that dugong numbers are declining'.

Dugongs have already disappeared from some places including Mauritius, western Sri Lanka, the Maldives, Japan's Sakishima Chains, Hong Kong's Pearl River Estuary, several islands in the Phillipines, Cambodia, and Vietnam (CRC, 2003). Remaining major populations have been reported in Australia, Persian Gulf, and parts of the Red

Sea, northern and eastern coast of east Africa, west coast of Sri Lanka, Indonesia and, the Pacific islands (Agrolink, 1996).



**Figure One: The known range of the Dugong (Source: UNEP, 2002)**

## 2.2 Habitat

Dugongs generally frequent coastal waters. Major concentrations tend to occur in wide shallow protected bays; wide shallow mangrove channels and on the lee of large inshore islands (Heinsohn *et al.* 1979). These areas are coincident with sizeable seagrass beds. However dugongs are also observed in deeper waters further offshore where the continental shelf is wide, shallow and protected. This distribution corresponds with that of deepwater seagrasses such as *Halophila spinulosa* (UNEP, 2002). There is evidence that dugongs use specialised habitats for various activities such as calving and mating (Anderson, 1981; Anderson, 1997). Life history attributes of dugongs are likely to vary across its range of habitat types.

## 2.3 Diet

Dugongs are seagrass specialists, uprooting whole plants when they are accessible, but feeding only on leaves when the whole plant cannot be uprooted. Dugongs prefer seagrasses that are pioneer species (Preen & Marsh, 1995), especially species of the genera *Halophila* and *Halodule*. Diet selection is correlated with the chemical and structural composition seagrass (Lanyon, 1991). Selection for the species that are highly digestible (*Halophila*) and have high nutrients (*Halodule*) means that dugongs maximize the intake of nutrients rather than bulk (Aragones, 1996).

The highly specialized dietary requirements of the dugong suggest that only certain seagrass meadows may be suitable as dugong habitat (Preen *et al.* 1995). It has been

suggested that grazing activity by dugongs alters the species composition of seagrass communities at a local scale to favour their dietary requirements. Thus, areas that support sizeable numbers of dugongs may have the capacity to provide better 'quality' food than areas that support few or no dugongs and rely only on natural turnover rates for recycling and redistribution of nutrients (Aragones & Marsh 2000).

#### 2.4 Life History

Dugongs are long-lived with a low reproductive rate, long generation time, and a high investment in each offspring (Marsh, 1999). Females do not bear their first calf until they are at least ten and as late as 17 years old. Gestation varies between 13-15 months, with a usual litter size of one. The calf will suckle for 14-18 months, and the period between successive calvings is spatially and temporally variable; estimates range from 2.4 to seven years (UNEP, 2002). Calving intervals may lengthen as a result of food shortages. The dugong's low reproductive rate means that a very high proportion (more than 95%) of adult animals have to survive each year for a dugong population to be maintained (Bryden et al. 1998). Population simulations indicate that even with the most optimistic combinations of life-history parameters (e.g. low natural mortality and no human-induced mortality) a dugong population is unlikely to increase more than 5% per year (Marsh, 1999). Thus the dugong's life history makes it particularly vulnerable to rapidly increasing human pressures.

#### 2.5 Movements

Dugong movement has been tracked spatially and temporally using VHF or satellite transmitters. Dugongs have exhibited individualistic patterns of movement within the same region, daily movements depending on tidal amplitude, and seasonal movements (UNEP, 2002). The capacity of dugongs to undertake long-distance movements indicates that the management of dugongs is an international issue over most parts their range.

### **3.0 Threatening Processes**

Dugongs are vulnerable to anthropogenic influences due to their life history and their dependence on seagrasses that are restricted to coastal habitats, and which are often under increased pressure from human activities. The rate of population change is most sensitive to changes in adult survivorship. Even a slight reduction in adult survivorship as a result of habitat loss, disease, hunting, or incidental drowning in nets, can cause a chronic decline in a dugong population. Given the extensive distribution of the dugong there are a range of threats, some of which are unique to particular regions and some which span its entire range. Nevertheless by dividing the species range into subregions, it is possible to gain an understanding of region-specific threats (Table One).

Subregion	Threatening Process						
	Habitat Loss and degradation	Fishing Pressure	Indigenous Hunting and Use	Vessel Strikes	Acoustic Pollution	Ecotourism	Diseases
Western Range (East Africa, Red Sea and the Arabian Gulf)	✓	✓	✓	✓		✓	✓
India & Sri Lanka (India with the Andaman and Nicobar Islands, Sri Lanka)	✓	✓	✓				✓
East & Southeast Asia (Japan, China, Philippines, Thailand, Cambodia, Vietnam, Malaysia, Singapore, Indonesia)	✓	✓	✓	✓		✓	✓
Pacific Islands (Palau, Papua New Guinea, Solomon Islands, New Caledonia, Vanuatu)	✓	✓	✓	✓		✓	✓
Australia (Western Australia, Northern Territory and the Queensland Coast of the Gulf of Carpentaria, Torres Strait and Northern Great Barrier Reef, Urban Coast of Queensland)	✓	✓	✓	✓	✓	✓	✓

**Table One: Summary of information regarding current threats to dugongs (Source: Modified from UNEP, 2002)**

### 3.1 Habitat Loss and Degradation

Seagrass ecosystems are very sensitive to human influence (Poiner & Peterken, 1996). Seagrass beds may be destroyed directly by trawling and mining, or lost through the effects of disturbances such as dredging, inland and coastal clearing, land reclamation and boat propeller scarring. These activities cause increases in sedimentation and turbidity which, in turn, lead to degradation through smothering and lack of light. Other threats include sewage, detergents, heavy metals, hypersaline water from desalination plants and other waste products.

Episodic losses of hundreds of square kilometers seagrass are associated with extreme weather events such as some cyclones, hurricanes and floods (Poiner & Peterken, 1996). Such events can cause extensive damage to seagrass communities through severe wave action, shifting sand, adverse changes in salinity and light reduction (Preen & Marsh, 1995; Preen *et al.* 1995). For example an unusual flood and cyclone event resulted in the near total loss of 1000 sq km of seagrass meadows in Hervey Bay, in eastern Australia. Many dugongs starved and eventually died, although some dugongs emigrated as far as 900km (Preen & Marsh, 1995).

Most losses, both natural and anthropogenic are attributed to reduced light intensity due to sedimentation and/or increased epiphytic growth caused by nutrient enrichment. *Halophila ovalis*, one of the preferred food species of dugongs, appears to be particularly sensitive to light reduction, with the duration and frequency of light deprivation events apparently being the primary factors affecting the survival of this seagrass in environments that experience transient light deprivation.

Global warming is an indirect threat to the dugong. The United Nation's Intergovernmental Panel on Climate Change (IPCC) has speculated that climate change due to increasing amounts of anthropogenic "greenhouse" gases may result in increased tropical sea surface temperatures (SSTs) and increased tropical rainfall associated with a slightly stronger intertropical convergence zone (ITCZ) (Houghton *et al.*, 1990, 1992, 1996). Because tropical cyclones extract latent and sensible heat from the warm tropical oceans and release the heat in its upper tropospheric outflow to fuel the storm's spin up, early work of the IPCC expressed concern that warmer SSTs will lead to more frequent and intense hurricanes, typhoons and tropical cyclones.

Thus global warming has the potential to interfere with the feeding patterns, as well as altering seasonal distributions, geographic ranges, migration patterns, nutritional status, reproduction success, and ultimately the abundance of the dugong.

### 3.2 Fishing Pressure and Shark nets

Accidental entangling in gill and mesh nets or traps set by fishers is considered a major, but largely unquantified, cause of dugong mortality in many countries, and is identified as a major concern in all subregions (UNEP, 2002) (Table One). Throughout most of the dugong's range, this pressure comes from locally based artisanal fisheries. Of more

concern, are the industrial scale gill net fisheries which have developed in some areas. However these fisheries usually operate in offshore waters, which are not major dugong habitats. No data is available on the take of dugongs by lost or discarded nets, although drowning in these nets presumably occurs (UNEP, 2002).

Shark nets set for public safety can be another source of dugong mortality. Between 1962 and 1995, shark nets set on swimming beaches in Queensland netted 837 dugongs (UNEP, 2002).

### 3.3 Traditional Use and Harvest

Within traditional communities great emphasis is placed on social sharing of dugong meat. In Australia for example, utilizing marine food resources demonstrates a continued connection with tradition and sea country, and dugong hunting in particular can be seen as an important expression of a person's Aboriginality (Smith and Marsh, 1990). Dugong is also an important source of protein for many communities and dugong oil is used as a panacea for a variety of illnesses (Smith and Marsh, 1990). The status of dugong meat in traditional culture is reflected in seasonal trends in take, with highest catch rates reported during the period around Christmas (Marsh, 1996).

### 3.4 Vessel Strikes

Whilst there is a dearth of information on this issue, vessel strikes are a potential source of mortality for dugongs. Increasing vessel traffic in the dugong's range increases the likelihood of strikes. Areas where there are extensive shallow areas used by regionally important populations of dugongs close to areas of high boat traffic are particularly at risk.

### 3.5 Ecotourism

The expansion of ecotourism has resulted in the establishment of tourism operation involving dugong-watching cruises at several locations in Australia, and swim with dugong operations in the Phillipines and Vanuatu. The effect of these activities on the animals is unknown, although it is under investigation in Western Australia (UNEP, 2002).

### 3.6 Acoustic Pollution

Despite consistent anecdotal reports of dugongs ceasing to use areas with high boat traffic, there has been no formal attempt to study the effect of acoustic pollution from boat traffic on the dugong. Acoustic pollution could be a potential impact in areas with large tidal ranges and little seagrass below the low tide mark. High levels of vessel traffic in these areas could prevent dugongs from using available intertidal seagrass meadows, by restricting their movement.

Seismic surveys are an essential component of offshore oil and gas exploration and are used to study rock strata below the seafloor. Marine seismic surveys use high-energy, low-frequency sound produced by arrays of air-guns which are designed to project very strong sounds downward through the water. A considerable amount propagates horizontally as well. Effects might include: interference with the animal's natural acoustic communication signals; damage to their hearing systems; behavioural changes including disturbance reactions, ranging from short-term to long-term effects on individuals and populations.

## **4.0 Conservation Initiatives**

Managing adverse impacts on dugongs throughout its vast and often remote range presents a challenge, which will require a pro-active and comprehensive approach. Ultimately conservation initiatives would seek to conserve dugong across both their historic and current range. Such a systematic and co-coordinated approach will benefit not only dugong populations but also the ecological integrity of the marine environment.

### 4.1 Habitat Protection

Measures for seagrass protection to date, have largely been through marine parks and fishing industry closures to prevent structural damage to seagrass beds through trawling. There have been few attempts to protect seagrass beds from adverse impacts on ecosystem processes associated with landuse, even though it is an issue of concern for all subregions (Table One). Localities that provide shelter and water conditions ideal for seagrasses are often the target for port developments and at the down-stream end of severely affected catchments. Research is required to gain an understanding of seagrass responses to natural and human factors and what the critical thresholds of change are.

### 4.2 Fishing Controls

Acoustic alarms (pingers) are proving effective at reducing the mortality of the harbour porpoise, *Phocoena phocoena*, in gill nets (UNEP, 2002). These alarms are increasingly being seen as a possible solution to the problem of marine animals drowning in nets in developed countries, although the associated costs are likely to preclude their use throughout most of the dugong's range. The effectiveness of the use of acoustic alarms in reducing the mortality of dugongs has not been tested. Given the dugong's specialized habitat requirements, it is important to test whether their use reduces the habitat available to dugongs before they are widely adopted (UNEP, 2002).

### 4.3 Traditional Use

The majority of coastal communities are aware of concerns in regards to dugong management, and many are exploring options for cooperative management. Measures which have been demonstrated to be effective include culturally appropriate education programmes (including posters and videos) for indigenous communities regarding dugong conservation, presenting research results to indigenous communities, and a

programme to collate indigenous knowledge of dugongs. Community-based management of dugong take is also being investigated.

#### 4.4 Boating Best Practice

The answer to reducing the number of vessel strikes lies in speed restrictions and community education. Voluntary speed restrictions and higher speed transit lanes might be options to be considered in the preparation of management plans. Education initiatives might include a series of signs placed at boat ramps to alert boaters to the risks of collisions with dugongs, and community service announcements or newsletters asking boat users to reduce speeds in shallow waters.

#### 4.5 Education

For management to be effective the general public must have an awareness and concern for dugong conservation, and therefore public education will be an important component of any conservation plan. Dugong education strategies should aim to enhance public awareness of the value and plight of dugongs, and outline how people can assist. Strategies could include: information kits; media releases; community service announcements; reef user workshops and liaison with advisory committees and stakeholders. Education and information about dugong status and conservation could be included in school curricular and in local media releases to generate community support. Such strategies will coordinate many of the actions aimed at particular interest groups such as boaters, fishers, and indigenous communities. Other initiatives which may raise awareness of dugongs, their threats and possible solutions may include a dedicated 'Dugong Awareness Day' and information displays at regional fora.

#### 4.5 Research and Monitoring

The threatening processes described above are widely distributed throughout the dugong's range due to high levels of human population growth and rapid rates of industrialization. Given the potential for multiple impacts research would be best targeted at determining a) which areas still support significant areas of dugongs; and b) identifying with extensive local involvement how impacts on dugongs can be minimized and the habitat protected in these key areas. Ideally this should be done in the context of comprehensive plans for coastal zone management (UNEP, 2002). The establishment of such areas as dugong protected areas should reduce dugong mortality provided the areas chosen consistently support high numbers of animals (see 4.1), even though individual dugongs will move in and out of these areas. The long-term effectiveness of these areas will depend on whether the high-quality habitat can be maintained. This will depend on the capacity to control land-based inputs. Candidate areas exist through much of the dugong's range (UNEP, 2002).

#### 4.6 Legislation

Conservation and management of dugong populations through domestic policy may be afforded through initiatives such as: formally declaring dugong protection areas, regulation and enforcement of activities within these areas; prohibition of direct take (except for traditional purposes); and the implementation of a rigorous and effective EIA process in areas of significance.

#### 4.7 Regional Arrangements

Recognition of the need for a cooperative international approach to the problems of threats to marine mammals is growing and there have been numerous international forums, agreements and conventions that have contributed to the conservation of marine mammals. Dugongs have a priority for conservation through their listing in the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The dugong was identified as an Appendix II species for cooperative action (COP & Rec 7.1). In addition, the CMS 7th Meeting of the Conference of the Parties recommended that all Range States of dugongs cooperate among themselves and participate actively to develop and conclude a memorandum of understanding and an action plan for the conservation and management of dugong throughout the species' range (Rec 7.5). The CMS and a range state arrangement for dugongs presents an opportunity for States to develop and implement conservation actions to restore the dugong to a favourable conservation status.

#### 6.0 Conclusion

It is clear that dugongs are vulnerable to anthropogenic influences due to their life history, extensive range, and distribution along rapidly developing coastal habitats. Given the dugong's capacity to move across jurisdictional boundaries, coordinating management initiatives across these boundaries will be crucial to its long-term survival. Without cooperative decision-making and action the future of the dugong looks uncertain.

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