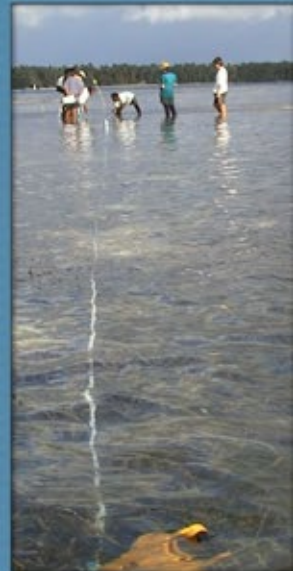




Bay of Bengal Large Marine Ecosystem Project



First bi-lateral consultation meeting on
Gulf of Mannar ecosystem
05-06 September 2011 • Rameshwaram India

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Report of the

**Bi-National Stakeholder Consultation
on Sustaining the Gulf of Mannar
Ecosystem and its Resources**

*5-6 September 2011,
Rameshwaram, India*

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Abbreviations

BOB	Bay of Bengal
BOBLME	Bay of Bengal Large Marine Ecosystem
BOBP-IGO	Bay of Bengal Programme Inter-Governmental Organisation
CBO	Community-based Organisations
CMFRI	Central Marine Fisheries Research Institute (India)
CORDIO	Coastal Oceans Research and Development in the Indian Ocean
CSMCRI	Central Salt & Marine Chemicals Research Institute, India
DAHD&F	Department of Animal Husbandry, dairying and Fisheries, Ministry of Agriculture, Government of India
DMCS	Department of Marine and Coastal Studies, Madurai Kamaraj University, India
DOF	Department of Fisheries
DSDs	Divisional Secretariat Divisions
EAF	Ecosystem Approach to Fisheries
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FAO RAP	FAO Regional Office for Asia and Pacific
GCRMN	Global Coral Reef Monitoring Network
GEF	Global Environment Facility
GIS	Geographic Information System
GoM	Gulf of Mannar
GOMNP	Gulf of Mannar National Park, India
GOMBRT	Gulf of Mannar Biosphere Reserve Trust, India
ICSF	International Collective in Support of Fishworkers
IUCN	International Union for Conservation of Nature
IW	International Waters
LME	Large Marine Ecosystem
MFARD	Ministry of Fisheries and Aquatic Resources Development, Government of Sri Lanka
M/DoEF	Ministry/Department of Environment and Forests, Government of India
MFF	Mangroves For the Future
MPA	Marine Protected Area
NARA	National Aquatic Resources Research and Development Agency, Sri Lanka
NGO	Non-Governmental Organisations
PSC	Project Steering Committee
RCU	Regional Coordinating Unit of the BOBLME Project
SACEP	South Asia Co-operative Environment Programme
SAP	Strategic Action Programme of BOBLME Project
spp.	Species (plural)
SSF	Small-Scale Fisheries
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
ZSI	Zoological Survey of India

Executive Summary

A Bi-National Stakeholder Consultation on Sustaining the Gulf of Mannar (GoM) Ecosystem and its Resources was organised from 5-6 September 2011 in Rameshwaram, India involving stakeholders from India and Sri Lanka. The Consultation was jointly organized by the Bay of Bengal Large Marine Ecosystem (BOBLME) Project and the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO). 54 participants representing governmental agencies; research institutes and universities; fishermen associations of both the countries and concerned international organizations including the Organizers took part. The aim of the Consultation was to bring the stakeholders together and initiate a process of dialogue which is expected to culminate in an ecosystem-based management framework for the GoM – a critical habitat. The objectives were to evaluate policy, science and information regarding the GoM and raising its profile in regional discourse.

The Consultation was carried out in four sessions. Three status papers on state of resources and livelihoods in GoM and one paper on ecosystem approach to fisheries were presented. The status papers described a myriad of problems in the GoM including the health of the resource and the scope of livelihoods. Based on the status papers, four task groups were constituted with specific mandate to: (i) review the existing management measures in the GoM and lessons learned from the past initiatives while identifying the concerned stakeholders and the role they are playing in the GoM ecosystem; (ii) identification of gaps in available information (biological and socio-economic) on the GoM ecosystem to delineate the status of the ecosystem and measures needed to address them; (iii) understanding trans-boundary importance and issues of the GoM ecosystem and modalities to approach them; and (iv) strengthening bi-national cooperation in managing the GoM ecosystem and moving towards an Ecosystem Approach to Fisheries (EAF).

Based on the recommendations made by the Groups, five priority initiatives were agreed for implementation with the support of the BOBLME Project: (i) Collaborative effort in conservation and management of charismatic species (*e.g.* Dugong, etc); (ii) Capacity building and training (*e.g.* stock assessment, water quality monitoring and use of GIS and remote sensing); (iii) Education and awareness building; (iv) Strengthening of data collection and processing mechanism; and (v) Sharing of information and networking. It was also agreed that the initial support of the BOBLME Project to implement the above activities will be in the form of capacity building. At the next Consultation, which was agreed to be held in Sri Lanka, these initiatives will be developed into projects and programmes. Once developed, these projects and programmes will be finalized at the final Consultation due in 2012. It was also agreed that these projects will be implemented under the aegis of the BOBLME Project and its partner organizations such as BOBP-IGO and Mangroves for the Future. At the next Consultation institutional arrangements for bilateral cooperation between India and Sri Lanka will also be developed. These will be finalized at the final Consultation.



Participants visiting the Information Centre of the Department of Forests in Krusudai Island

Report

A. Background

1.0 The Gulf of Mannar (GoM) is an ecologically important critical habitat shared by India and Sri Lanka. Within the framework of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project, the Governments of India and Sri Lanka have the scope to work together to establish a collaborative arrangement for management of the GoM ecosystem. Such collaborative arrangements can ensure that decisions are made on the use of the GoM resources with due consideration to both ecological and human well-being and do not compromise on the needs of future generations. Towards this, the Bi-National Stakeholder Consultation on Sustaining the Gulf of Mannar Ecosystem and its Resources was held in Rameshwaram, India from 5-6 September 2011. The Consultation was organized by the BOBLME Project and the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO).

2.0 The objectives of the Consultation were to re-evaluate the importance of GoM for India and Sri Lanka and the present state of the ecosystem; to review the existing management measures and lessons learnt; to learn about the Ecosystem Approach to Fisheries (EAF) as a management paradigm for GoM; to identify the key stakeholders and their role in GoM; and to reach an understanding on the need of bi-national cooperation in management of GoM and continuation of in-country and inter-country activities toward this. The Prospectus of the Consultation is placed as [Annexure 1](#). The Agenda for the Consultation is placed as [Annexure 2](#). 54 participants representing various Ministries/Departments of the Government of India and Sri Lanka, International organizations, NGOs and research organizations took part in the Consultation. The List of participants is placed as [Annexure 3](#) of this report.

B. Opening session (Session I)

3.0 The Bi-National Consultation was inaugurated by lighting the traditional oil lamp. Dr Y S Yadava, Director, BOBP-IGO extended a hearty welcome to the participants and thanked them for travelling to Rameshwaram to attend the Consultation within a short notice. He said that in spite of problems in connectivity, the Consultation was organized in Rameshwaram due to its proximity to GoM as the participants could visit the Indian side of the GoM during their stay in Rameshwaram. Dr Yadava said that the Consultation was the first of its kind in respect of the GoM and the long-term objective is to ensure sustainability of the GoM - a vital ecosystem in the Bay of Bengal region.

4.0 Dr Rudolf Hermes, Chief Technical Adviser, BOBLME Project, in his introductory remarks welcomed the participants and said that due to its importance, GoM was included in the project planning phase of the BOBLME Project. Informing about a similar programme undertaken in Mergui Archipelago shared by Myanmar and Thailand, Dr Hermes said that the GoM Consultation could learn from the BOBLME Project's experience in the Mergui Archipelago. He said that if an action plan could be arrived under the present Consultation process, the same could be supported by the BOBLME Project under its various project components. He thanked the BOBP-IGO for cooperating with BOBLME Project in organizing the Consultation.

5.0 Mr Indra Ranasinghe, Director General (Development), Ministry of Fisheries and Aquatic Resources Development (MFARD), Government of Sri Lanka in his welcome remarks said that GoM is a vital ecosystem, and the coastal population of Puttalam, Mannar and Kilinochchi Districts of Sri Lanka are dependent on it for their sustenance. While the Government of Sri Lanka could not pay much attention on management of the GoM resources for the last thirty years owing to conflicts in the area, it is now giving attention for sustainable management of the GoM. He said that the changing climate could also affect the GoM ecosystem and should be considered in the development plan.

Mr Ranasinghe welcomed the Consultation for its importance and timeliness and said that the two countries could together bring a positive change.

6.0 Mr B Vishnu Bhat, Fisheries Development Commissioner, Department of Animal Husbandry, Dairying and Fisheries (DAHD&F), Ministry of Agriculture, Government of India in his welcome remarks said that GoM is an important habitat and keeping in view its rich biodiversity, there is a need to ensure that fisheries resources of the GoM are conserved. He said that since the GoM is shared by India and Sri Lanka, this makes a fit case for collaborative management of the resources. Mr Bhat said that there is a need to promote continuous dialogue between the fishers of India and Sri Lanka and both the Governments and also referred to the proposed Memorandum of Understanding between the two countries.

7.0 Dr J R Bhatt, Director, Ministry of Environment and Forests, India and chair of the Consultation, in his opening remark welcomed the participants and said that such a large presence shows that there is overwhelming support from both India and Sri Lanka for



sustaining the GoM ecosystem and its resources. He said that the Consultation provides

Lighting of the traditional lamp

a platform for learning and sharing experience and knowledge and also promotes bilateral ties between the two countries. Urging the participants to be forthcoming with their views, he said that everybody should feel free to share their experiences, knowledge and views. Dr Bhatt said that year 2011 has been declared by the United Nations as **International Year of Forests** and the Consultation is a good opportunity to work for a common good between the two countries. "The BOBLME Project, the BOBP-IGO and Mangroves for the Future (MFF) should collaborate to support sustainable development of the GoM. Let us keep this dialogue alive. If resources are depleting, let us use science to augment the resources and rejuvenate them", said Dr Bhatt.

C. Technical Session (Session II)

8.0 The Technical Session comprised five presentations. In the first presentation, Dr Rudolf Hermes outlined the structure and activities of the BOBLME Project and also elaborated on the objectives of the Consultation. He said that the Governments of India

and Sri Lanka have agreed that the GoM is an important critical habitat and through the BOBLME Project they have the scope to work together to establish a collaborative management arrangement for GoM. This will promote, advocate and ensure that decisions on the use of the GoM are made after due consideration of both ecological well-being and human well-being, and do not compromise the needs of future generations. The presentation made by Dr Hermes is given as [Annexure 4](#).

9.0 Dr G Gopakumar, Principal Scientist, Central Marine Fisheries Research Institute (CMFRI- Mandapam Regional Centre) presented a status paper on the Gulf of Mannar Ecosystem of India. He said that the GoM is a unique ecosystem characterized by its rich biodiversity including the corals. The GoM covers a total area of 10 500 km² located between 8° 35' N to 9°25' N latitude and 78° 8' E to 79° 30' E longitude on the southeast coast of India. The total spread of the GoM is about 15 000 km² in which commercial fishing is carried out in about 5 500 km² up to a depth range of 50 to 200m.

Dr Gopakumar said that the GoM is considered as 'biologists' paradise' because of its rich biodiversity encompassing about 3 600 species of flora and fauna. It is home to an endemic organism called balanoglossus (*Ptychodera flava* Eschscholtz 1825), an acorn worm of the class enteropneusta and a unique living fossil that links vertebrates and invertebrates. The diverse nature of the ecosystem in the GoM supports a wide variety of species, including 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes and 147 species of seaweeds, apart from the seasonally migrating marine mammals like whales, dolphins, porpoises and turtles.

"The GoM alone produces about 20 percent of the marine fish catch in Tamil Nadu. Of the 2 200 fish species distributed in Indian waters, 450 species have so far been recorded in this area. The fishery is multi-species as well as multi-gear and diverse fishing practices are found in this region", said Dr Gopakumar.

On the quality of information on GoM, Dr Gopakumar said that a reservoir of information is available on the ecosystem. However, the research work carried out by various agencies is purely based on their own mandates and there is a need for a coordinated effort by various agencies to undertake collaborative research programmes in a holistic manner for better understanding of the ecosystem and its resources. Dr Gopakumar identified the following areas for collaborative research:

- Database of corals and associated resources on a GIS platform;
- Standardized techniques for coral propagation in order to carry out restoration of corals in depleted reef areas;
- Monitoring the status of coral reefs and reef-associated fauna on a long-term basis;
- Intensive and long-term research programmes to ascertain the invasiveness of *Kappaphycus alvarezii* in the GoM;
- Urgent need to understand the present status of marine mammals (sea cow, *Dugong dugon*) for their conservation, and an inventory to be evolved by undertaking regular observations on their sightings;
- Identification of viable alternate livelihood options (e.g. mariculture), which can be taken up by the fishing communities.
- Study on valuation of biodiversity of the GoM ecosystem; and
- DNA bar-coding of the GoM resources, especially of the endangered groups and development of a database.

On the efficacy of the existing management measures, Dr Gopakumar said that there is lack of coordination between different agencies. Such complexities arise out of the dual control of the resources by the Department of Environment and Forests and the Department of Fisheries. Since proper co-ordination and interaction between the agencies is lacking, harmful and destructive fishing practices are carried out, which destroys biodiversity. The current management measures have not given any serious concern to the livelihood options. It is well known that for sound management of the

resources a strong participatory approach is required and this aspect is somewhat lacking in the current management programmes on the GoM.

Dr Gopakumar suggested that many agencies are involved in the collection and collation of research data, evolving conservation measures and implementing management policies. It is necessary to constitute a Research Advisory Committee (RAC) for the entire GoM ecosystem. The RAC should be empowered for screening of research projects and approving them for implementation. Even though the Department of Environment and Forests is vested with the implementation of management measures, the Department has limitations because the requirements of managing the marine resources are different from their core specialization. Hence, for effective management of the GoM ecosystem, it is proposed to involve scientists from Government agencies, which is likely to result in better management of the GoM ecosystem. [Annexure 5](#) contains Dr Gopakumar's presentation.

10.0 Dr Shamen Vidanage of the IUCN Country Office in Sri Lanka presented the status paper on the GoM ecosystem of Sri Lanka. He said that there are four coastal administrative areas (Divisional Secretariat Divisions or DSDs) of Mannar district bordering the GoM, namely Musali, Nanaddan, Mannar and Mantai West and two coastal DSDs of Puttalam district, namely Kalpitiya and Vanatavillu. The terrestrial habitats within those six DSDs are also included in the GoM ecosystem. The marine and coastal ecosystems represent the entire range of such ecosystems in Sri Lanka, including coral reefs, seagrass beds, mangroves, salt marshes, tidal mud flats, sand dunes, sandy coastal islets, pearl beds, lagoons and estuaries. The area harbours the largest tract of seagrass beds, as well as the largest tract of intact mangroves (Kala-oya estuary) in Sri Lanka. The GoM contains the single largest coral reef ecosystems in Sri Lanka – Bar Reef Marine Sanctuary, which consist of true coral reefs and sandstone reef habitats.

Dr Vidanage said that 'fishery is the backbone' of the people living around the GoM. As of August 2010, 28 852 people in the Mannar district, belonging to 7 813 families are dependent on marine fishery sector. Of these 7 547 are listed as active fishers. A large number of fishermen from the adjacent Puttalam district too are engaged in fishing within the GoM. The total catch of finfishes, crustaceans, echinoderms and chanks in Mannar district for 2008 and 2009 was 5 735 metric tonnes (mt) and 6 528 mt respectively. The fin-fish catch data for July 2010 showed that *Ilisha spp.* dominated the catch (64,400 kg) followed by *Hilsa kelee* (Kelee shad/seriya – 52 390 kg), carangids (51 195 kg), rock fish (38 690 kg) and rays (21 255 kg).

Explaining the destructive fishing practices, Dr Vidanage said that the following practices are likely to impact the fishery resources in the GoM area:

- Dynamiting – illegal but still taking place in some areas between Pallimunai to Thavulpadu;
- Use of monofilament nets (*Thangus*) – being used in almost every landing site, but re-enforcement of the ban from 3 October 2010 is in place;
- Brush piles and multi hook artificial bait for cuttlefish are being used in 2 of the 14 landing sites surveyed: Pallimunai and Vankalai;
- *Surukku* nets – banned from 3 October 2010, but still being used in some areas (*e.g.* Pappamodda in Mantai West DSD);
- SCUBA diving to collect sea cucumber and conch – banned in GoM but fishermen from Kalpitiya still collect these from Silavatturai in Musali DSD;
- Bottom Trawling – this is presently limited to Pesalai in Mannar DSD;
- Uncontrolled exploitation - collection of holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) without permit or without conforming to the conditions of the permit, especially on recommended sizes;
- Poaching in Sri Lankan waters - there is an ongoing feud between fishermen of Sri Lanka and India. There are allegations and counter-allegations and the Government will have to step in to address this issue. Fishermen in Mannar claim that large fleets

of Indian fishing boats are poaching in Sri Lankan waters and thereby reducing their catch and destroying the benthic habitats; and

- By-catch - currently, the by-catch is discarded in an indiscriminate manner, causing significant pollution of the beach and attracting dogs, cats and birds, which also visit the fish drying areas. Often, faecal matter can be found in fish drying areas. Proper disposal of by-catch, perhaps using it for preparing fish meal, is necessary.

On the efficacy of existing management measures, Dr Vidanage said that there are a number of development activities taking place within Sri Lankan side of the GoM and in the immediate area, which have a direct influence on the GoM. Sri Lanka Tourism Development Authority is in the process of developing the Kalpitiya Tourism Development Area (KTDA) plan which falls partly within GoM. Oil exploration within Cauvery Basin of North-western Sri Lanka is another major development activity identified in the GoM in Sri Lanka. There are other influences such as increased fishing pressure, opening up of land for resettlement, infrastructure development and proposed developments such as Sethu Samudram Ship Canal on the Indian side of the GoM.

Dr Vidanage informed that through MFF, IUCN Sri Lanka has facilitated a meeting with the Joint Secretary of the Ministry of Environment and Forests, India and key Sri Lankan Officials in May 2011 on the possibility of developing a joint project proposal for conservation oriented research activities in GoM. The status paper on Sri Lanka is given as [Annexure 6](#).

11.0 Ms Ramya Rajagopalan of the International Collective in Support of Fish Workers (ICSF) presented a paper on 'Issues regarding livelihoods in Gulf of Mannar National Park and Biosphere Reserve (GOMBR), Tamil Nadu, India'. Ms Rajagopalan said that Tamil Nadu has three marine protected areas (MPAs): the Point Calimere Wildlife Sanctuary, the Pulicat Wildlife Sanctuary and the Gulf of Mannar National Park and Biosphere Reserve. The Gulf of Mannar National Park (GOMNP), though proposed by scientists in 1976 to prevent the destruction of coral reefs by the construction industry, was officially declared as a national park in 1986 to conserve the marine ecosystem. Despite the area being declared a national park more than two decades ago, the settlement of the rights of the communities within the park area is yet to be completed, and the second legal notification as per the Wildlife (Protection) Act, 1972 is still to be issued.

"Limited participation of local communities in decision-making processes is one of the main issues facing the management of this MPA. Communities play very little or no role in the formulation of plans, but are expected to cooperate in their implementation. Multiple institutional structures and legal regulations for governance result in confusion", said Ms Rajagopalan.

Describing the community attributes in the area, Ms Rajagopalan said that while there were periodic estimates on the status of biological resources, neither the Tamil Nadu Department of Environment and Forests nor the Department of Fisheries have any estimates on the total number of people dependent on the marine resources in the GOMNP and the GOMBRT. "Rough estimates put the number of fishing villages in the GoM area, dependent on fishery resources, including seaweeds and sea cucumbers, at 125. There are, however, a total of 252 villages in the wider coastal belt (10 km width), and their 150 000 inhabitants frequently also depend on marine resources. During discussions with the Ramnad Traditional Fishworker's Union, it was suggested that this total population includes 35 000 small-scale fishers and over 5 000 divers. Of the 35 000 fishers, there are 5 000 fisherwomen who directly depend on seaweed collection for their livelihoods", said Ms Rajagopalan.

Further elaborating on the issues, Ms Rajagopalan said that the local Ramnad Fishermen's Union has been protesting against the restrictions on fishing imposed in the GOMNP. Ironically, though these villages are categorized as "high threat" by the GOMBRT, the villagers have not been involved in the development of the park/reserve management framework, nor have they been actively involved in the eco-development

schemes. The fishers consulted argue that trawler fishing – which is largely conducted from landing sites outside the GOMNP area, has more impact on marine resources, and call for strict implementation of the Tamil Nadu Marine Fishing Regulation Act (MFRA). They also allege that pollution, sedimentation and impacts from developmental and industrial activities in the larger region affect the fragile and unique ecology of the area, yet they are virtually unregulated, while fishing is considered as a major threat.

Ms Rajagopalan informed that the State Department of Environment and Forest has identified the use of prohibited fishing gear and techniques near the islands – including dynamite or blast fishing, pair trawling, purse-seining, use of roller nets and drag-nets, and seaweed collection – as major threats, and has developed regulations for the same. The GOMBRT has also made efforts towards providing alternate livelihoods to some of the fishing communities living in villages classified as high threat to the ecosystem.



Dr Rudolf Hermes, BOBLME Project



Dr G Gopakumar, CMFRI



Dr S Vidanage, IUCN



Ms Ramya Rajagopalan, ICSF



Dr E Vivekanandan



Dr Shekhar Kumar Neeraj making a point

Presentations made in the Consultation

She further said that the fishing communities in certain villages have rejected the alternate employment package offered by the GOMBRT, as they were not seen as viable and sustainable. Communities in the region have also taken up their own management

initiatives. Example: Chinnapalayam and Thopukadu villages have developed their own management regulations, partly in order to reduce conflicts with the Forest Department. Such community regulations include ban on collection of protected species and destruction of coral, cutting of mangroves and wood in the islands, catching turtles, harvesting sea cucumbers and restricting the number of days of seaweed collection to 12 days a month. Community-initiated self-regulations for conservation and sustainable use are generally still to be recognized and supported by government institutions. Traditional ecological knowledge systems, which underlie such self-regulatory behaviour, are thus not utilized in formulating official plans and regulations.

Concluding the presentation, Ms Rajagopalan said that the GoM is undoubtedly a unique and fragile ecosystem, whose resources need to be protected and conserved, but it is also a region where thousands of people depend on its fisheries and marine resources for livelihoods. The local fishing communities are hopeful that issues of participation and livelihoods will be taken more seriously in future, so that both conservation and fisheries can benefit. Ms Rajagopalan's presentation is placed as [Annexure 7](#).

12.0 Dr E Vivekanandan, Principal Scientist, CMFRI, Chennai Centre presented a paper on 'Ecosystem Approach to Marine Fisheries (EAF)' in relation to the application of such an approach to manage the GoM in a sustainable manner. He said that EAF calls for recognition of fisheries management and exploitation as an integral part of the marine ecosystem. The EAF is defined by Ward *et al.* (2002) as "an extension of conventional fisheries management recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations, *e.g.* conserving critical habitats, reducing pollution and degradation, minimizing waste, protecting endangered species". The EAF's main purpose is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems.

Dr Vivekanandan said that the key objective of EAF is the sustainable use of the whole system and not just targeted species. The EAF also recognizes that people are an integral component of the ecosystem and that many (sometimes competing) interests of people in fisheries and marine ecosystems have to be addressed. The EAF represents the combination of two different perspectives, namely *ecosystem management* and *fisheries management*. As a result, while EAF is the responsibility of fishery agencies, its full implementation will require cooperation and collaboration with agencies responsible for managing other activities that impact on the aquatic ecosystem (*e.g.* coastal zone development, offshore mining and oil and gas extraction). For EAF to be fully realized, it is important that these agencies and stakeholders interact and work together.

"While EAF is a major conceptual advancement, the practical problems raised by it are immense. There is still uncertainty on how to implement an effective EAF. Nevertheless, there are pragmatic ways to begin implementation and to deal with complex interactions of institutions and societies", said Dr Vivekanandan. [Annexure 8](#) contains Dr Vivekanandan's presentation.

D. Group discussion and preparation of group reports (Session III)

13.0 The objective of group discussion was to thoroughly review the documents presented during the Consultation and also to draw from the experience of the participants to contribute towards the outcome of the Consultation. For this purpose, the participants were assigned to four groups and each group was requested to undertake close examination of a specific issue concerning the GoM as delineated below. Detailed information on each issue and distribution of participants is given in [Annexure 9](#).

Group 1: Review of the existing management measures in the Gulf of Mannar (GoM) and lessons learned from the past initiatives while identifying the concerned stakeholders and the role they are playing in the GoM ecosystem.	Group II: Identification of gaps in available information (biological and socio-economic) on the GoM ecosystem to delineate the status of the ecosystem and measures needed to address them.
Group III: Understanding trans-boundary importance and issues of the GoM ecosystem and modalities to approach them.	Group IV: Strengthening bi-national cooperation in managing the GoM ecosystem and moving towards an EAF.

Recommendation of Group I

14.0 The Group observed that both India and Sri Lanka have elaborate and comprehensive legislative and surveillance measures in general and particularly for GoM (in case of India) to conserve the resources. However, the efficacy of existing management measures from the perspective of ecological and livelihood security is limited due to vastness of the area to be managed, inadequate financial and human resources and technical capacity of different implementation and enforcement agencies. There is lack of awareness among the communities on different regulations. There is also lack of community consultation and participation in developing and implementing management measures. The other inadequacies highlighted by the Group are as follows:

- Lack of baseline data for management of activities, especially other than fisheries;
- Inadequate information on sustainable harvest levels of different species;
- No economic valuation of the resources;
- Importance of livelihood aspects not translated into management plans;
- Lack of coordination among agencies involved; and
- Existing management measures not based on ecosystem principles and resultantly there is no holistic approach to development of the area.

The Group also identified relevant stakeholders in the two countries and regional/international agencies to support the cause. The stakeholders include fishers and fish traders; other local communities, ministries/departments responsible for protection of environment and forest, fisheries development agencies; law enforcement and surveillance agencies, research agencies and local NGOs and CBOs. Regional and international agencies identified for supporting the cause include FAO, UNDP, GEF, SACEP, MFF, GCRMN, CORDIO, BOBLME Project and the BOBP-IGO.

The Group suggested that in the short run baseline inventories on biological resources and economic actors should be prepared through coordination in research and planning in both the countries. This information should be available from a common platform for the use of stakeholders. In the long run, there should be harmonization of legal statutes and policy measures to the extent possible (joint management measures for sea-cucumber, sea-horse and dugong, etc.) by incorporating the principles of EAF. The Group also suggested signing of an agreement by the countries facilitating creation of a trans-boundary biosphere reserve for GoM and for recognition of access rights of communities to fish in the traditional fishing grounds. The Group advocated phasing out of bottom trawling, GIS mapping of the area, development and monitoring of ecosystem indicators and development of viable breeding and culture technologies for commercially important and ecologically important marine species (including transfer and standardization of technology). The Group’s presentation is given in [Annexure 10](#).

Recommendation of Group II

15.0 Group II observed that the GoM ecosystem is a typical example where the health and integrity of the ecosystem has been impacted due to various anthropogenic activities and the expected or desired management interventions are not adequately reflected. The basic requirements for corrective action in this case are a thorough understanding of the causes through well planned and coordinated scientific studies. In other words, all future policy decisions should be based on scientific data and information. In this regard, the Group suggested: (i) information from both countries on similar parameters with similar denominators; (ii) uniform/standard protocols for generation of information in time and space; (iii) collaborative mechanisms for analyzing information on an ongoing basis; and (iv) joint mechanisms to implement the plan of action and monitoring of results.



Participants engaged in Group Discussions

The Group suggested on the need for an updated inventory of the existing resources, both flora and fauna of the GoM. It observed that while in India some information is available; in Sri Lanka detailed studies are needed. The Group also suggested rapid appraisal of the status of critically threatened species (*e.g.*, dugong, dolphins, whales, green turtle, olive-ridley turtle, sea-horse, molluscs, balanoglossus, etc) across the GoM. In addition to biological parameters, information is also needed on hydrological, geophysical and climatic regime of the GoM; sources and degree of pollution; impact of existing management measures on both the sides; data on coral depletion; and an update on fishery, trade and socio-economic parameters. The Group recommended that collaborative or joint research should be implemented to generate the above information, except where site-specific information is needed (*e.g.* seaweed culture, mariculture, etc).

The Group suggested that under the aegis of a relevant regional organization, a mechanism should be initiated for standardization or harmonization of research methodologies on either side of the GoM and for sharing and dissemination of data generated on a regular basis. The presentation of Group II is contained in [Annexure 11](#).

Recommendation of Group III

16.0 The Group carried out a causal analysis to identify the issues and to propose solutions. The Group suggested that the issues concerning sustainability of the ecosystem and resources of GoM are:

- weak governance of the shared ecosystem;
- poor management of the shared fishery resources for sustainable use;
- degradation of the habitat and loss of biodiversity; and
- pollution.

The Group suggested that the root causes of these issues are sub-optimal appreciation of ecosystem services; lack of cooperative mechanism; illegal, unreported and unregulated (IUU) fishing and destructive fishing practices and ineffective implementation of laws and regulations concerning pollution.

To address these issues, the Group suggested formation of a high level joint advisory committee on both scientific and socio-economic matters, promoting cooperation, raising awareness, and better monitoring of resources and capacity building. The Group also suggested joint monitoring of marine pollution in the area including development of common indicators for pollution and identification of hotspots and raising the profile of the GoM to draw attention to its plight. [Annexure 12](#) provides the Group's presentation.

Recommendation of Group IV

17.0 The Group observed that GoM is a common heritage of both India and Sri Lanka. However, currently there is lack of awareness in the two countries on policies, laws and regulations concerning management of the GoM. Towards this, application of EAF could ensure the sustainability of its ecosystem and the resources. In addition, since both the countries are signatories to regional and international treaties on conservation of biodiversity and related subjects, they are duty-bound to manage the ecosystem and resources of GoM on a sustainable basis. The Group suggested that for managing GoM from an ecosystem perspective, it is necessary to generate baseline data (climatic, socio-economic and biological) for developing predictive models. The Group also highlighted the requirement for enhanced communication among regulating agencies and sharing of patrolling data.

The Group observed that there are laws in both countries to manage ecosystems and natural resources. In India there is a monsoon ban on fishing from 15 April to 31 May, when only traditional fishing is allowed. As regards conservation of species, fishing of sea-cucumber is banned in India, while it is allowed in Sri Lanka including export under a permit system. Capture of turtle is banned in both the countries while conservation

measures are in place. A closed season and size restriction is in force in Sri Lanka in respect of lobster fishing. Also taking, keeping in possession and sale including export of gravid female lobsters is banned. The marine ornamental fishery is regulated in India under the Wildlife Protection Act, and in Sri Lanka under the Fauna and Flora Protection Ordinance and Fisheries and Aquatic Resources Act.

Both India and Sri Lanka have banned the use of dynamite and poisons for fishing. In India use of fishing nets below 10 mm mesh size, pair trawling and purse seining is banned. In Sri Lanka, the use and import of monofilament nets is banned. The discharge of ballast water and effluents and introduction of alien invasive species is regulated in both the countries. However, policy and legal provisions have been formulated in Sri Lanka for involvement of the fisher community in management of fisheries, but not explicitly in India. The Group also suggested guidelines for strengthening bi-national cooperation based on shared principles and commonalities in national policies. The guidelines may include an agreement between the two countries for ecologically sound management of the GoM; conducting a feasibility study and preparation of action plans; implementation of the action plan on EAF; and pilot testing of the action plan.

The Group suggested that for capacity development, training and awareness programmes need to be conducted on EAF at various levels including school children; species identification; diving and snorkeling; coastal health monitoring; GIS and remote sensing; oceanography; participatory approaches; post-harvest management, and marketing and value addition. The Group also suggested infrastructure requirements for carrying out the above objectives, including construction of marine laboratories; cold storage facilities and improved fish landing sites; infrastructure for data recording and retrieval and Navy/Coast Guard support for monitoring of the resources. The Group's presentation is given in [Annexure 13](#).

E. Adoption of recommendations (Session IV)

18.0 After considering the recommendations made by the four Groups, the following five priority initiatives were agreed with the consensus of participants for implementation with the support of the BOBLME Project.

- Collaborative effort in conservation and management of charismatic species (e.g. dugong, etc);
- Capacity building and training (e.g. stock assessment, water quality monitoring, and use of GIS and remote sensing);
- Education and awareness building;
- Strengthening of data collection and processing mechanisms; and
- Sharing of information and networking.

19.0 It was also agreed that the initial support of the BOBLME Project to implement the above initiatives will be in the form of capacity building. At the next Consultation, which was agreed to be held in Sri Lanka, these initiatives will be developed into projects and programmes. These projects and programmes would then be finalized at the final Consultation due in 2012. It was also agreed that these projects will be implemented under the aegis of the BOBLME Project and its partner organizations such as BOBP-IGO, MFF, etc. It was also agreed that at the next Consultation institutional arrangements for bilateral cooperation between India and Sri Lanka will be developed, which could then be finalized at the final Consultation.

F. Field Visits

20.0 In the final session of the first day, a field trip was undertaken to Dhanushkodi (4 - 6.30 PM). Dhanushkodi is a small village at the southern tip of Rameshwaram Island. It is the Indian end of Rama Setu, a chain of limestone shoals between Rameshwaram Island off the south-eastern coast of Tamil Nadu, India, and Mannar Island off the north-western coast of Sri Lanka. This small patch of land is about 31 km

from Sri Lanka and was once a famous centre for trade and tourism between India and Sri Lanka. A video documentary was also prepared during the visit to Dhanushkodi.

21.0 On the morning of the second day (6 to 10 AM) of the Consultation, the participants visited Krusadai, an inhabited island under the GOMBRT, which also houses an Information Centre of the Department of Environment and Forests. On this occasion Mr Shekhar Kumar Neeraj, Conservator of Forests & Director of the Gulf of Mannar Biosphere Reserve, welcomed the participants and explained the activities of the Trust and the problems faced by the Trust in conservation of the resources. During interactions, the participants enquired about the role of the community, especially the fishermen and the interactions of the Trust with the community. This field visit was also documented in video.

G. Conclusion

22.0 In his concluding remark, Dr Rudolf Hermes said that the BOBLME Project is currently cooperating with the countries in capacity building in areas reflected in the recommendations of the Consultation and this cooperation would continue. He said that training in stock assessment is an ongoing activity of the BOBLME Project and sought cooperation from IUCN-Sri Lanka in implementation of education and awareness programmes. He thanked all partner organizations in the BOBLME Project and the BOBP-IGO. He also thanked organizers of the field visits.

23.0 Mr Indra Ranasinghe in his concluding remarks thanked the Government of India and the BOBP-IGO for organizing the Consultation successfully. He thanked the participants for their co-operation and positive contributions. He proposed that a working group be set up to continue with the cooperation. He said that the Government of Sri Lanka is giving priority to development in northern Sri Lanka. He further said he and his team will facilitate the next Consultation, which is proposed to be held in Jaffna and extended invitation to the participants to join the next round of Consultation in Sri Lanka.

24.0 Mr B Vishnu Bhat in his concluding remarks expressed satisfaction over the conduct of the Consultation and hoped that the recommendations made at the Consultation would make positive contributions towards sustainability of the GoM. He complimented the BOBLME Project and the BOBP-IGO for the initiative and arrangements made for the Consultation. He said that the Government of India will support the initiative since it benefits the fisher communities and other stakeholders of the GoM. He thanked the participants from Sri Lanka for the cooperation extended.

25.0 Dr J R Bhatt in his concluding remarks reminded about the long standing friendship between India and Sri Lanka. He said that the credit of the success of the Consultation should go to all the participants. He thanked the BOBLME Project and the BOBP-IGO for organizing the Consultation and all the participants for actively participating in it.

26.0 Dr Y S Yadava proposed the vote of thanks. He said that the Consultation had achieved its objectives and thanked the participants for their active involvement; the local organizations in providing logistic support; the Department of Environment and Forests and the Department of Fisheries of the Government of Tamil Nadu and the Mandapam Camp Centre of CMFRI for their assistance in organization and conduct of the Consultation and the two field visits. He also thanked the Chair, Dr J R Bhatt for giving guidance and conducting the proceedings in an effective manner.

27.0 The recommendations of the Bi-National Stakeholder Consultation on Sustaining the Gulf of Mannar Ecosystem and its Resources were confirmed during the closing session on 06 September, 2011 in Ramanathapuram.

Annexure 1

Prospectus

1.0 The Bi-national Stakeholder Consultation

The Gulf of Mannar (GoM) is an ecologically important critical habitat shared by India and Sri Lanka. Within the framework of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project, the Governments of India and Sri Lanka have the scope to work together to establish a collaborative arrangement for management of the GoM ecosystem. Such collaborative arrangements can ensure that decisions are made on the use of the GoM resources with due consideration to both ecological and human well-being and do not compromise on the needs of future generations.

2.0 Objectives of the Consultation

The Consultation will bring stakeholders from India and Sri Lanka together to develop a roadmap/framework for fostering cooperation in management of the GoM ecosystem. The specific objectives of the consultation are:

- To re-evaluate the importance of GoM for India and Sri Lanka and the present state of the ecosystem;
- To review existing management measures and lessons learnt;
- To learn about the Ecosystem Approach to Fisheries (EAF) as a management paradigm for GoM;
- To identify the key stakeholders and their role in GoM; and
- To reach an understanding on the need of bi-national cooperation in management of GoM and continuation of in-country and inter-country activities toward this.

3.0 Date and venue

The Consultation will be held from 5 - 6 September 2011 in Rameshwaram, Tamil Nadu, India. Representatives of concerned Governmental agencies from India and Sri Lanka, research organisations, NGOs and representatives of the primary users (mainly the fishermen) will participate in the Consultation.

Expected outputs and outcomes from the consultation:

- A report on the outcome of the Consultation.
- A status report on the GoM, including the environment, fisheries, socio-economic importance and governance.
- Identification of major information gaps.
- Identification of issues pertaining to the GoM with national implications.
- Identification of issues pertaining to the GoM with transboundary implications.
- Development of a mutually acceptable roadmap/framework for continuing dialogue and undertaking activities to enhance cooperation in management for sustaining the GoM ecosystem and its resources.
- Raising the profile of GoM as a shared ecosystem.
- Improved understanding on the Ecosystem Approach to Fisheries Management.

4.0 The Organizers

The Bay of Bengal Large Marine Ecosystem (BOBLME) Project

Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project

to lay the foundations for a coordinated programme of action designed to improve the lives of the coastal populations through improved regional management of the environment of the Bay of Bengal and its fisheries. The Food and Agriculture Organization of the United Nations (FAO) has been at the forefront of developing the Ecosystem Approach to Fisheries Management over the past decade, and the BOBLME Project is building on this by applying it to some of the most important fisheries and critical habitats in the Bay of Bengal region. Project sub-component 2.4 of the BOBLME Project relates to *Collaborative Critical Habitat Management* and supports the promotion of multi-national approaches to manage and address issues affecting transboundary coastal/marine eco-systems within the broader BOBLME region. The GoM has been identified as an area of focus for the Project. For more information see www.boblme.org.

The Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO)

The BOBLME Project is collaborating with the BOBP-IGO on *Sustaining the Gulf of Mannar Ecosystem and its Resources* programme of work. The BOBP-IGO is a regional fisheries advisory body working in the Bay of Bengal region for sustainable utilization of fisheries resources and ensuring well-being of fishers in the region. The Governments of Bangladesh, India, Maldives and Sri Lanka are the constituents of the Organisation. One of the important mandates of the BOBP-IGO is to enhance cooperation among member-countries, other countries and organisations in the region and provide technical and management advisory services for sustainable marine fisheries development and management in the Bay of Bengal region. For more information see www.bobpigo.org.

5.0 The Gulf of Mannar Ecosystem

The GoM is an inlet of the Indian Ocean, between southeastern India and western Sri Lanka. It is bounded to the northeast by Rameshwaram (Island), Adam's Bridge (Rama Setu) and Mannar Island. The Gulf is 130–275 km wide and 160 km long. It receives several rivers, including the Tambraparni (India) and the Aruvi (Sri Lanka). The Gulf supports a diverse and productive community of marine life that was famous historically for its pearl oyster banks and large population of the globally-endangered sea mammals, the dugong, reliant on the extensive shallow sea grass meadows. The Gulf has rich inshore fishing grounds that are exploited by large number of artisanal and commercial fishers using a variety of gear. The GoM is also at the centre of budding urban centres and industrial hubs like Ramanathapuram and Tuticorin in Tamil Nadu, India.

According to various studies conducted in the region, about 3 600 species of fauna and flora have so far been identified from the GoM. It is one of the richest regions in the whole of Indo-west Pacific region. There are about 160 identified algal species and about 120 species of corals in the Gulf alone. However, the corals are deteriorating due to human interference. The GoM is also famous for its chank and pearl fisheries. The most preferred species of pearl oyster is *Pinctada fucata*. It has been observed that the Indian pearl oyster beds get periodically replenished by larvae carried by currents from the Sri Lankan coast and *vice versa*.

The GoM is also rich in animal life, apart from corals. It is home to many coral fishes, eels, molluscs and stomatopods. The other fauna includes sea anemones, planarians, hydroids, ear-shells, octopus, holothurians and ascidians. Pelagic gastropods, crabs, star fishes, sea urchins and hermit crabs are also common. Four of the seven species of sea turtles found worldwide are reported to occur in the GoM. These are the olive ridley, the green, the hawksbill and the leatherback. The region is also one of the last few homes of the dugong –an endangered species.

Studies conducted by the Gulf of Mannar Biosphere Reserve Trust (India), the Central Marine Fisheries Research Institute (India) and IUCN (Sri Lanka) have found that the rich bio-diversity of GoM is under pressure due to anthropogenic interventions and sub-

optimal implementation of existing management measures. Fishing is the most prominent activity in the Gulf. However, fishermen often use prohibited and destructive fishing gear such as dynamites while fishing. Apart from fishing, the GoM has opportunities in mineral and petroleum deposits in the Gulf and is also a popular destination for tourism.

The fact that the GoM is economically important for the two countries and provides a host of ecological services, it is in the best interest of the countries to design a roadmap for optimal utilization of the ecological and economic services of GoM while ensuring its pristine conditions in a sustainable manner. Isolated production decisions in such a case can lead to competitive exploitation programmes and finally resulting in undesirable outcomes for all the stakeholders. That is the future of the Gulf is a complex question before the concerned parties and the uncertainties about its sustainability can be minimized by a common approach adopted by the two neighbours, India and Sri Lanka.

6.0 The format of the Consultation

The Consultation will comprise technical presentations, highlighting the key issues regarding the GoM. Following technical presentations, the participants will break into groups for thorough discussions on key issues and formulation of suggestions. The Consultation will be conducted in English.

7.0 Participants

Following organisations are expected to participate in the Consultation:

India	Sri Lanka	International/Regional Organizations/NGOs
1. Ministry of Environment and Forests, Government of India	1. Ministry of Fisheries and Aquatic Resources Development	1. International Collective in Support of Fishworkers
2. Ministry of Agriculture (DAHD&F), Government of India	2. Department of Fisheries and Aquatic Resources	2. Mangroves for the Future
3. Department of Fisheries, Government of Tamil Nadu	3. Ministry of Environment and Natural Resources;	3. International Union for Conservation of Nature
4. Indian Coast Guard;	4. Central Environment Authority	4. South Asia Cooperative Environment Programme (SACEP)
5. Department of Environment & Forest, Government of Tamil Nadu	5. National Aquatic Resources Research and Development Agency	5. Food and Agriculture Organization of the United Nations
6. Fishery Survey of India	6. Department of Coast Conservation	6. BOBLME Project
7. Gulf of Mannar Biosphere Reserve Trust (GOMBRT)	7. Mannar District Secretariat	7. BOBP-IGO
8. Zoological Survey of India	8. University of Ruhuna	
9. Centre for Advanced Study in Marine Biology, Annamalai University	9. University of Kelaniya	
10. Central Marine Fisheries Research Institution, Kochi	10. University of Jaffna	
11. National Institute of Ocean Development	11. Wayamba University of Sri Lanka	
12. MS Swaminathan Research Foundation	12. Representatives of fishermen associations	
13. Suganthi Devadasan Marine Research Institute, Tuticorin		
14. South Indian Federation of Fishermen Societies		
15. Representatives of fishermen associations		

8.0 Travel and related arrangements

The BOBLME Project will bear the cost toward the participation of the delegates in the Consultation. The BOBP-IGO will be making arrangements for travel, boarding and lodging of the participants. The Consultation will be held in Hotel Vinayaga, # 5, Railway Feeder Road, Rameshwaram 613 526, Tamil Nadu, India (*Tel: +91 4573 222 361; Fax: +91 4573 222 362; Web: www.vinayagahotel.com*). Detailed notes on travel arrangements will be communicated to the delegates once their nominations are received.

9.0 Contact

For any further information or clarification on the Consultation please contact:

Dr Chris O'Brien

Regional Coordinator
Bay of Bengal Large Marine Ecosystem
Project
77, Moo 7, Sakdidej Rd
Makham Bay, T. Vichit
A. Muang, Phuket 83000
Thailand
Tel: +66- 76-391861;
Mob: +66- 844395210
Fax: +66-76-391864
Email: Chris.O'Brien@boblme.org

Dr Yugraj Singh Yadava







Director
Bay of Bengal Programme
Inter-Governmental Organisation
91 St. Mary's Road, Abhiramapuram
Chennai 600 018, Tamil Nadu
India
Tel: +91- 44- 24936188;
Mob: +91-9841042235
Fax: +91- 44- 24936102
Email: yugraj.yadava@bobpigo.org

Agenda & Time Table








Sun, 04 September 2011	Arrival of participants
Mon, 05 September 2011	Day 1
0830 – 0900	<i>Registration</i>
0900 - 1000	Session I: Opening Session
0900 - 0905	Introductory and Welcome Remarks: BOBLME Project
0905 - 0910	Introductory and Welcome Remarks: BOBP-IGO
0910 - 0915	Introductory and Welcome Remarks: Ministry of Fisheries & Aquatic Resources Development, Government of Sri Lanka
0915 - 0920	Introductory and Welcome Remarks: Ministry of Agriculture, Government of India
0920 - 0930	Introductory and Welcome Remarks: Chairperson
0930 – 0940	Introduction by the participants
0940 - 1000	<i>Group Photograph; Tea/Coffee</i>
1000 – 1230	Session II: Technical Session
1000 - 1020	Objectives of the Workshop: BOBLME Project
1020 - 1100	The Gulf of Mannar Ecosystem - India: CMFRI
1100 - 1140	The Gulf of Mannar Ecosystem – Sri Lanka: IUCN
1140 - 1220	Issues regarding livelihoods of fishers in Gulf of Mannar: ICSF
1220 - 1300	Ecosystem approach to manage marine fisheries: CMFRI
1300 – 1400	<i>Lunch</i>
1400 – 1600	Session III: Group Discussion
1400-1415	Formation of Group and tasks before the groups: BOBP-IGO
1415 -1530	Group discussion (Four Groups)
1530 – 1600	<i>Tea/ Coffee</i>
1600 - 1800	Field Visit
2000 -	Consultation Dinner
Tue, 06 September 2011	Day 2
0600 - 1030	Field Visit
1030 – 1230	Session III: Group Discussion continued
1030 – 1230	Preparation of Group Reports
1230 – 1400	<i>Lunch</i>
1400 – 1700	Session IV: Group Presentation & Adoption of Recommendations
1400 – 1530	Group Presentations (20mins x 4 Groups)
1530 – 1600	<i>Tea/ Coffee</i>
1600 – 1700	Adoption of the recommendations & conclusion
1900 hrs onwards	Participants departure








Annexure 3








List of Participants








SL. NO	NAME	POSITION & ADDRESS	TEL, FAX, MOBILE, EMAIL
India			
Ministry of Agriculture			
1.0	K Vijayakumaran 	Director General Fishery Survey of India Botawala Chambers, Sir P M Road, Fort Mumbai – 400 001, Maharashtra India	Tel: + 91 22 22617144; Fax: + 91 22 22702270 Email: vijayettan@yahoo.com
2.0	B Vishnu Bhat 	Fisheries Development Commissioner Department of Animal Husbandry Dairying & Fisheries Ministry of Agriculture Room No 242-C, Krishi Bhavan New Delhi - 110 001 India	Tel: + 91 11 23363798; Fax: + 91 11 23384030 Email: bhatvishnu@gmail.com
3.0	J C Dhas 	Junior Fisheries Scientist Fishery Survey of India (Chennai Base) Fishing Harbour Complex, Royapuram Chennai - 600 013, Tamil Nadu INDIA	Tel: + 91 44 25953121; Fax: + 91 44 2597605 Email: jeyadhas94@gmail.com
Ministry of Environment & Forests			
4.0	J R Bhatt 	Director Ministry of Environment & Forests Paryavaran Bhawan, CGO Complex Lodhi Road, New Delhi - 110 510 INDIA	Tel: + 91 11 24362543; Fax: + 91 11 24362543 Email: jrbhatt@nic.in
5.0	S Balaji 	Chief Conservator of Forests & Trust Director Gulf of Mannar Biosphere Reserve Trust 1 st Floor, Jawan Bhavan Devipattinam Road, Kenikarai Ramanathapuram - 523 501, Tamil Nadu INDIA	Tel: + 91 4567 226335
6.0	Shekhar K. Neeraj 	Conservator of Forests & Director of Gulf of Mannar BR Collectorate Campus, Virudhnagar Circle 187, Malaipettai Street Virudhnagar 626 001, Tamil Nadu INDIA	Tel: + 91 4562 2521581; Fax + 91 4562 2521581 Email:
7.0	V Deepak Samuel	Project Support Associate (UNDP- GEF) O/o the Trust Director	Email: deepak.samuel@undp.org








		Gulf of Mannar Biosphere Reserve Trust 1 st Floor, Jawan Bhavan Devipattinam Road, Kenikarai Ramanathapuram 523 501, Tamil Nadu INDIA	
8.0	Pradeep TP 	Inspector WildLife Crime Control Bureau Trikoort – 1, Biajicama Place New Delhi – 110 066	<i>Tel: + 91 11 26182484</i> <i>Email: pradeepub@gmail.com</i>
Indian Coast Guard			
9.0	Donny Michael 	Deputy Inspector General Coast Guard Headquarters National Stadium Complex New Delhi – 110 001 INDIA	<i>Tel: + 91 11 23388668;</i> <i>Fax: + 91 11 23074131</i> <i>Email: donnymyke@gmail.com</i>
10.0	H H More 	Commandant MRSSC Mandapam C/o ICGS Mandapam Mandapam, Tamil Nadu INDIA	<i>Tel: + 91 4573 241634;</i> <i>Fax: + 91 4573 241718</i> <i>Email: hh.more@gmail.com</i>
Government of Tamil Nadu			
11.0	Reena Selvi 	Joint Director Department of Fisheries Government of Tamil Nadu DMS Complex, Teynampet Chennai – 600 006, Tamil Nadu INDIA	
12.0	V Ravichandran 	Deputy Director of Fisheries Petchiamman Padithurai Road Madurai – 625 001 INDIA	<i>Tel: + 91 452 2345903</i> <i>Fax: + 91 452 2345303</i> <i>Email:</i> <i>kanmaniravi79@gamil.com</i>
Research and Educational Institutions			
13.0	E Vivekandan 	Principal Scientist & Scientist in Charge Madras Research Centre Central Marine Fisheries Research Institute 75, Santhome High Road Chennai – 600 028, Tamil Nadu INDIA	<i>Tel: + 91 44 24617264;</i> <i>Fax: + 91 44 24617290</i> <i>Email:</i> <i>evivekandan@hotmail.com</i>







14.0	<p>G Gopakumar</p> 	<p>Principal Scientist & Scientist in Charge Mandapam Regional Centre Central Marine Fisheries Research Institute Marine Fisheries PO Mandapam Camp– 623520, Tamil Nadu INDIA</p>	<p>Tel: + 91 4573 241443; Fax: + 91 4573 241502 Email: drggopakumar@gmail.com</p>
15.0	<p>K Vinod</p> 	<p>Senior Scientist Marine Biodiversity Division Mandapam Regional Centre Central Marine Fisheries Research Institute, Marine Fisheries PO Mandapam Camp– 623520, Tamil Nadu INDIA</p>	<p>Tel: + 91 4573 241443; Fax: + 91 4573 241502 Email: vinod_karungal@yahoo.co.in</p>
16.0	<p>B Johnson</p> 	<p>Scientist Socio-Economic and Extension Division Mandapam Regional Centre Central Marine Fisheries Research Institute, Marine Fisheries PO Mandapam Camp– 623520, Tamil Nadu INDIA</p>	<p>Tel: + 91 4573 241443; Fax: + 91 4573 241502 Email: jsfaith@gmail.com</p>
17.0	<p>A Sivakumar</p> 	<p>Senior Scientist Coastal Systems Research M S Swainathan Research Foundation 285 Park Road, Mariappa Nagar Annamalai Nagar 608 002, Tamil Nadu INDIA</p>	<p>Tel: + 91 4144 239006 Email: siva_tcm@rediffmail.com</p>
18.0	<p>T T Ajith Kumar</p> 	<p>Assistant Professor Faculty of Marine Sciences Centre of Advanced Study in Marine Biology Annamalai University Parangipettai - 608 502, Tamil Nadu INDIA</p>	<p>Tel: +91 4144 253999; Mob: +91 94430 01785 E-Mail: ttajith87@gmail.com</p>
19.0	<p>S Sundaramoorthy</p> 	<p>Scientist 'F' ICMAM Project Directorate 2nd Floor, NIOT Campus Velacherry-Tambaram Main Road Pallikaranai, Chennai – 600 100, Tamil Nadu INDIA</p>	<p>Tel: +91 44 22462413; Fax: +91 44 22460657 E- Mail: sundar@icmam.gov.in</p>
20.0	<p>Rajkumar Rajan</p> 	<p>Scientist 'C' Marine Biology Regional Centre Zoological Survey of India 130, Santhome High Road Chennai – 600 028, Tamil Nadu INDIA</p>	<p>Tel: +91 44 24642680; Fax: +91 44 24642680 Email: rajkumar_rajan@rediffmail.com</p>
21.0	<p>J Patterson Edward</p>	<p>Director Suganthi Devadason Marine Research Institute 44, Beach Road Tuticorin – 628 001, Tamil Nadu INDIA</p>	<p>Tel: + 91 461 2323007; Fax: + 91 461 2325692 Email: edwardjpkpatterson@sdmri.in</p>

			
22.0	C Thomson Jacob 	Project Support Associate (UNDP-GEF) O/o the Trust Director Gulf of Mannar Biosphere Reserve Trust 1 st Floor, Jawan Bhavan, Devipattinam Road, Kenikarai Ramanathapuram 523 501, Tamil Nadu INDIA	<i>Email:</i> deepak.samuel@undp.org
Fishers and fishermen organisations			
23.0	Vincent Jain 	Executive (Post-Harvest & HRD) South Indian Federation of Fisherman Societies J.F.Mansions Medavilacom, Kollencode P.O. Kanyakumari 629 160, Tamil Nadu INDIA	<i>Tel:</i> + 91 471 2343711; <i>Fax:</i> + 91 471 2342053 <i>Mob:</i> +91 94465 45953 <i>Email:</i> Jain1.siffs@gamil.com
24.0	F Justin 	Jerat Secretary ADSGAF Divine Complex, College Road Thoothoor (Post), K K Dist– Tamil Nadu INDIA	<i>Tel:</i> + 91 4651 240617
25.0	U Arulanandham 	Coordinator Alliance for Release of Innocent Fisherman (ARIF) Anbaham, Sauthragiri Street Pamgan, Ramnad – 623 521, Tamil Nadu INDIA	<i>Mob:</i> + 91 9443976626
26.0	C Ganapathy 	Coordinator Alliance for Release of Innocent Fisherman (ARIF) Anbaham, Sauthragiri Street Pamgan, Ramnad – 623 521, Tamil Nadu INDIA	<i>Mob:</i> + 91 9443013665
SRI Lanka			
Ministry of Fisheries & Aquatic Resources Development			
27.0	Indra Ranasinghe 	Director General (Technical) Ministry of Fisheries & Aquatic Resources Development Maligawatta, Colombo – 10 SRI LANKA	<i>Tel:</i> + 94 11 244 9754; <i>Fax:</i> + 94 11 243 8005 <i>Email:</i> iranasinghe@fisheries.gov.lk


28.0	<p>G N Ganesha Moorthy</p> 	<p>Assistant Director (Acting)/Fisheries Inspector Department of Fisheries & Aquatic Resources District Office, Kilinochchi SRI LANKA</p>	<p>Tel: + 94 11 2478689; Fax: + 94 11 2478689 Email: jayamini.adikari@gmail.com</p>
29.0	<p>B S Miranda</p> 	<p>Assistant Director (Acting)/Fisheries Inspector Department of Fisheries & Aquatic Resources District Office, Mannar SRI LANKA</p>	<p>Tel: + 94 0779585699; Fax: + 94 0232222173 Email: d.far_mnr@yahoo.com</p>
30.0	<p>Anil Premaratne</p> 	<p>Director General Coast Conservation Department 4th Floor, New Secretariat Building Maligawatta, Colombo – 10 SRI LANKA</p>	<p>Tel: + 94 11 2449754; Fax: + 94 11 2438005 Email: premaratnaanil@yahoo.com</p>
31.0	<p>A R M Haleem</p> 	<p>Planning Officer Department of Coast Conservation Mannar District Secretariat Mannar SRI LANKA</p>	<p>Tel: + 94 718363965; Fax: + 94 232222232 Email: armhaleem@gmail.com</p>
Ministry of Environment & Natural Resources			
32.0	<p>K A I D Silva</p> 	<p>Director (Policy & Planning) Ministry of Environment & Natural Resources 82, Sampathpaya, Rajamalwatta Road Battaramulla – 10120 SRI LANKA</p>	<p>Tel: + 94 11 2877290; Fax: + 94 11 2877292 Email: koralage2001@yahoo.com</p>
33.0	<p>R A R Premakumara</p> 	<p>Environment Management Officer Ministry of Environment & Natural Resources 82, Sampathpaya, Rajamalwatta Road Battaramulla – 10120 SRI LANKA</p>	<p>Tel: + 94 11 2887068; Fax: + 94 714333989 Email: ranwan23@hotmail.com</p>
Research and Educational Institutions			
34.0	<p>K Arulanathan</p> 	<p>Research Officer/Head Oceanography Division National Aquatic Resources Research & Development Agency Crow Island, Colombo – 15 SRI LANKA</p>	<p>Tel: + 94 11 2521002; Fax: + 94 11 2521952 Email: k.arulan@gmail.com</p>

35.0	Rekha Maldiniya 	Head Marine Biological Research Division National Aquatic Resources Research & Development Agency Crow Island, Colombo – 15 SRI LANKA	Tel: + 94 11 2521000; Fax: + 94 11 2521952 Email: rekhamaldeniya@gmail.com
36.0	P B T Pradeep Kumara 	Head Department of Oceanography & Marine Geology Faculty of Fisheries & Marine Sciences and Technology University of Ruhuna Matara – 81000 SRI LANKA	Tel: + 94 41 2222681-2; Fax: + 91 41 2222683 Email: terneypradeep@yahoo.co.uk
37.0	Upali S Amarasinghe 	Senior Professor Department of Zoology University of Kelaniya Kelaniya GQ 11600 SRI LANKA	Tel: + 94 11 2903397; Fax: + 94 11 2914479 Email: zoousa@kln.ac.lk
38.0	A S Sosai 	Senior Lecturer Department of Geography University of Jaffna PO Box – 57, Thirunelvely Jaffna SRI LANKA	Tel: + 94 21 222 5317; Fax: + 94 21 2226512 Email: assoysa@gmail.com
39.0	Sevvandi Jayakody 	Senior Lecturer Department of Aquaculture & Fisheries Wayamba University of Sri Lanka Makandura, Gonawila Sri Lanka	Tel: + 94 31 2299870; Fax: + 94 31 2299870 Mobile: + 94 77 7947907 Email: sevvandi_jayakody@yahoo.com
International/Regional Organizations			
40.0	Chandrika Sharma 	Executive Secretary International Collective in Support of Fishworkers 27, College Road Chennai – 600 006, Tamil Nadu India	Tel: + 91 44 28275303; Fax: + 91 44 28254457 Email: icsf@icsf.net
41.0	Ramya Rajagopalan 	Programme Associate International Collective in Support of Fishworkers 27, College Road Chennai – 600 006, Tamil Nadu INDIA	Tel: + 91 44 28275303; Fax: + 91 44 28254457 Email: icsf@icsf.net

42.0	<p>Shamen V Vidanage</p> 	<p>Acting Country Representative International Union for Conservation for Nature Sri Lanka Country Office 53, Horton Place, Colombo – 07 SRI LANKA</p>	<p>Tel: + 94 11 2694094; Fax: + 94 11 2682470 Email: Shamen.vidanage@iucn.org</p>
43.0	<p>Kumudini Ekaratne</p> 	<p>Senior Programme Officer & Marine Biologist International Union for Conservation for Nature Sri Lanka Country Office 53, Horton Place, Colombo – 07 SRI LANKA</p>	<p>Tel: + 94 11 2694094; Fax: + 94 11 2682470 Email: kumudini.ekaratne@iucn.org</p>
44.0	<p>Ranjith Mahindapala</p> 	<p>Programme Manager Mangroves for the Future (MFF) IUCN Asia Regional Office 63, Soi Prompong, Sukhumvit Soi – 39 Bangkok – 10110 THAILAND</p>	<p>Tel: + 66 26624029; Fax: + 66 26624387 Email: ranjith.mahindapala@iucn.org</p>
45.0	<p>N M Ishwar</p> 	<p>Coordinator Mangroves for the Future IUCN India Office 20, Anand Lok, New Delhi – 110049 INDIA</p>	<p>Tel/Fax: + 91 11 2625 7742; Mobile: + 91 98409 81971 Email: nm.ishwar@iucn.org</p>
46.0	<p>Nishanthi M P Perera</p> 	<p>Programme Officer South Asia Co-operative Environment Programme 10, Anderson Road, Colombo 5 SRI LANKA</p>	<p>Tel: + 94 11 258 9787; Fax: + 94 11 258 9369 Email: nmpperera@yahoo.com</p>
47.0	<p>Chandra Mohan</p> 	<p>Consultant FIMSUL Project FAO of the United Nations O/o Commissioner of Fisheries DMS Complex, Teynampet Chennai – 600 006, Tamil Nadu India</p>	<p>Tel: + 91 44 65159121 Email: cmohan.fimsul@gmail.com</p>
Bay of Bengal Large Marine Ecosystem Project			
48.0	<p>Rudolf Hermes</p> 	<p>Chief Technical Advisor Bay of Bengal Large Marine Ecosystem Project C/o Andaman Sea Fisheries Research Development Center 77, Sakdidej Road Phuket – 83000, Thailand</p>	<p>Tel: + 66 76391861; Fax: + 66 76391864 Email: rudolf.hermes@boblme.org</p>
Bay of Bengal Programme Inter-Governmental Organisation			

49.0	<p>Y S Yadava</p> 	<p>Director Bay of Bengal Programme Inter-Governmental Organisation 91, St Mary's Road, Abhiramapuram Chennai 600 018, Tamil Nadu India</p>	<p>Tel: + 94 44 24936188; Fax: + 91 44 24936102 Email: yugraj.yadava@bobpigo.org</p>
50.0	<p>A Hettiarachchi</p> 	<p>Consultant 90/1/8, Mihindu Place, Ragama Road Kadawatha Sri Lanka</p>	<p>Email: hetti-a@sltnet.lk</p>
51.0	<p>S Jayaraj</p> 	<p>Publication Officer Bay of Bengal Programme Inter-Governmental Organisation 91, St Mary's Road, Abhiramapuram Chennai 600 018, Tamil Nadu India</p>	<p>Tel: + 94 44 24936188; Fax: + 91 44 24936102 Email: s.jayaraj@bobpigo.org</p>
52.0	<p>R Mukherjee</p> 	<p>Policy Analyst Bay of Bengal Programme Inter-Governmental Organisation 91, St Mary's Road, Abhiramapuram Chennai 600 018, Tamil Nadu India</p>	<p>Tel: + 94 44 24936188; Fax: + 91 44 24936102 Email: rmukherjee@bobpigo.org</p>
53.0	<p>Em Shiva Kanth</p> 	<p>Videographer Bay of Bengal Programme Inter-Governmental Organisation 91, St Mary's Road, Abhiramapuram Chennai 600 018, Tamil Nadu India</p>	<p>Tel: + 94 44 24936188; Fax: + 91 44 24936102</p>
54.0	<p>V Sreenivasan</p> 	<p>Administrative Assistant Bay of Bengal Programme Inter-Governmental Organisation 91, St Mary's Road, Abhiramapuram Chennai 600 018, Tamil Nadu India</p>	<p>Tel: + 94 44 24936188; Fax: + 91 44 24936102 Email: V.Sreenivasan@bobpigo.org</p>

The Bay of Bengal Large Marine Ecosystem Project - Collaborative Critical Habitat Management




The Bay of Bengal Large Marine Ecosystem Project
- Collaborative Critical Habitat Management

Rudolf Hermes
Chief Technical Advisor
BOBLME Project

First Bi-National Stakeholder Consultation
on Sustaining the Gulf of Mannar
Rameshwaram, Tamil Nadu, India 05-06 September, 2011

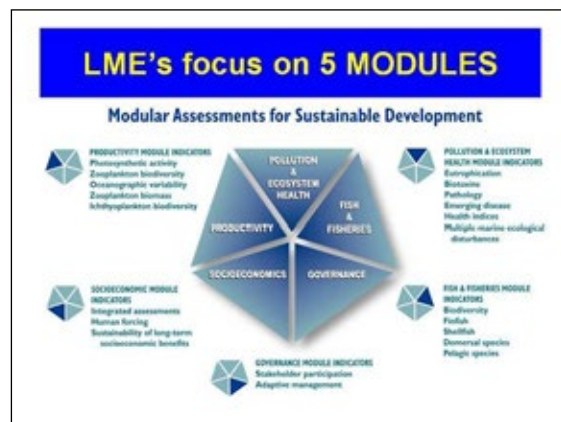
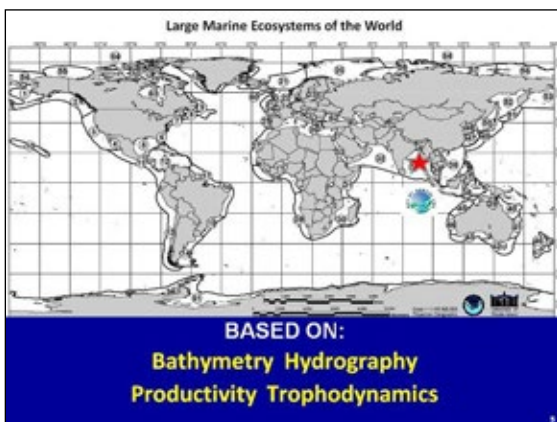


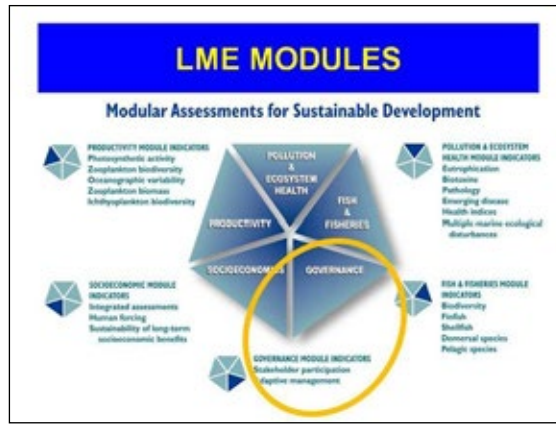
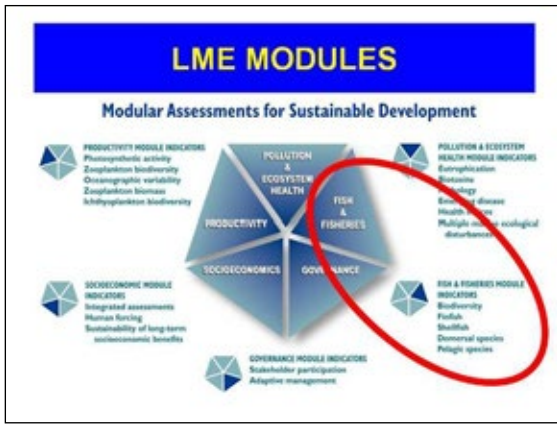
Rapid population growth and high dependence on aquatic resources for food, trade, livelihoods, increased land use are having major impacts on the marine ecosystem



The Bay of Bengal is experiencing

- over exploitation of fish stocks
- habitat degradation
- land based pollution
- uncertainty whether the ecosystem will be able to support livelihoods in the future





Expected outputs of the BOBLME project

1. Trans-boundary Diagnostic Analysis (TDA)
2. Commitment to implement a Strategic Action Programme (SAP)

Expected outcomes of the BOBLME project

- **Stronger governance:**
 - Processes for planning and dialogue
 - Enhanced mechanisms for regional collaboration
- **Improved resource management:**
 - Best practices ✓
 - Better understanding of small-scale fisheries issues ✓
 - Multi-sectoral involvement ✓
 - Healthier ecosystems, sustainable fisheries
- **Improved well-being and resilience of coastal fisher communities:**
- **Better knowledge of:**
 - Fisheries for hilsa, Indian mackerel and sharks ✓
 - BOBLME's large-scale processes and ecology ✓
 - Basic ecosystem health indicators ✓

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Collaborative Critical Habitat Management

"promote multi-national approaches to manage and address issues affecting transboundary coastal/marine ecosystems"

Collaborative Critical Habitat Management

Common issues and unilateral issues identified

- Confirm major issues / priorities
- Identify existing initiatives to build on
- Decide on a collaborative way forward

Collaborative Critical Habitat Management: Gulf of Mannar

Objectives of this Consultation:

- To re-evaluate the importance of GoM for India and Sri Lanka and the present state of the ecosystem;
- To review existing management measures and lessons learnt;
- To learn about the Ecosystem Approach to Fisheries (EAF) as a management paradigm for GoM;
- To identify the key stakeholders and their role in GoM; and
- To reach an understanding on the need of bi-national cooperation in management of GoM and continuation of in-country and inter-country activities toward this.

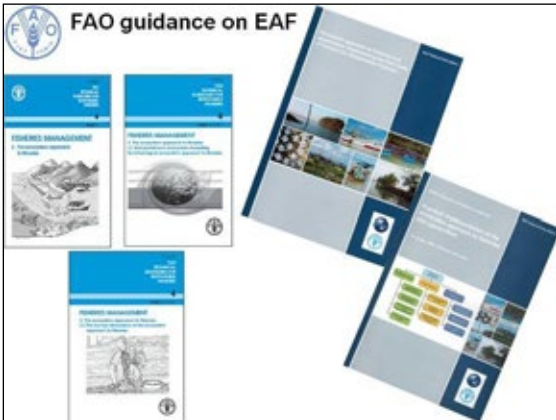
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Collaborative Critical Habitat Management: Gulf of Mannar

- The Governments of India and Sri Lanka have agreed that the Gulf of Mannar is an important critical habitat for both countries
- Through the BOBLME PROJECT they have the scope to work together to establish a collaborative management arrangement
- This will promote, advocate, ensure that decisions on the use of the Gulf of Mannar are made after due consideration of the both ecological well-being and human well-being, and do not compromise the needs of future generations.



BOBLME

FAO

The Ecosystem Approach to Fisheries (EAF) is the approach BOBLME will use to promote sustainable development

Sustainable Development (EAF)

- Ecological well-being
- Human well-being
- Governance - ability to achieve -

Linking EAF to the BOBLME

Ecological well-being

- Assessment of major shared fisheries resources
- Promoting management of critical habitats
- MPA's
- Pollution reduction
- Understanding large-scale environmental processes, climate change health indicators

The image shows a harbor scene with several wooden boats docked at a pier. The water is calm, and the sky is clear.

Linking EAF to the BOBLME

Human well-being

- Community involvement and participation in fisheries and habitat management
- Alternative / sustainable livelihoods
- Improving resilience to extreme natural events

The image is a collage showing a large community gathering with many people, a person in a blue shirt standing near a boat, and a person fishing from a pier.

Linking EAF to the BOBLME

Governance - ability to achieve -

- Policy harmonization
- Coastal management best practices
- Multi-sectoral involvement
- Enhance communication
- Strengthening institutions
 - National government Fisheries/Environment agencies
 - Regional management
- EAFM training

The image shows a meeting with people seated around a table, and a community gathering with people standing under a canopy.

The image shows a beautiful sunset over the ocean with the sun low on the horizon, casting a golden glow across the sky and water.

Thank you for your attention

www.boblme.org

The Gulf of Mannar Ecosystem of India¹

1.0 The Gulf of Mannar Ecosystem

The Gulf of Mannar (GoM) is a unique ecosystem characterized by its rich biodiversity including the corals. It covers a total area of 10 500 sq km located between 8° 35' N to 9°25' N latitude and 78° 8' E to 79° 30' E longitude on the southwest coast of India. The Exclusive Economic Zone (EEZ) of GoM is about 15 000 km² in which commercial fishing is carried out in about 5 500 km² up to a depth range of 50 to 200m.

The GoM ecosystem has a chain of 21 islands extending from Mandapam to Tuticorin, covering an area of 623 ha. The extent of the individual islands varies from 0.25 ha to 130 ha. It is the core area of the GoM Biosphere Reserve, which includes a 10 km buffer zone around the park, including the populated coastal area. The islands (listed southwest to northeast) include four in the Tuticorin group *viz.*, Vaan (16.00 ha), Koswari, (19.50 ha), Vilanguchalli (0.95 ha) and Kariyachalli (16.46 ha); three in the Vembar group: Uppu Thanni (22.94 ha), Puluvinu Challi (6.12 ha), Nalla Thanni, 101.00 ha; seven in the Keelakarai group *viz.*, Anaipar (11.00 ha), Vali Munai (6.72 ha), Poovarasan Patti (0.50 ha) Appa (28.63 ha), Talairi (75.15 ha), Valai (10.10 ha) and Mulli (10.20 ha); seven in the Mandapam group *viz.*, Musal (124.00 ha), Manoli (25.90 ha), Manoli-Putti (2.34 ha), Poomarichan (16.58 ha), Pullivasal (29.95 ha), Kurusadai (65.80 ha) and Shingle island (12.69 ha). Most of the islands have a luxuriant growth of mangrove vegetation along the shore lines and also have highly productive fringing and patchy coral reefs. The sea bottoms of the inshore areas around the islands are carpeted with seagrass beds which serve as a rich nursery and feeding ground of many important species.

The UNESCO initiated the concept of Biosphere Reserve in 1971 in its Man and Biosphere (MAB) Programme with the idea of oneness of humanity transcending national frontiers and recognizing the need for conservation of the vanishing species and habitats. The IUCN commission on National Parks and WWF identified the Reserve as being an area of particular concern given its diversity and special multiple use management status. As the GoM Biosphere Reserve (GOMBR) is the first Marine Biosphere Reserve declared in India (and also in South and south-east Asia), this area has long been a National priority. It extends over 10 500 sq. km with a core area of 560 sq. km, which has a status of a National Park and includes a chain of 21 islands. The intention to declare the 21 islands including 3.5 fathoms depth on the bayside to 5-fathom depth on the seaward side as Marine National Park for the purpose of protecting marine wildlife and its environment is through an Act of the Parliament.

2.0 Resources and ecosystem services provided by the GoM

The GoM is considered as 'Biologists' paradise' because of its extremely rich biological diversity encompassing about 3 600 species of flora and fauna. It is the home to an endemic organism called *Balanoglossus (Phychodera fluva)*, a unique living fossil that links vertebrates and invertebrates. The diverse nature of ecosystems in the GoM supports a wide variety of significant species including 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes and 147 species of seaweeds apart from the seasonally migrating marine mammals like whales, dolphins, porpoises and turtles.

¹ The paper is prepared by G. Gopakumar, K. Vinod and B. Johnson, Mandapam Regional Centre of the Central Marine Fisheries Research Institute, Mandapam, Tamil Nadu, India. Email: drggopakumar@gmail.com.

Seaweed ecosystem

Seaweeds or marine algae are primitive plants without any definite root, stem and leaves. They grow in the inter-tidal and sub-tidal areas of the sea. They flourish wherever rocks, corals and other substrates are available for their attachment. Sea weeds are renewable important marine living resources. The GoM marine area has 147 species of seaweeds. Of these, 42 species are green algae, 31 brown algae, 69 red algae and five species are blue-green algae. About 17 economically important species from agarophytes, carreegenophytes, alginophytes and edible seaweeds have been recorded from this area. Around 5 000 women from 25 villages in the GoM region, especially in the Ramanathapuram district of Tamil Nadu depend on seaweed collection (*Gelidiella acerosa*, *Sargassum* spp., *Turbinaria* spp., *Gracilaria edulis*) for their livelihoods. The collections are done mainly from around the 21 islands in GoM areas.

Seagrass ecosystem

The GoM coast and the Islands are very rich in sea grasses. They are submerged marine angiosperms having adaptation to survive in the saline environment. Thirteen species are found along the GoM area. The sea grass beds provide feeding grounds for the highly endangered sea-mammal *Dugong dugon*. The sea grass beds also provide a suitable habitat for many marine animals for spawning. The sea cow *D. dugon*, which is an endangered marine mammal, is found in this ecosystem.

Mangrove ecosystem

Some of the islands such as Manoli, Manoliputti, Pullivasal and Poomarichan exhibit a rich diversity of mangrove species like *Avicennia*, *Rhizophora*, *Brugueira*, *Ceriops*, *Lumnitzera* and *Pemphis acidula*. The mangrove habitats in the GoM have nine different species of vegetation supporting a variety of marine fauna including seabirds and sea snakes. The mangroves help to prevent coastal erosion and provide food, shelter and breeding ground for many marine organisms including finfish and shellfish.

Coral ecosystem

Coral reefs form an ideal habitat and feeding ground for shrimps, crabs, reef fishes and other various marine animals. Coral reefs absorb carbon dioxide (CO₂) and convert it into calcium carbonate and thus act as carbon sink to reduce the CO₂ content in global environment. They also protect seashore from erosion. The corals are commonly called "Ever green forests of the sea". The coral reefs are very rich in faunal and floral wealth and considered as one of the most diverse marine ecosystems. A total of 82 species of hermatypic corals belonging to 27 genera are reported from GoM Biosphere Reserve (Venkataraman *et al.*, 2003). Dominant genera include *Acropora*, *Montipora* and *Pocillopora* among the ramose forms and *Porites*, *Favia*, *Favites*, *Goniastrea*, *Platygyra* and *Symphyllia* among the massive forms. Some of the species found in this region include *Porites mannarensis*, *Montipora digitata*, *Pocillopora damicornis*, *Acropora formosa*, *Acropora rudis*, *Acropora austera* and *Acropora samoensis*. Recent studies by CMFRI (Rani Mary George and Sandhya Sukumaran, 2007) listed 80 species of hard corals from GOMBR of which 4 species were new records to India and 4 species of *Acropora* were new to science (*A. thomasi*, *A. valimunensis*, *A. mannarensis*, *A. josephi*).

Marine sponges

The sponges are yet another important group of organisms in the reef ecosystem and the GoM ecosystem is also rich in sponge diversity. The species belonging to the order Dictyoceratida and Haplosclerida are dominant. The other common species belong to the order Poecilosclerida, Halichondrida, Dendroceratida and Hadromerida. A total of 275 sponge species belonging to 8 orders, 38 families and 136 genera were recorded by Thomas (1985) from the GoM and Palk Bay. Some of the commonly found sponges include *Clathria* spp., *Endectyon* spp., *Mycale* spp., *Axinella* spp., *Callyspongia* spp., *Spongia* spp., and *Hyatella* spp. An intensive exploration of sponge resources in the GoM is important to understand their present diversity and abundance.

Sea cucumber

The sea cucumbers are an interesting group of purely marine animals. They are a delicacy in far east Asian countries and are consumed in fresh, chilled, frozen, dried and

in processed forms. They find an important place in traditional Chinese medicines. Since sea cucumbers do not offer resistance at the time of capture, they are easily over-exploited. Nearly 200 species are available in Indian waters of which fifteen are used for processing. Some of the important species of the GoM include *Holothuria scabra*, *H. atra*, *H. spinifera* and *Stichopus varigatus*.

All sizes of sea cucumbers are indiscriminately caught without giving a chance to breed atleast once during their life. To prevent collection of smaller forms, the Government of India imposed a ban in 1982 on the export of animals less than 75 mm in length. In 2011, the Ministry of Environment and Forests, Government of India brought all sea cucumbers under Schedule I of the Wildlife Protection Act, 1972 and strictly banned their collection. Due to the ban, livelihood of a few thousand fishing population is now in jeopardy with no alternate profession.

Marine turtles

Five species of marine turtles are known from this area. They are the Hawks bill (*Eretmochelys imbricate*), Green turtle (*Chelonia mydas*), Olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*) and Logger head (*Caretta caretta*). All turtles are listed under the Schedule I of the Indian Wildlife (Protection) Act, 1972.

In 1960s, sea turtle fishing was carried out in GoM and Palk Bay region and live turtle trade existed with Sri Lanka. An estimated 3 000 to 4 000 turtles were landed annually between Rameshwaram and Mimisal during that period and the green turtles represented three-fourth of the catch (Rajagopalan, 1984). A survey by CMFRI in 1977 revealed turtle nesting in Puluvinichalli, Nallathani, Anaipar, Valiamunai, Appa, Valai, Mulli, Hare, Manoli, Manoli-Putti and Pullivasal Islands (CMFRI, 1977). In the Kanyakumari to Trichendur stretch, the core nesting areas existed between Manapad and Periathalai (Bastian Fernando, 1983).

Recent studies on the sea turtles of GoM are poor and therefore, a detailed study on the sea turtles of GoM is essential to understand the distribution, nesting beaches, foraging grounds and their migratory behaviour. The nesting and foraging habitats are to be given top priority in the conservation agenda. The existing nesting beaches have to be identified and protected through community conservation measures. The use of Turtle Excluder Device (TED) also needs to be encouraged in the trawl nets.

Marine mammals

Dolphins, dugongs and whales represent the marine mammals in the GoM. The common dolphins, spinner dolphins and the bottlenose dolphins are common in this region. The sea cow (*D. dugon*) and baleen whale are critically endangered species and the extensive sea grass beds provide an important habitat for the sea cow which is herbivorous and voracious feeder of sea grasses.

Fishery resources

The GoM produces about 20 percent of the marine fish catch in Tamil Nadu. Of the 2 200 fish species distributed in the Indian waters, 450 species have so far been recorded from the GoM waters. More than 50 000 fishermen directly depend on the fishery resources of the reserve for their livelihood. Of the 10 500 sq. km EEZ of GoM, fishing is done in about 5 500 sq. km with a depth range of 50 to 200 meters. In the GoM, more than 90 fishing villages are situated. In Ramanathapuram and Thoothukudi districts, fishes are landed at nearly 89 fish landing centres, of which 7 are major centres. The fishery is multi-species as well as multi-gear with diverse fishing practices. There are around 850 trawlers, 5 300 vallams, 2 100 FRP boats and 300 catamarans operating in the GoM. The major gear operated are trawl nets, hook and line, shore seine, gill nets, drift nets, purse-seine, trammel net, stake net, traps and long lines.

Trawl nets form the dominant gear, followed by gill nets and long line. About 465 species of bony fishes are used as food fish in the GoM region. About 175 species can be used as potential marine ornamental fishes and about 145 species are categorized as trash

fishes, mostly utilized for preparing poultry feed. A total of 68 species of elasmobranches have also been recorded, which include 41 sharks and 27 rays.

The GoM has a rich diversity of finfishes. A total of 734 bony fish species have been recorded from this ecosystem (GOMBRT, 2011). The family Carangidae is represented by 50 species followed by Serranids with 47 species and Labrids by 33 species. The species belonging to families like Acanthurids, Balistids, Chaetodontids, Haemulids, Labridae, Lethrinids, Lutjanids, Mullids, Scarrids, Pomacentrids, Pomacenthids, Serranids, Scorpaenids, Sparids and Syngnathids are fairly represented in the catch. The pelagic fishes like the sardines, anchovies, engraulids and mackerel are caught mainly by gill nets and shore seines. Seer fishes and tunas are caught by surface gill net, drift gill nets and long line. Species like *Sardinella gibbosa*, *S. albella*, *S. sirm*, *S. longiceps*, *Stolephorus commersoni*, *S. indicus*, *Euthynnus affinis* are dominant among the pelagic resources. Seer fish species such as *Scomberomorus commerson* and *S. guttatus* are commercially exploited seer fishes of the GoM, caught mainly by gill net (65%) and hook and line. Four species of silverbellies viz., *Leiognathus equulus*, *L. bindus*, *L. dussumieri* and *L. splendens* are also fishes commercially caught in GoM. The mackerel fishery is supported by *Rastrelliger kanagurta* and tuna fishery is supported by 7 species of tunas viz., *Euthynnus affinis*, *Thunnus albacares*, *Auxis thazard*, *Auxis rochei*, *Katsuwonus pelamis*, *Sarda orientalis* and *Thunnus tonggol*. The pigface breems (Lethrinidae) are abundant in this region and the fishery comprises six species and is dominated by *Lethrinus nebulosus*, *L. miniatus*, *L. harak*, *L. ornatus*, *L. lentjan* and *L. kallopterus*. The fishery of Sphyraenidae is supported by *Sphyraena jello*, *S. barracuda*, *S. picuda* and *S. obtusata*. The goatfish fishery is supported mainly by *Parupeneus indicus* and *Upeneus bensasi*. Among the groupers, *Epinephelus tauvina*, *E. undulosus*, *E. malabaricus* and *Cephalopholis sonneratti* form the dominant catch. The other grouper species that support the fishery include *Epinephelus longispinis*, *E. areolatus*, *E. chlorostigma* and *E. bleekeri*. The snapper (Lutjanidae) fishery is supported by *Lutjanus rivulatus*, *L. fulviflammus*, *L. argentimaculatus*, *L. johni*, *L. russelli*, *L. lineolatus* and *L. vaigiensis*.

The main shrimp species landed in large quantities are *Penaeus semisulcatus*, *P. indicus* and *P. monodon* and those landed in lesser quantities include *Metapenaeus dobsoni* and *M. stridulans*. Of these, *P. semisulcatus* forms the major fishery at Thoothukudi and Mandapam. About 11 species of lobsters have been recorded in the GoM, of which only 3 species viz., *Panulirus homarus*, *P. ornatus* and *P. versicolor* form sizable portion of fishery. Deep-sea lobsters like *Puerulus sewelli* and other scyllarids are rarely caught along the Tuticorin coast. There are about 100 species of brachyuran crabs in the GoM. The Portunid species like *Portunus* and *Charybdis* are commercially harvested by bottom set gill nets, locally called 'Nandu valai'. Part of the catch is also landed by trawl nets as by-catch. The dominant crab species landed include *P. pelagicus* and *P. sanguinolentus*. Species like *Scylla serrata* and *S. tranquebarica* are exported live.

Ornamental fishes

Venkataramani *et al.* (2004) reported 113 species of ornamental fishes while Kumaraguru (2005) reported 115 species of coral fishes belonging to 53 genera and 28 families from the GoM and the Palk Bay. The marine ornamental fishes are caught by shore seines, trawl nets and traps. Some of the common ornamental fishes of the region include *Amphiprion sebae*, *Dascyllus trimaculatus*, *Abudefduf vaigiensis*, *Chaetodon collare*, *C. octofasciatus*, *C. vagabundus*, *Pomacanthus annularis*, *P. semicirculatus*, *Labroides dimidiatus*, *Thalassoma lunare*, *Zebrasoma veliferum*, *Scarus gobban*, *Zanclus cornutus*, *Lutjanus fulviflamma*, *Platex teira*, *Siganus javus* and *Gymnothorax favagineus*.

Molluscan resources

The molluscan fishery is supported by cephalopods, gastropods and bivalves. Squids, cuttlefish and octopus support the cephalopod fishery. Common cephalopod species in the catch include *Loligo duvacelli*, *Doryteuthis sibogae*, *Sepioteuthis lessoniana*, *Loliolus spp.*, *Sepia pharonis*, *S. prashadi*, *S. ramani*, *S. prabahari*, *S. aculeate*, *Sepiella inermis* and *Octopus spp.*

Among the bivalves and gastropods, targeted fishery exists only for the sacred chank, *Turbinella pyrum*. In the GoM, chank exploitation is a regular and organized fishery even today. The shells are sent to the market directly by the divers since the government monopoly over the chank do not exist. The Department of Fisheries of the Government of Tamil Nadu on the basis of licensing from 1993 onwards used to organize the most popular chank fishing in Tuticorin. The chanks are landed at Tuticorin and also at Thiruchendur landing centres. The chanks are found populated in the Paar areas, locally known as Sangu nilam where coarse sand and dead corals characterize the bottom areas. About 49 such Paars extending on an average from 4 to 25 sq km are present in the GoM. The depth of these grounds ranges from 16-24 meters.

In the GoM, the pearl banks extend from Kilakarai to Cape Comorin at depths of 15 to 20m. The northern and southern banks are almost barren and those in the central sector between Kayalpatnam and Vaippar alone remain productive and the fisheries are operated from Tuticorin.

In the earlier days, during sorting of by-catch, various shells were thrown out into the sea as discards. Once the shell-craft industry got established and flourished these gastropods were brought ashore and exclusively sold to the industry. They in turn sold the gastropod shells to the exporters. The most important shells of commercial value include the Button shell (*Umbonium* spp.), Winged shells (Strombidae), the spider shells or the scorpion shells (*Lambis* spp.), Cowries (Cypraeidae), Helmet shells (Cassididae), Hairy tritons (Cymatidae), Frog shells (Bursidae), Murex shells (Muricidae), Rock snails (Thaididae) and Whelks (Nassaridae). In the GoM, the near shore areas of the islands provide a favourable environment for various gastropod species to thrive.

3.0 Sources of information on GoM

Various organizations including research institutions, universities, developmental agencies, non-governmental organizations (NGOs) and private agencies are linked to the GoM ecosystem. The research institutions like CMFRI and the Central Salt and Marine Chemicals Research Institute (CSMCRI) are actively involved in various research programmes in the region. The CMFRI has contributed enormously to the studies on biodiversity assessments and taxonomy of various resource groups including the scleractinian corals, gorgonids, sponges, echinoderms, gastropods, bivalves, finfish and crustaceans. It has also carried out intensive studies on fishery resources and catch estimates over a long period of time. The seaweed biodiversity, biomass estimation and processing of seaweeds for value addition are some of the other contributions of this Institute. The Mandapam Station of CSMCRI has also been a forerunner in research on various aspects of seaweeds.

The Fisheries College and Research Institute, Tuticorin; Centre for Advanced Studies in Marine Biology, Annamalai University; Madurai Kamaraj University and the Sugandhi Devadason Marine Research Institute (SDMRI), Tuticorin are also engaged in conducting various research programmes leading to a better understanding of the GoM ecosystem.

The GOMBRT is an independent governmental statutory body mandated to implement the activities and to play more than an advisory role facilitate appropriate integrated coastal development actions in the biosphere reserve. The Trust is currently co-ordinating implementation of the GEF-UNDP supported project "*Conservation and sustainable use of GoM Biosphere Reserve's coastal bio-diversity*" which was approved during the year 2002. The programme was designed to demonstrate how to integrate bio-diversity conservation into coastal marine management plan and implement the same in a large biosphere reserve with various multiple uses.

The Department of Fisheries, Government of Tamil Nadu is involved in collating information received from various research institutions and in planning and implementation of various developmental programmes for the benefit of different stakeholders involved in fishery. They are also involved in management of fisheries in the GoM. The Department of Forests play an active role in the protection and

conservation of resources in the GoM. Further, NGOs like the MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation are involved in the formation of various Self-Help Groups (SHGs). These SHGs play a vital role in self-regulation in fisheries and generate income through alternate livelihood avenues.

4.0 Quality of information on GoM & suggestions for improvement

A reservoir of information is available on the GoM and its resources. This information, contained in the form of reports, bulletins, leaflets, pamphlets, monographs, books and research papers published by various agencies have given timely and relevant information for use of the stakeholders. Since the research works carried out by various agencies are purely based on their own mandates, the reports or findings vary accordingly. Hence there is a need for a coordinated approach by various agencies to undertake collaborative research programmes in a holistic manner for better understanding of the ecosystem and its resources.

5.0 Ongoing research activities in GoM

The CMFRI has an on-going research project "Understanding the threatened coral reef ecosystems of southern India and developing interventions aimed at their restoration" and also includes GoM coral reef ecosystem. Besides, the Institute is also regularly studying the fishery resources and landings of the GoM. The CSMCRI is at present working on the biodiversity and cultivation of seaweeds in the GoM.

The SDMRI has been conducting long-term coral reef monitoring in the GoM in order to assess the status of reef health, including coral diseases and bleaching due to climate change. The SDMRI is also involved in the FSA survey in the GoM region since 2007 in order to collect baseline data on the reef fish spawning aggregations, species, season and habitats. The Department of Marine and Coastal Studies (DMCS) of Madurai Kamaraj University imparts education in the field of marine sciences. The on-going research projects of the Department are focused on coral reef ecology and conservation, marine pollution and marine ecotoxicology. At present, the University's 'Marine Ecotoxicology Field Research Facility' at Pudumadam in Ramanathapuram District has a project on development of seawater quality criteria for coral reef environment of the GoM. The Centre for Advanced Studies in Marine Biology, Annamalai University is involved in research on mangrove ecosystems of the GoM. They are also working on the captive breeding of syngnathids, particularly sea horses. The Fisheries College and Research Institute, Tuticorin is conducting investigations on the biodiversity of corals and distribution of endangered fauna in the GoM. The Zoological Survey of India (ZSI) is currently studying the status of sea cucumbers in the GoM, a project sponsored by the GOMBRT.

Areas where more research is needed

- A strong database on corals and associated resources on a GIS platform and periodic updating of the database is essential.
- The GoM region is well known for its rich coral diversity in the fringing and patchy coral reefs around the islands. The corals are extremely sensitive to natural as well as man-made perturbations. An increase in sea surface temperature beyond its optimum requirement may lead to coral bleaching. Human interventions, particularly destructive fishing practices do a lot of damage to the sensitive corals. Therefore, it is imperative to standardize the techniques of coral propagation in order to carry out restoration of corals, in already depleted reef areas.
- Monitoring the status of coral reef and the reef-associated fauna on a long-term basis is to be given topmost priority. The studies should also encompass hydrography (water quality, current patterns etc.) and sedimentology (physical & chemical nature) in the coral reef areas.
- The GoM is also known for its rich endemic seaweed resources. Collection of different species of seaweeds has been in practice by the local communities, since ages. The CSMCRI introduced farming of *Kappaphycus alvarezii* as an alternate livelihood option

for the fishermen community. The alternate livelihood avenues would bring down the fishing pressures on the ecosystem. However, there is a continued debate on the invasive nature of *K. alvarezii* and its impact on the corals. Therefore, intensive and long-term research programmes need to be taken up to ascertain the invasiveness of *K. alvarezii* on the corals.

- The GoM is a congenial habitat for marine mammals and is also a home to the highly endangered sea cow, *D. dugon*. Research work needs to be focused on the marine mammals of the GoM including sea cows. There is an urgent need to understand their present status for developing appropriate strategies for their conservation. A proper inventory needs to be evolved by undertaking regular observations on their sightings.
- The coral reef areas being ecologically significant are highly vulnerable to global warming and climate change. Therefore, long-term studies on climate-change in the GoM are of paramount importance to develop suitable mitigation measures.
- The fishing pressure on the ecosystem can be minimized if only the fishers are given alternate options for income generation. Thus, there is a need to undertake research to understand the viable alternate livelihood options, which can be taken up by the fishing community. Technologies for small-scale sea farming of finfish/shellfish/seaweeds etc., which are environment-friendly and economically viable need to be developed, demonstrated and disseminated to the fishers.
- Conservation is yet another area of research priority. The development of propagation techniques for hard and soft corals is an urgent need. Besides, developing viable technologies for breeding of endangered fishes and invertebrates with a view to enhance their natural stock through sea ranching is required.
- Based on the exploited fishery resources data of GoM and by collating with the environmental and other parameters, an ecopath model for sustainable exploitation of different resources of the region can be developed.
- Human interventions have caused lot of changes to the ecosystems, resulting in loss of biodiversity. Valuation of biodiversity is yet another emerging area of interest and such studies need to be undertaken for the GoM ecosystem. Inferring the value of biodiversity requires an in-depth understanding of the links between biological diversity, biodiversity functions, and the services that are subsequently generated. Valuation typically addresses ecosystem services and not just biodiversity alone.
- DNA bar-coding is of paramount importance to many of the resources of GoM. Globally, many investigators working on species specific markers have proposed and initiated DNA bar-coding based on mitochondrial cytochrome C oxidase (COX). Several workers have also validated the effectiveness of DNA bar-codes in fish identification. This effective taxonomic tool should be employed to the diverse resources of GOM, particularly to the endangered groups.

6.0 Existing management measures

The GoM assumes great significance owing to its rich biological diversity and as such many management measures are already in place for the protection and conservation of the resources. The Wildlife (Protection) Act, 1972 provides legal protection to many endangered and threatened organisms like the marine mammals, turtles, some shark species, giant grouper and sea horse, corals, sea cucumbers, gorgonids, etc. Joint patrolling is being carried out by the Departments of Forests and Fisheries, Police and Coast Guard to ensure better protection of the endangered resources of GoM.

The Marine Fisheries Regulations Act (MFRA) was adopted in 1983, amended in 2000 and Rules notified in 1983. The MFRA insists registration of all fishing vessels and licenses required for fishing. Daily tokens are issued to mechanized vessels to venture into the sea. Three/four day rule was adopted in 1990s, which allows for the mechanized vessels to fish for 3 days and small-scale vessels for four days in a week. There is a trawl ban for a period of 45 days every year (closed season). The use of fishing gear with a mesh size of 10mm (knot to knot) is strictly prohibited. Also, pair trawling and purse seining are prohibited.

Apart from these, there are self-imposed regulations initiated by few villages that include prohibition on collection of protected species, destruction of coral reefs, cutting of mangroves and collection of seaweeds only for 12 days in a month. Further, the fishing communities along with the traders and Forest Department officials have also decided to ban collection of seaweeds using destructive methods.

Efficacy of existing management measures

It is well understood that management measure should be directed towards sustainability of natural resources. There is no doubt that a resource which is declining has to be restored by adopting all possible management measures, including total ban on harvesting of the resources, if necessary. However, it is also important that sound database is essential for considering a species or group to be included in the Schedule. It is felt that a realistic long-term database is not yet developed for the major resources of GoM ecosystem. Such a database, if developed, will help in the long-term to evolve appropriate management measures.

Another vital aspect is to review the quality and availability of resources and ecosystem services after implementation of the management measures in order to compare it with the pre-management scenario. This should be given topmost priority and suitable agencies should be identified and the data should be collected to get a real picture. It is understood that in marine resource assessments, many assumptions are made to estimate the stock. However, the methodology adopted and the samplings methodology should be scientifically robust and well accepted.

There is also a lack of coordination and interaction in the implementation by different agencies. This is largely due to the multiple-ownership of the resources. Example - the conservation aspects fall under the jurisdiction of the Department of Forests, while the Department of Fisheries manages the fisheries resources. This dual control of the resource leads to many activities that are detrimental to the health of the ecosystem. Further, the current management measures in the region have not made any serious attempt on alternate livelihood options. Since the management measures are affecting the livelihoods of fishing communities, it would be appropriate to have a participatory conservation approach.

It is evident from the above that certain improvements are essential for the development of effective management measures. Sustainable exploitation of the resources of the GoM can be practiced, with a participatory approach. It is seen that in some parts of the world, the coral reef ecosystem are permitted for sustainable exploitation, which can substantially contribute to the economy. The policy of total ban should be resorted only when it is absolutely warranted. Otherwise, the rules may be flouted with illegal exploitation of the resources, which is more harmful to the ecosystem.

7.0 Climate Change

The coral reefs provide habitat for one-quarter of all marine species. They are at risk from climate change impacts due to increasing temperatures, acidity, storm intensity, sea level rise and non-climatic factors such as over-exploitation, introduction of non-native species and increasing nutrient and sediment loads. Three different time scales can be identified for climate change related impacts to coral reef ecosystem:

- (i) Annual: increased temperature effects on coral bleaching, which have become more frequent and will lead to steady degradation of coral reefs.
- (ii) Decadal: increasing acidification and dissolution of carbonate structures of reefs.
- (iii) Multi-decadal: weakening of structural integrity of reefs and increasing susceptibility to storms and erosion events as a result of increased temperature and acidification, leading to large-scale composition shifts.

It is clear that large-scale weakening and erosion of coral reefs over a long-term will severely impact the animals which depend on these reefs for their food and habitat. The GoM is predominantly a coral reef ecosystem and hence any serious damage to the corals due to climate change can lead to a total collapse of the ecosystem in the long run. The research on climate change in the region is practically in infancy and it is also felt that the few investigations carried so far are of elementary nature. It is, therefore, essential that long-term monitoring of parameters related to the impact of climate change on coral reefs and associated resources is undertaken.

8.0 Proposed/expected actions of Government

It is noted that many agencies are involved in the collection and collation of research data, evolving conservation measures and implementation of management policies. In addition, there are different stakeholders who are dependent on the resources and ecosystem services in the region. A proper co-ordination and consultation between the different agencies involved is essential. Presently, each agency is adopting a stand-alone approach and the data obtained is fragmentary and inadequate. Thus an integrated approach may be adopted. In this regard, the Government may constitute a committee incorporating all the agencies involved in the research and management of GoM and also include representatives of all the stakeholders who are dependent on the ecosystem services for their livelihood. The Committee should interact at regular intervals and make necessary recommendations to the Government for implementing the management measures.

Prior to eighties, the CMFRI was the only research institution involved in R & D activities on marine resources in the region. However, now many other agencies are working on the GoM ecosystem. It is observed that this development has brought not only duplication of work but also contradictions in research findings. To stop this wasteful exercise and also confusion, it is suggested that a Research Advisory Committee (RAC) for the entire GoM ecosystem may be constituted involving all the concerned R&D Institutions working on the GoM. The RAC should be empowered for screening and evaluation of the research projects and their regular monitoring.

Even though the Department of Forests is vested with the implementation of management measures, this Department has limitations because of the lack of in-house capacity to deal with matters concerning marine ecosystem. Hence, for the effective management of the GoM ecosystem, it is proposed to involve scientists from the R&D Institutions, which can result in better management of the GoM ecosystem.

Providing alternate livelihood options is a matter of serious concern. Any awareness programme on the need of regulation of exploitation of resource is futile if alternate livelihood options cannot be provided to the fisherfolk who are dependent on the resources for their livelihood. In this context, small-scale mariculture practices can be encouraged as alternate livelihood options. Certain areas of the GoM can be demarcated as mariculture zones where small-scale sea-cage farming, seaweed farming, lobster and crab fattening, oyster farming, ornamental fish culture and integrated farming of finfish and shellfish with seaweeds can be promoted by Government agencies.

Government R&D Institutions should also have free access to the GoM for authorized research programmes and for collection of data and specimens. The hatchery production of seed of many depleting species is possible only by collecting the brood stock of the concerned species from the wild. If brood stock collection of such species is not easily allowed, it will affect the progress of productive research.

Currently there are accepted methodologies for enhancement of stock of depleted resources. In this regard, conservation, mariculture involving seed production of the target species and large-scale sea ranching can play a significant role. The process is a non-commercial activity which has to be practiced on a massive scale involving R & D institutions and a host of voluntary agencies. Policies for providing incentives to authorized voluntary agencies involved in such conservation and stock enhancement programmes will go a long way in the replenishment of many stocks.

9.0 Scope for co-operation in information collation and research

A perusal of the voluminous literature accumulated on GoM reveals that much information is scattered and fragmentary. The efforts taken for compilation of bibliography of GoM by CMFRI and GOMBRT (in association with MKU) are commendable. However, a collection of research results by different research agencies is lacking. There

is duplication of research work by different institutions and thus that there is a need to prepare a compendium on the information available on various resources of the region contributed by different research institutions. The compendium can throw light on the status and quality of the information besides revealing the areas where more research is needed. Based on the compendium, future research programmes can be formulated.

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The Gulf of Mannar Ecosystem of Sri Lanka^{2,3,4}

1.0 Gulf of Mannar Ecosystem (GoM) within the maritime boundary of Sri Lanka

The Gulf of Mannar (GoM) is a large shallow bay in the Indian Ocean and lies between the southeastern tip of India and the west coast of Sri Lanka. Its width ranges between 160 and 200 km. A chain of low islands and reefs known as Adam's Bridge, also called *Rama Sethu*, separates the Gulf of Mannar from the Palk Bay, which lies to the north between India and Sri Lanka. There are four coastal administrative areas [Divisional Secretariat Divisions (DSDs)] of Mannar District bordering the Gulf of Mannar (GoM), namely Musali, Nanaddan, Mannar and Mantai West, and two coastal DSDs of Puttalam District, namely Kalpitiya and Vanatavillu. The terrestrial habitats within those six DSD were also included in the GoM ecosystem.

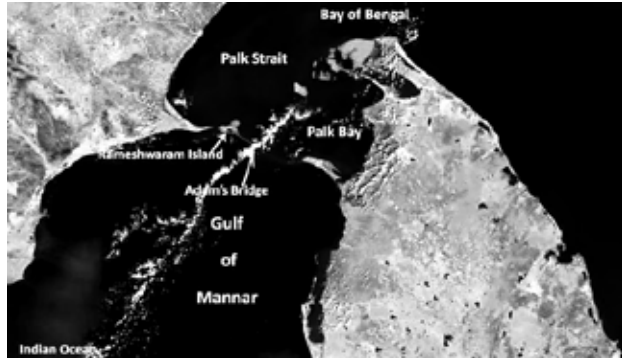


Figure 1: Location of the Gulf of Mannar (Source: Google Earth, 2011)



Figure 2: Map of lagoon estuaries and rivers

There are nine major rivers covering a land area of 9 113 km², apart from seasonal, minor streams that flow to the Gulf of Mannar. These main rivers from Mantai West to Vannatavillu DSDs discharge about 1 706 MCM fresh water into the coastal areas annually. Along the coastline are two small lagoons: Periya Kalapu and Vidattaltivu Lagoon and one large estuary: the Puttalam estuary (many call it Puttalam lagoon) (Fig 2). GoM has biodiversity-rich ecosystems that are providing valuable services. Coastal and marine, forests, inland wetlands, and agricultural lands are major coastal and terrestrial habitat types found here.

The marine and coastal ecosystems represent the entire range of such ecosystems in Sri Lanka, including coral reefs, sea grass beds, mangrove, salt marshes, tidal mud

² Paper prepared by Shamen Vidanage, Kumudini Ekaratne and Sampath Goonatilake. International Union for Conservation of Nature (IUCN), Sri Lanka Country Office. 53, Horton Place, Colombo – 07, SRI LANKA, Email: Shamen.VIDANAGE@iucn.org.

³ The paper is largely based on IUCN (2011). Biodiversity and Socioeconomic information of selected areas of Sri Lankan side of the Gulf of Mannar: report submitted by IUCN Sri Lanka Office to BOBLME Project Component 2.4 Collaborative Critical Habitat Management: Gulf of Mannar and the Cumarantunga, P R T, Kumara, P B T P, Jayasinghe A, Arachchige, T P K, Kumara P, Darshani, S, Perera A, Samantha A H R and Haleem A R M (2010). Rapid Biodiversity Survey of the Proposed Mannar Biosphere, Sri Lanka a report submitted to IUCN by University of Ruhuna with financial support from Mangroves for the Future (MFF) Initiative.

⁴ In this paper the GoM ecosystem is defined broadly including terrestrial habitats of the coastal Divisional Secretariat Divisions bordering the Sri Lankan side of the Gulf of Mannar.

flats, sand dunes, sandy coastal islets, pearl beds, lagoons and estuaries. The area harbours the largest tracts of sea grass beds, as well as the largest tract of intact mangrove (Kala-oya estuary) in Sri Lanka. The GoM contains the single largest coral reef systems in Sri Lanka – Bar reef marine sanctuary, which consist of true coral reefs and sandstone reef habitats.

It also provides important refuge (feeding and breeding grounds) for a wide range of marine and brackish water fish, marine reptiles, sea birds and marine mammals. The shallow marine areas, together with the sea grass beds, mangrove and rivers discharging into the sea (*i.e.*, Kala-oya, Moderagam ara, Aravi ara, etc.) have all contributed to a high productivity in this area, supporting a diverse marine life. The most common terrestrial natural vegetation types are tropical dry mixed evergreen forest and dry thorny scrubland found on the coastal DSD bordering the GoM (IUCN, 2011).

2.0 Description of resources and ecosystem services provided by GoM, especially in Sri Lankan context. This should also include description of the length and breadth of its domain where people earn their living from GoM

The terrestrial habitats of the GoM possess 12 percent of the flowering plant species found in Sri Lanka. A total of 583 plant species (in 119 families) have been recorded and among them eight species are endemic and 11 species are nationally threatened (IUCN, 2011).

A total of 496 inland faunal species have been recorded within the inland coastal habitats of GoM, including 31 endemic, 66 migratory birds, two introduced freshwater fishes and eight domesticated mammals. Among them, 46 species have been recognized as nationally threatened (IUCN, 2011).

Most of the previous studies related to marine habitats have been carried out within the GoM and north-western province of Sri Lanka is confined to Kalpitiya and Mannar (Ohman *et al.*, 1997, Rajasuriya *et al.*, 1998, Siriwardena 2003 and Bambaradeniya *et al.*, 2005 a & b). During these studies, 122 stony coral species (Rajasooriya *et al.*, 1998) and more than 300 reef and reef associated fish species (Ohman *et al.*, 1997) from the Bar Reef located in the Southern Gulf of Mannar have been observed.

Bambaradeniya *et al.* (2005) have also recorded 43 species of marine and/or brackish water fish species from the Kalpitiya North. Eighty six (86) species of birds have been observed from Kalpitiya North area, Mannar and Adams bridge Islands by Siriwardena (2003) and Bambaradeniya *et al.* (2005 a & b). More detailed studies from the different reefs located within the Palk Bay are not available due to the civil disturbances in this area during the last three decades, which prevented carefully designed scientific reef surveys.

A recent survey conducted from 20 February to 31 March 2010 by the University of Ruhuna gathered a wealth of information. The survey team visited the area on two occasions, from 20 to 25 of February and 20 to 26 of March. Thirty one (31) sites were surveyed.

Coral species

Reefs of Mannar (off Pallimunai), Arippu, Silavatturai, Vankalai and Bar reef were surveyed in 2010 by the University of Ruhuna. Silavatturai and Arippu reefs extend South North direction starting from Silavatturai area through Arippu towards the tip of the Thalaimannar headland. Both Silavatturai and Arippu reefs are rich with live coral cover. Healthy, monospecific strands of *Echinopora Lamellosa*, *Porites cylindrica* and various *Acropora* species were observed. In addition to that, healthy populations of reef fishes were also observed. Some patchy areas were found recently dead, mostly because of the bleaching caused by 1998 El Niño event. However, the signs of human impacts were frequently observed, mainly through fishing activities on and around the reef. As a result, number of entangled nets was observed on the live coral colonies. In addition to

that, number of boat anchor damage, boat grounding and coral trampling damages were also observed (University of Ruhuna, 2010).

Of the coral reefs surveyed during this study, 31 species were recorded from the Bar Reef Marine Sanctuary, the single largest coral reef system in Sri Lanka, which consists of true coral reefs and sandstone reef habitats. In the other reefs, Silavatturai, Arippu, Vankalai and Pallimunai, 15, 13, 9 and 13 species were recorded respectively. Corals belonging to Acroporidae were quite common in all these reefs. Coral belonging to Family Acroporidae (*Acropora hyacinthus*, *A. latistella*, *A. Formosa*, *A. cythrea* and *Montepora aequituberculata*), Family Pociliporidae (*Pocilipora damicornis*) and Family Favidae (*Echinophora lamellose*) were common to all five reef sites included in the present survey (University of Ruhuna, 2010). *Montepora speciosa*, *Pocilliopora verucosa*, *Oulophillia crista* were observed only within the Bar Reef. *Acropora robusta* was observed only in the reef off Pallimunai in Mannar. These observations indicate that Bar Reef within the GoM has the highest coral diversity followed by Silavatturai.

All reef sites included in the present survey could be categorized as very sensitive ecosystems because in addition to the reef forming organisms observed in them many other associated species including reef fish and fish larvae were also observed. Shoals of fry of *Hemirhamphus* sp. were observed within the reef site off Pallimunai, Mannar during the survey in March 2010 (University of Ruhuna, 2010).

The reef off Pallimunai is very shallow (0.5 – 2.0 meters), compared to other four reefs studied. The reef is surrounded by large extents of sea grass ecosystems. The water depth around the reef is in the range from 1-3 meters and rich with sediments. Coral cover mainly comprises branching and foliaceous corals such as *Acropora*, *Montipora* and *Echinopora* sp. Most of the time, the live coral cover exceeded 80% in this reef.

Reefs in Arippu and Silavatturai are affected by sedimentation. Reefs in all sites should be conserved as they have unique diversities. In Arippu and Silavatturai corals are affected by sedimentation and seaweed growth over the corals was evident in certain areas due to eutrophication. This could be a result of anthropogenic activities in the North-Western Province. However, all the reefs surveyed herein can be categorized as very sensitive eco-systems with respect to their biodiversity, especially due to the presence of a live coral cover. To study the distribution of corals more investigations should be carried out (University of Ruhuna, 2010).

From November 2010 to January 2011, IUCN conducted a rapid socio-economic and terrestrial biodiversity survey in GoM area. The area identified for this survey comprised four coastal DSDs of Mannar District bordering the GoM, namely Musali, Nanaddan, Mannar and Mantai West, and two coastal DSDs of Puttalam District, namely Kalpitiya and Vanathavillu. All information contained in the report was gathered through secondary sources, consultations with local officials, key informants' interviews and field observations.

Floral diversity

Over 50 percent of the district is under forest cover; largely tropical dry mixed evergreen forest and dry thorny scrublands (Fig. 3). The Mannar Island and a coastal belt of the mainland have been identified as arid zones based on their climatic features. Consequently the vegetation is largely dry, thorny scrubland with isolated trees. The scrubland is the secondary vegetation that has developed after clearing of primary forest.

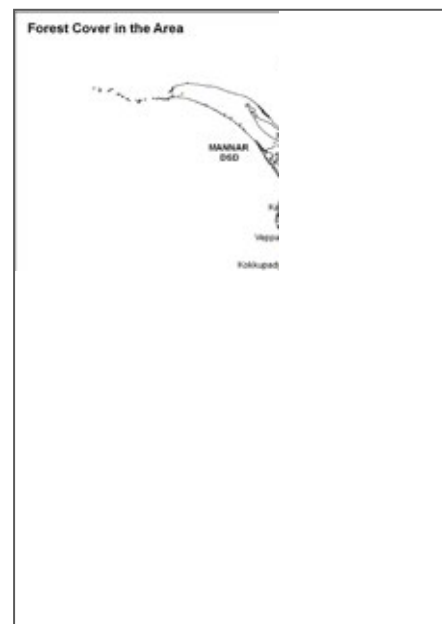


Fig. 3: Forest cover in the study

The mangroves and salt marshes are distributed predominantly in the coastal areas of Puttalam lagoon and along the coastal stretch from Vankalai to Vidattaltivu. The current survey recorded a total of 583 plant species (in 119 families) from Mannar Bay and the coastal belt from Kalpitiya to Puttalam. Among them, eight species are endemic and 11 species are nationally threatened (IUCN & MENR, 2007). Among the endemic species, *Vernonia zeylanica*, *Cassine glauca* and *Dendrophthoe ligulata* were recorded from the coastal belt. *Cynometra iripa*, *Scyphiphora hydrophyllacea* and *Psilanthus wightianus* are critically endangered species. *Diospyros ebenum* and Wal- *Tragia plukenetii* are endangered species in the dry mixed evergreen forest. *Jatropha glandulifera*, which has been recorded only from Mannar and Matale districts and *Pancratium biflorum* which has a limited distribution in the country were also recorded along the GoM coast.

Mangroves

The largest mangrove area in the country is recorded in the Kala Oya and Malwathu Oya estuaries, which are connected to GoM. *Avicennia marina*, *Rhizophora mucronata*, *Sonneratia alba*, *Ceriops tagal* and *Excoecaria agallocha* are the dominant species, and are distributed in more saline and flat land areas. *Avicennia marina* is more abundant as a mono-specific species towards inland areas. Associate mangrove species such as *Clerodendrum inerme*, *Thespesia populnea*, *Hibiscus tiliaceus* and *Tamarix indica* were also found.

Salt marshes

The GoM area is rich in salt marsh vegetation than other coastal areas of the country. Salt marshes are often associated with mangrove habitats and found in the inter-tidal flats of sand, silt or clay; especially in flats protected by bars and cliffs from erosion by sea waves and currents.

In most areas plants include perennial herbs such as *Suaeda monoica*, *S. vermiculata*, *S. maritima*, *Salicornia brachiata*, *Halosarcia indica* and *Sesuvium protulacastrum* as the dominants that cover the bare ground, with prostrate and upright shoots. The *Halosarcia indica* cover is able to trap wind-borne sand, prevents wind-induced erosion and also enhances nutrients in the soil. Some species show green, brown and red colouration enhancing the scenic beauty of the area.

Salt marshes also function as an important habitat and feeding ground for coastal aquatic and migratory birds due to the high abundance of benthic invertebrates. *Suaeda maritima* is used as a leafy vegetable by the coastal communities.

Mud flats

Mudflats are sedimentary inter-tidal habitats created by mud deposition in low energy coastal environments, particularly in sheltered areas during the low tidal season (Pathirana *et al.*, 2008). These sediments consist mostly of silt and clays with a high organic content and are associated with seagrass meadows. Mudflats are found scattered around Mannar islands and Mantai West area lagoons and bays; e.g. Vankalai and Palakamunai (IUCN, 2011).

Sea grass meadows

Sea grass meadows are found in the shallow areas of sub tidal zone and are a major aquatic habitat type in the study area. They grow either homogeneously or heterogeneously in mixed populations forming thick and dense meadows on muddy, sandy, clay soil of the coastal area. The study area is a favourable habitat for seagrass due to shallow and limited water movement.

During the 2010 IUCN survey, seagrass species such as *Enhalus acoroides*, *Thalassia hemprichii*, *Syringodium isoetifolium*, *Cymadocea rotundata*, *Cymadocea serrulata*, and *Halophila sp.* were recorded. Seagrasses help reduce surface erosion in the sedimentation areas and maintain the nutrient cycle.

Sea weeds are also seen associated with seagrasses and are associated with micro or macro green, red, brown and blue green algae. One of the green algal species (*Gracilaria*

spp.) has been used to make a delicious drink, and currently it can be seen in a limited area. Harmful and unsustainable fishing methods such as drag nets and beach seine have led to the degradation of seagrass meadows with an indirect adverse effect on fish catch in the area. Seagrass beds are also affected by unplanned establishment of fish landing sites and fishing boats.

Sand dunes and beaches (including seashore vegetation)

The sand dune and beach vegetation occurs above the high tide mark, which is least affected by tidal action in the coastal areas where the land is gently sloping towards the sea. The hillocks of sand dunes are infertile land that supports vegetation, especially creeping species such as *Spinifex littoreus* and *Launea tomentosa*, etc. The coastal beaches are dominated by *Cynodon dactylon*, *Spinifex littoreus*, *Cassia auriculata*, *Phoenix pusilla*, *Dichrostachys cinerea* and *Borassus flabellifer* towards the land side.

Faunal diversity

The GoM area comprises a variety of marine and brackishwater ecosystems. Additionally, terrestrial and freshwater ecosystems such as tropical dry mixed evergreen forests, scrub forests, villus, rivers and manmade tanks can be observed in the vicinity of the coastal belt of the GoM. Due to the close proximity to the Indian mainland, GoM coastal ecosystem harbours a large number of migratory bird species, which directly land from the Indian mainland during the winter migratory period (Bambaradeniaya *et al.*, 2007). During the annual water bird census, a total of 166 300 water birds were recorded from this region (Talaimannar, Adams bridge, Vankalai) in 2003 (Siriwardena, 2003). Therefore, these ecosystems are important as feeding, resting, and roosting grounds for migratory birds.

A total of 398 vertebrates including freshwater fishes, amphibians, reptiles, birds, and mammals and 98 invertebrates (dragonflies and butterflies) were reported within the six coastal DSDs in the GoM. The vertebrates comprise 31 endemic and proposed endemic species, 66 migrant bird species, two introduced freshwater fishes and eight domesticated mammal species. Among the recorded species five are listed as Critically Endangered (CR), 10 as Endangered (EN), 31 as Vulnerable (VU), 36 as Near Threatened (NT) and four as Data Deficient (DD) in the 2007 Red List of Threatened Fauna and Flora of Sri Lanka (IUCN & MENR, 2007).

There are 36 freshwater fish species recorded in the freshwater bodies (such as rivers, tanks, channels, etc) along the coastal region, mainly spread out along the Vanathavillu, Musali and Nanaddan DSDs. Six endemic species, *Labuca lankensis*, *Puntius melanomaculatus*, *P. singhala*, *Clarias brachysoma*, *Orizias cf. dancena*, and *Channa ara* have been recorded from previous surveys. Two freshwater fish species were identified as Nationally Vulnerable (IUCN & MENR, 2007).

Amphibian diversity in the region is much lower compared to the other faunal groups. A total of 17 amphibians were recorded in inland water bodies and amongst them were three endemic amphibians (*Bufo atukoralei*, *Polypedates cruciger*, and *Hylarana gracilis*), which were recorded along the riverine forests at the Kala Oya, Modaragan Ara, Kal Ara, and Malwatu Oya (IUCN, 2011).

A total of 69 reptile species were recorded within the region and among them were three marine turtles (*Chelonia mydas*, *Lepidochelys olivacea* & *Erytmochelis imbricata*) and 10 species of sea snakes. The GoM is known to be an important foraging site and a migratory route of e *Erytmochelis imbricate* population inhabiting the South Asian marine region (Kapurusinghe and Cooray, 2002). The GoM also provides habitats for 10 endemic species, 14 nationally threatened (2-CR, 4-EN and 8-VU) and six Near Threatened species (IUCN & MENR, 2007). *Bungarus caeruleus*, *Naja naja*, *Daboia russelii* and *Echis carinatus* are the lethal venomous snakes in the region. The lizard, *Chamaeleo zeylanicus* is confined to this arid region, especially in the scrub forests and is a Near Threatened species (Somaweera & Somaweera, 2009). The Critically Endangered *Gerarda prevostiana* has been found in the Kala Oya estuary; there are only five known

sightings of this species from the vicinity of the Kelani basin, Negombo Lagoon, and Kala Oya basin (Somaweera, 2006).

Birds are the most significant faunal group in the GoM. Adams' bridge and Mannar Island are important gateways for migratory bird species into the country from the Indian mainland. A total of 205 bird species have been recorded along the coast of the GoM (IUCN, 2011). Among them 66 species were identified as migratory species. Most of the water birds use mud flats around the Vankalai, Vidattativu and Mantai West as their first resting and feeding ground. Three endemic and five proposed endemic bird species were also recorded in the forest areas of the region especially Musali, and Vanathavillu DSDs. The GoM also provides shelter for eight Nationally Threatened species (2-CR, 1-EN and 5-VU) and 16 Near Threatened species. Critically Threatened *Anas poecilorhyncha* and *Sterna saundersi* are known to breed only in the Mannar region. Most of the forest occurring species take refuge in the Vanathavillu and Musali DSDs where the tropical dry-mixed evergreen forests yet remain. Wilpattu National Park provides shelter to a large number of native and migratory bird species within its different habitat types. Healthy populations of *Francolinus pondicerianus* can be seen as small flocks in the open habitats along the region. This species was a popular game bird among the hunters during the colonial period.

A total of 59 terrestrial mammal species and 13 marine mammals have been recorded from the GoM region (IUCN, 2011). Among them four species are endemic (*Macaca sinica*, *Semnopithecus vetulus*, *Paradoxurus stenocephalus* and *Moschiola meminna*), and eight species are introduced. Northwest sub-species of endemic Purple Faced Langur (*Semnopithecus vetulus harti*) population can be seen in the riverine forests at Kala Oya and Modaragan Ara. This sub-species has unique morphological features compared to the neighbouring dry zone sub-species (*S. v. philbrikii*) which can be seen in the North Central Province and the Eastern Province. *Elephas maximus* is only found in the deciduous forest and scrub lands in the Vanathavillu and Musali DSDs. Elephant aggregations were observed near the freshwater waterholes at Illuvankulama and Periya kalapu areas in the Wilpattu National park during the dry season. Elephants were found roaming in the Musali DSDs where the new resettlement sites were established. In future, elephant-human conflict may be expected within these areas with the establishment of agricultural lands.

A healthy feral Donkey (*Equus asinus*) population can be seen in the Mannar Island and three colour forms were observed. Four Nationally Endangered and eight vulnerable mammal species were recorded in the area. Among the threatened endangered species, *Hipposideros galeritus*, *Kerivoula picta*, *Prionailurus rubiginosus* and *Melursus ursinus* are found in the Wilpattu National Park in the Vanathavillu DSDs (IUCN, 2011).

The largest mammal of the world, *Balaenoptera musculus* which is globally endangered, is also observed in the GoM. *Dugong dugon*, which was one of the common marine mammals recorded a few decades back is now found occasionally. During the study period, two dugongs were killed by fishermen using dynamite and were intercepted by security forces while being brought ashore for sale.

A total of 14 dragonflies and damselflies were recorded from the region. Among them *Pantala flavescens* is the most common species which was found throughout the region. A rare damselfly, *Pseudagrion decorum* that had been recorded from the Giant's tank in Mannar by Bedjanic *et al.* (2007) was not recorded during the current survey.

Butterfly fauna of the Wilpattu National Park (Vanathavillu DSD) and Kalpitiya Peninsula (Kalpitiya DSD) has been well studied (Weeratunga, 2009; IUCN, 2010). Of the 84 butterfly species that have been recorded along the coastal region of GoM, five were Nationally Threatened species - *Azanus ubaldus* being Critically Endangered and *Colotis fausta*, *Colotis aurora*, *Chilades parrhasius* and *Deudorix epijarbas* being Vulnerable - and another eight were Near Threatened species (IUCN & MENR, 2007).

The invasive species, *Prosopis juliflora*, Water hyacinth (*Eichhornia crassipes*) and Cat's tail (*Typha angustifolia*) are spreading rapidly. The uncontrolled grazing by goats, cattle and donkeys that goes on is a matter of concern.

Livelihoods

Fishery

Fishery is the backbone of the people living around GoM. As at August 2010, 28 852 people in the Mannar district, belonging to 7 813 families, are dependent on the marine fishery sector. Of these 7 547 are listed as active fishers. A large number of fishermen from the adjacent Puttalam District too engage in fishing within the GoM.

Mannar District comprises 06 Fisheries Inspector Divisions (FID), covering 38 fishing villages (Table 1). These 38 villages have 50 landing sites.

Table 1: Fisheries Inspector Divisions in Mannar District

DS Division	FI Division	Fishing Village	No. of Fishing Villages
Mannar	Pesalai	Thalaimannar West, Thalaimannar Pier, Thalaimannar Station, Nadukkudah, Sriskanda; Pesalai	6
	Erukkalampiddy	Siruthoppu; Periyekarisal; Sinnakaraisal; Puthukkudiyiruppu; Erukkalampiddy; Tharapuram	6
	Mannar	Pallimunai, Panankaddikooddu Thalvupadu, South Bar; Periyakadai, Uppukulam	6
Nanaddan	Nanaddan	Vankalai; Naruvilikkulam; Achankulam	3
Musali	Silavatturai	Arippu; Saveriyar Puram; Thomaiyar; Silavatturai; Kulankulam; Kokkupadayan; Kondachchi; Kondachikudah; Karadykuli; Mullikulam	10
Mantai West	Vidattaltivu	Pappamoodai; Vidatalative; Kalliady; Illuppaikadavai; Anthonyar Puram; Monrampiddy; Thevenpidy	7
Total	6		38

The number of fishing households and active fishers in Mannar District over the period 1972 to 2010 is given in Table 2. It reveals the large scale movement of people since 1996, in and out of the district, in response to the war situation. The numbers in 2010, after the dawn of peace are the highest on record.

Table 2: Number of fishing households and active fishers in Mannar District, 1972–2010

Variable/Year	1972	1989	1996	1999	2004	2008	2010
Fishing households	2 093	5 127	6 000	4 175	7 300	5 810	7 813
Active fishers	2 848	5 684	5 900	4 593	5 400	5 960	7 547

Sources: Assistant Director of Fisheries, Mannar; Ministry of Fisheries & Aquatic Resources Development (MFARD)

Fishing crafts

Several types of fishing crafts are used in the GoM. These include inboard engine multi day boats (IMUL), inboard engine 1day boats (1DAY), out-board engine fibre reinforced plastic boats (OFRP), motorized traditional boats (MTRB), non-motorized traditional boats (NTRB) and non-motorized beach seine boats (NBSB). There were 2 223 registered boats in the Mannar District as in August 2010 (Office of ADF, Mannar). Composition of crafts operated from Mannar district is given in the Table 3 below.

Table 3: Type and number of fishing boats in 2006 and 2010, by DSDs, in Mannar District

DSD	IMUL		IDAY		OFRP		MTRB		NTRB	
	2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
Mannar	0	9	51	85	947	1 050	74	73	265	342
Nanaddan	0	0	0	0	321	223	0	0	2	0
Musali	0	0	0	0	210	229	0	1	22	90
Mantai West	0	0	0	0	136	59	99	38	130	10

Source: Mannar Statistics Book, 2010

Composition of the fish catch

The composition of the fish catch at the different landing sites surveyed did not vary much. As depicted in IUCN, 2011 the composition of the fish catch is given below.

Marine sector

The total catch of finfish, crustaceans, echinoderms and chanks in Mannar district for 2008 and 2009 was 5 735 MT and 6 528 MT, respectively. According to finfish catch data for July 2010, *Ilisha spp.* dominated the catch (64 400 kg) followed by *Hilsa kelee* (Kelee shad/seriya – 52 390 kg), carangids (51 195 kg), rock fish (38 690 kg) and rays (21 255 kg). Other fin fish varieties totalled 155 840 kg. Of the crustaceans and echinoderm varieties, 65 280 kg of sea crabs (*Portunus pelagicus*/blue swimming crab), 28 750 kg of squids and cuttlefish, 19 720 kg of prawns (*Penaeus spp.*) and 5 420 kg of sea cucumber had been harvested during July 2010 (*Assistant Director of Fisheries, Mannar, personal communication*). The fish production for the month of July in 2008, 2009 and 2010 is 397 932, 594 559 and 551 503 kg respectively, showing a slight decline in July 2010.

Prices of fish are more or less the same at all landing sites surveyed. Seer fish is sold at Rs 400-500/kg, queen fish (*Scomberoides spp*) at LKR 500/kg, carangids at LKR 350/kg, sea cat-fish (*Arius spp*) at Rs 150/kg, *Mugil spp.* at LKR 400/kg, pony fish (*Leiognathus* and *Secutor spp*) at LKR 100-150/kg and *Sardinella spp.* at LKR 60/kg.

Inland fishery

Oreochromis spp., *Channa striata* (striped snake-head or Murrel), freshwater *Macrobrachium spp.* and mud crabs dominate the inland catch.

Dry fish production

Dry fish production takes place at *wadis* (drying centres) located close to landing sites. Landing site survey reveals sea catfish, rock fish, *Scomberoides commersonianus* (Talang queenfish), rays, *Strongylura leiura* (banded needlefish), *Secutor insidiator* (Pugnose ponyfish) as the dominant species. The highest price is fetched by Talang queenfish (LKR 350–700/kg). Rock fish (*Liza spp.*, *Mugil cephalus*) is sold at LKR 400/kg and banded needlefish, sea catfish and Pugnose ponyfish are sold at LKR 300, LKR 150 and LKR 100 per kg respectively.

Of the landing sites/fishing villages surveyed, Mannar DSD has the highest number of dry fish centres; Pallimunai has 15 centres and Panankaddikoodu and Periyakadai fishing villages that share a common landing area have three centres; and Talaimannar Pier is reported to have 20 centres. In Nanaddan DSD, Vankalai fishing village has 10 centres while Kondachikudah, and Arippu in Musali DSD has one and five centres respectively. Total dry fish production in Mannar District in July 2010 was 59 245 kg, with the highest production from Nanaddan FID (20 250 kg), followed by FIDs of Pesalai (17 100 kg), Vidattaltivu (9 925 kg), Silavatturai (6 620 kg) and Mannar (5 350 kg). Carangids, *Sardinella spp.* and rock fish were the dominant varieties produced in July with 14 525 kg, 12 640 kg and 6 640 kg respectively (*Assistant Director of Fisheries, Mannar, personal communication*).

In many places visited, fish was being dried under unhygienic conditions with crows and dogs having free access to the drying areas. Bulk of the salt requirement for dry fish is purchased from Mantai Salt Ltd in Mannar and the prices range from Rs. 800-900 per 50 kg. Dry fish centres in Pallimunai also purchase salt from Puttalam at Rs. 700 per 50 kg. Holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) are being collected without permits and without conforming to the recommended sizes. This will affect the sustainability of this sector.

The entire Mannar coast does not have a proper fishing harbour. All fibreglass boats and other smaller boats land on the beach while trawlers and multi-day boats anchor in the sea. Fish marketing is not well organized; middle men make unjust profits at the expense of the fishermen. Other issues of concerns related to fishery are insufficient ice

production, unsatisfactory handling of fish resulting in quality deterioration of the catch, poor processing facilities.

Fisheries in GoM– some issues

The fishers need to know their resource base well, and should respect the need for sustainable harvesting. Following are the main issues related to fisheries in the GoM.

Destructive fishing practices

The following destructive fishing practices, which will impact the fishery resources, were observed during the study:

- Dynamiting –illegal but still taking place in some areas (between Pallimunai to Thavulpadu).
- Use of monofilament nets (*Thangus*) – were being used in almost every landing site, but re-enforcement of the ban from 3 October 2010 is in place.
- Brush piles and multi hook artificial bait for cuttlefish were being used in 2 of the 14 landing sites surveyed: Pallimunai and Vankalai.
- *Surukku* nets – banned from 3 October 2010, but still being used in some areas (e.g. Pappamoddai in Mantai West DSD).
- SCUBA diving to collect sea cucumber and conch – banned in GoM but fishermen from Kalpitiya still collect these from Silavatturai in Musali DSD.
- Bottom Trawling – This is presently limited to Pesalai in Mannar DSD.

Some of the other issues are as follows:

- Uncontrolled exploitation: Collection of holothurians (sea cucumber), gastropods (conch) and bivalves (oysters) without permit or without conforming to the conditions of the permit, especially on recommended sizes.
- Poaching in Sri Lankan waters: There is an ongoing feud between fishermen of Sri Lanka and India. There are allegations and counter-allegations and the Government will have to address this issue. Fishermen in Mannar claim that large fleets of Indian fishing boats are poaching in Sri Lankan waters and thereby reducing their catch and destroying the benthic habitats.
- By-catch: Currently, the by-catch is discarded in an indiscriminate manner, causing significant pollution of the beach and attracting stray animals and birds, which also visit the fish drying areas. Often, faecal matter can be found in fish drying areas. Proper disposal of by-catch is necessary. Perhaps it can be used for preparing fish meal.

Agriculture

Agriculture, a major economic sector of the Mannar District, is expanding in parallel to the rapid resettlement programme. Rice is the main crop covering 9.6 percent of the land area, followed by perennial crops and highland crops. Of the 20 700 families in the district, more than 75 percent (16 331 families) are engaged in agriculture.

Paddy cultivation

The paddy lands served by the cluster of tanks in Nanaddan, Musali and Mantai West DSDs form the Rice Bowl of Sri Lanka. These paddy fields are fertile and produce high yields (IUCN, 2011). Considerable areas of paddy land in the district, abandoned due to the long civil conflict, are to be cultivated in the coming season. The displaced families are returning and there is a great demand for land for cultivation and for settlement; forest areas in Musali Division and Mantai West are being cleared to meet the demand. A farmer family owns about 2-5 acres of paddy land and an upland home garden, but the income is mainly from paddy cultivation. Almost all the farmers own livestock and engage in tank fishing. Cattle and goats are reared for milk and meat. Paddy is cultivated mainly in the Maha season; a mere 5 percent of the paddy lands are cultivated in Yala as irrigation water is inadequate. Shortage of buyers for paddy, inadequate rice processing mills and storage facilities are highlighted as some of the issues.

Many agencies are involved in the agriculture sector, performing different functions. Inter agency coordination in planning is inadequate and lack holistic approach. Agricultural extension services are weak. They lack sufficient staff, technical capacities, and opportunities for interaction with counterparts in other areas and exposure to modern tools and methods. As a result communities lack access to new information on sustainable agricultural practices.

Highland and perennial crops

About 2 percent of the land in Mantai West, Musali and Nanaddan is under highland crops (field crops and vegetables). Although suitable land is available for expansion of highland crops, water is a limiting factor. The use of ground water for irrigation is minimal in these areas as it is saline. Currently there are 110 tube wells used exclusively for cultivation.

About 5 percent of the land is under perennial crops. Palmyra, coconut, cashew and mango are the main perennial crops. Coconut is cultivated on a plantation scale in the Mannar Island and in other areas, as well as in home gardens. Perennial crop produce is mainly sold as raw product. Sizeable industries based on perennial crop produce are not found; only very small-scale cottage industries use Palmyra and coconut by-products.

Home gardens

About 200 ha of land in Mannar District is under home garden at present. Home gardens mainly have coconut, fruit plants such as mango, papaw, guava, pomegranate, wood apple, lime and banana, etc. Almost every home garden has a well grown coconut palm. Home garden vegetable cultivation is actively pursued in the Maha season, but not so in the Yala season as water is scarce.

Archaeology

GoM is rich with archaeological monuments and traditional legends. These include several Miocene fossil (5 to 28 Million years) sites, many prehistoric (belonging to the Palaeolithic and Mesolithic periods), proto-historic human settlements and historical monuments. The ancient Mantai port served as a hub for ancient maritime silk route where the east and west maritime merchants met (IUCN, 2011). Many archaeological monuments have been destroyed and some of them have been converted to other uses. The remaining sites are in a vulnerable state and immediate action is needed for their preservation.

3.0 Sources of information on GoM

The civil unrest that existed in this area for the past 30 years has limited/prevented any in-depth scientific research being carried out in the area. Thus the availability of recent information on natural resources, land use pattern and possible threats is very limited.

The information gathered through the recent surveys carried out by University of Ruhuna and IUCN was disseminated to Government Officers including the Naval Officers, secondary school teachers, staff of the Zonal Education Department and fisher communities in Mannar District and recently also placed on the web (http://cmsdata.iucn.org/downloads/boblme_report_final.pdf).

BOBLME project supported activities have also helped in collating and dissemination of information on the GoM ecosystem. The Review of Community-based integrated coastal management: best practices and lessons learned in the Bay of Bengal, South Asia and Integrated coastal management (ICM): Best practices and lessons learned: workshop report are two such sources of information.

As mentioned before, previous surveys in the Bar Reef Marine Sanctuary have been conducted by Ohman *et al.*, 1997, Rajasuriya *et al.*, 1998, Siriwardena 2003 and Bambaradeniya *et al.*, 2005 a & b. National Aquatic Resources Research and Development Agency (NARA) carried out reef monitoring on periodic basis. More recently Weerakkody and Subhashana, (2011) have assessed the status, trends and

management needs of Dolphin and Whale watching tourism at Kapitiya and the Bar Reef Marine Sanctuary; the report will be available in the near future.

4.0 Quality of information on GoM and suggestions for improvements

With the end of the civil war, new research activities are being carried out. The marine and inter-tidal survey carried out by the University of Ruhuna and the terrestrial biodiversity and socio-economic surveys done by IUCN are two of them, and the findings are being shared with a wide audience. These are snapshots of the status through rapid assessments; more long-term research is needed to better understand the ecosystem dynamics, fish stocks and sustainable yields of the main fisheries of the GoM.

5.0 Ongoing research activities and areas where more research is needed

Seismic data of the Cauvery Basin (see Figure 4), which includes the south eastern region of Indian and north and north western part of Sri Lanka and the Palk straits including the GoM, has revealed the potential for hydrocarbon accumulations and the Government of Sri Lanka is preparing to offer exploration licenses for oil and gas extraction in the Mannar basin.

Figure 4 indicate the sites ear-marked for dredging within the Indian and Sri Lankan territories for exploration of oil and gas. Rapid assessment of the Biodiversity within the GoM and the Palk Bay and an evaluation of the status of their sensitive ecosystems (with respect to biodiversity and physicochemical parameters) available in the area and those which may get affected due to dredging is therefore important. Such information will also be important to identify the post-war status of the complex and unique ecosystems and to establish the base-line information, prior to commencement of dredging of the Cauvery Basin for oil and gas exploration

Detailed information on marine fauna and flora. Although the survey conducted by University of Ruhuna over a period of about two months provided some insight, a detailed survey covering a period 12 months is vital to have a clear picture of the current diversity. This should not only focus on reef associated fauna, but should also cover marine mammals, especially dugong which is presently under severe threat, and marine invertebrates and vertebrates, algae and sea grasses.

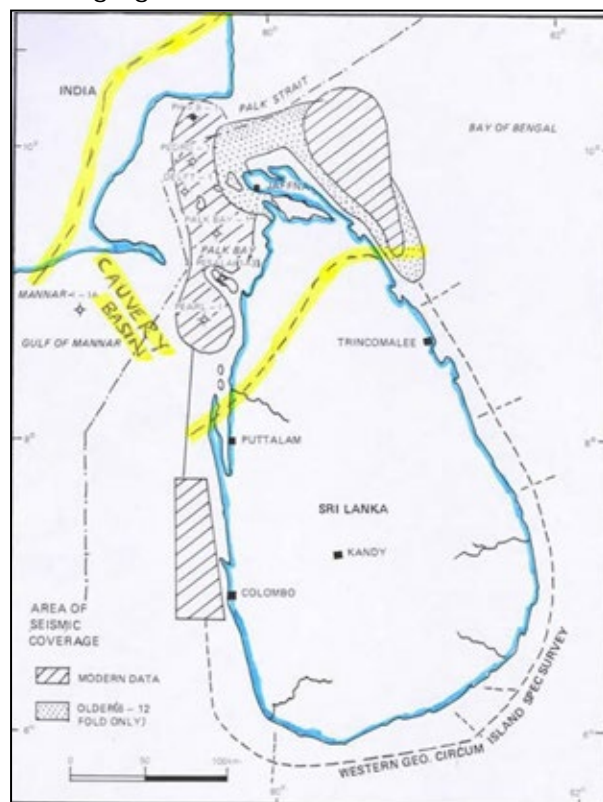


Figure 4: Sri Lanka Oil Exploration Map Showing Cauvery Basin (yellow lines show the boundaries of Cauvery Basin on land). (University of Ruhuna, 2010))

6.0 Existing management measures: Theoretical background and measures applied on field

Within the coastal DSDs bordering the GoM, Wilpattu National Park and Bar Reef Marine Sanctuary (off Kalpitiya DSD) and Vankalai Sanctuary (Mantai DSD) have been declared under the Fauna and Flora Protection Ordinance of 1938. More recently, Vankalai Sanctuary was declared a RAMSAR site on 12 July 2010. The protection granted to these sites will provide added protection.

by The National Science Foundation of Sri Lanka had initiated a move to declare Sri Lankan side of GoM as a MAB reserve and to combine it subsequently with the Indian side of the MAB to make it a trans-boundary MAB reserve. Figure 5 depicts the boundaries of the proposed MAB Reserve.

On fisheries aspects, there are six Fishery Inspector Divisions in Mannar District and each division is headed by a Fishery Inspector. Although harmful fishing practices such as collection of sea cucumbers using SCUBA diving, dynamiting, using monofilament nets for fishing and poaching (marine mammals) are banned, sightings of these are not uncommon. It should be mentioned that the Sri Lanka Navy plays an important role in bringing such activities under control.

The development activities proposed need to give adequate consideration for biodiversity conservation. Of particular concern is the possible increase of firewood collection by people in the resettlements, illegal logging for timber and extensive land clearing for agriculture.

The Gulf of Mannar Reef, Vankalai Reef, Arippu Reef, Silvatturai Reef and Vidattaltivu Lagoon which have been identified as environmentally important areas with high biodiversity and should receive special consideration and protection.

7.0 Efficacy of existing management measures: Trends in quality and availability of resources and ecosystem services in GoM and impact of climate change

There are number of development activities taking place within Sri Lankan side of the GoM and in the immediate area which has a direct influence on the GOM. Sri Lanka Tourism Development Authority is in the process of developing the Kalpitiya Tourism Development Area (KTDA) plan, which falls partly within the GoM. Oil exploration within Cauvery Basin of North-western Sri Lanka is another major developmental activity identified in the GoM in Sri Lanka. There are other influences such as increased fishing pressure, opening up of land for resettlement, infrastructure development and proposed developments such as Sethu Samudram Ship Canal on the Indian side of the GoM.

In light of the above developments and potential impacts of climate change, the existing management measures needs to be strengthened further. National Science Foundation is working with other relevant agencies in proposing the Sri Lankan side of the GoM as a Man and Biosphere Reserve (MAB), which will be considered for later declaring as a

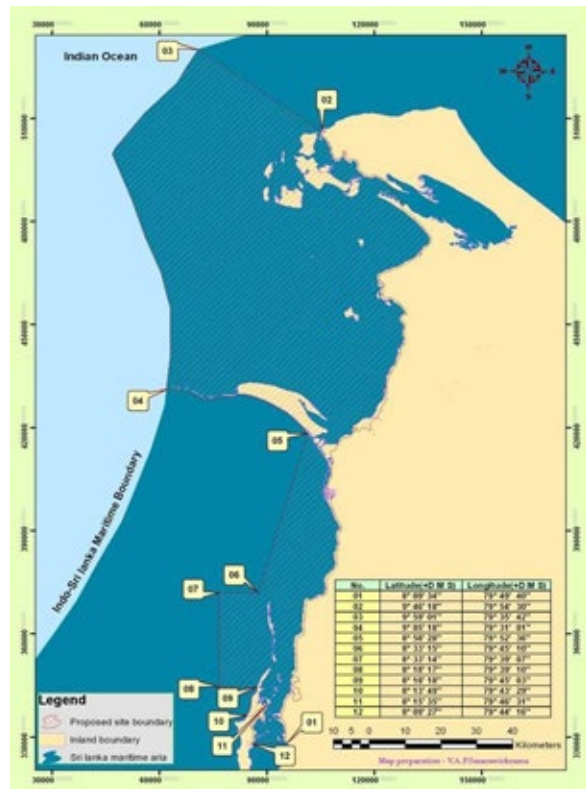


Figure 5: General location map of Proposed Biosphere reserve

trans-boundary MAB Reserve along with Indian GoM MAB Reserve. With respect to trans-boundary issues, it is noted that capacities for co-management are improved (through bi-lateral and multi-lateral cooperation negotiations and agreements, etc) (IUCN Asia ELG & BOBLME, 2010).

8.0 Suggestions for new management measures, keeping in view the need for ecosystem approach to fisheries management

As mentioned before, in-depth studies need to be conducted on the GoM ecosystem to understand the ecosystem dynamics and fish stocks. Effective management mechanisms need to be developed based on such studies to conserve critical habitats of unique and commercially important aquatic life in the GoM. Existing management measures need to be strengthened, especially to arrest the use of destructive fishing practices and enhance sustainable harvesting of fish stocks. Special attention is needed for managing Bar Reef Marine Sanctuary and other coral reefs in the GoM. When approaches to coastal resources management are developed, the overlapping of narrow legal belt encompassing both land and sea which partially overlaps with the fishery management jurisdictions should be taken into consideration (Samarakoon, 2010).

9.0 Proposed/expected actions of the Government of Sri Lanka.

The government of Sri Lanka is committed to conduct more research on the area and strengthening the existing management measures. In addition measures have been taken to propose the Sri Lanka side of Gulf of Mannar as a MAB Reserve. Discussions have been already commenced to study the habitats and behavior of *D. dugon* and develop a management plan for this threatened species.

10.0 Scope for cooperation in information collation and research with India

Through Mangroves for the Future Initiative, IUCN Sri Lanka has facilitated a meeting with the Joint Secretary, Ministry of Environment, India (Mr B P Nilaratna) in May 2011 and key Sri Lankan Officials on the possibility of developing a joint project proposal for conservation oriented research activities in GoM. Scope for cooperation in information collation and research between the two countries will be further discussed at the Bi-National Stakeholder Consultation in Ramanathapuram, India during 5 and 6, September 2011 where many stakeholders from the two countries will be meeting.

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Issues regarding livelihoods in Gulf of Mannar National Park and Biosphere Reserve, Tamil Nadu, India⁵

1.0 Introduction

Tamil Nadu has a coastline of 1 076 km on the east coast and 60 km on the west coast with a continental shelf area of 41 412 sq. km, and territorial waters of approximately 19 000 sq km (Government of Tamil Nadu, 2005). According to the 2005 Marine Fisheries Census for Tamil Nadu, covering its 13 coastal districts, there are 352 landing centres and 581 marine fishing villages in the State, with a total fishermen population of 0.79 million (mn), of whom 0.2 mn are active fishermen (CMFRI, 2006). The total fishermen population almost doubled from 0.39 mn in 1980 to 0.79 mn in 2005. The population of active fishers increased from 0.09 mn in 1980 to 0.2 mn in 2005. The fishers belong mainly to the Paravar, Valaiyar, Kadaiyar and Karaiyar communities.

In 2009-10, the total catch from marine capture fisheries in Tamil Nadu was 0.40 mn tonnes, of which 18 percent came from Ramanathapuram district and 14 percent from Tuticorin district (Government of Tamil Nadu, 2011). According to CMFRI's 2011 Annual Report, Tamil Nadu's marine capture fish production (0.55mn tonnes) exceeded that of Gujarat and Kerala (CMFRI 2011). The major species caught in Tamil Nadu include oil sardines (*Sardinella longiceps*), lesser sardines (*Sardinella spp.*), silver bellies/pony fish (*Leiognathus sp.*), penaeid shrimp, crabs, perches, skates and rays, and mackerel. Recent reports from CMFRI highlight that it is important to control effort in the Gulf of Mannar (GoM) area, as increased effort has resulted in drastic reduction in the cumulative catch (CMFRI, 2011). The exploitation rate for Indian Mackerel (*R.kanagurta*) was very high at Mandapam at 0.93.

The islands in the GoM are located close to both Ramanathapuram and Tuticorin districts. This group of 21 islands provides livelihoods to thousands of people in the two districts. The CMFRI, 2005 census shows that Ramanathapuram district has the maximum number of landing centres, fishing villages, fishermen families and population in Tamil Nadu (see Table 1). Ramanathapuram is also unique as it has over 5 000 women involved in harvesting seaweeds from areas around these islands, for their livelihood (Rajagopalan 2008). Besides, there are around 4 500 divers who are dependent on sea cucumbers for their livelihood, of which 1 000 divers are also involved in chank collection (Personal communication with Ramnad Fishermen's Union during January 2011 field visit).

Some of the main fish landing centres in the GoM area include Keezhakarai, Mandapam, Periyapattinam, and Pamban. There are 96 mechanized fishing vessels (MFVs) and 1134 non-mechanized vessels in Keezhakarai. Not many motorized boats are operating in the GoM area, as these were banned due to security reasons (Rajagopalan, 2008). In Rameshwaram (including Pamban), there are 1 118 MFVs operating (Pers. Communication with AD Fisheries, Rameshwaram).

Table 1: Fisheries Statistics of Tamil Nadu

Parameters	Tamil Nadu	Ramanathapuram (includes Palk Bay & Gulf of Mannar)	Tuticorin
Landing centres (nos.)	352	80	22
Fishing villages (nos.)	581	180	31

⁵ Paper prepared by International Collective in Support of Fishworkers, 27, College Road, Chennai – 600 006, Tamil Nadu, INDIA. Email: icsf@icsf.net.

Fishermen families (nos.)	192 152	38 800	18 671
Fisherfolk (total) (nos.)	790 408	175 421	78 487
Active fisherfolk (nos.)	206 908	38 892	21 613
Mechanized fishing vessels (nos.)	7 711	1 409	480
Motorized fishing vessels (nos.)	22 478	2 009	2 984
Non-motorized fishing vessels (nos.)	24 231	6 351	637

Source: CMFRI. 2006. Marine Fisheries Census 2005. Part IV: Tamil Nadu.

2.0 Gulf of Mannar National Park and Biosphere Reserve

Tamil Nadu has three marine protected areas (MPAs): the Point Calimere Wildlife Sanctuary; the Pulicat Wildlife Sanctuary (1980); and the Gulf of Mannar National Park and Biosphere Reserve. The GoM National Park (GOMNP), though proposed by scientists in 1976 to prevent the destruction of coral reefs by the construction industry, was officially declared as a national park in 1986 to conserve marine ecosystem. Though the area was declared a national park more than two decades ago, the settlement of the rights of the communities within the park area is yet to be completed, and the second legal notification as per the Wildlife (Protection) Act, 1972 (WLPA, 1972) is still to be issued. The national park forms the core area of the Gulf of Mannar Biosphere Reserve (GOMBR), declared in 1989, which is the first marine biosphere reserve in India (Melkani *et al.* 2006).

The marine ecosystem in the GOMNP has been established as being highly diverse, comprising 3 600 species, of which 44 are protected as endangered species under the WLPA, 1972. The area is home to 79 species of crustaceans, 108 species of sponges, 260 species of molluscs, 441 species of finfishes and 147 species of seaweeds (Melkani *et al.* 2006). The inter-tidal regions near the islands are an important source of sea cucumbers, which are exported as *bêche de mer*. These *Holothurians* were listed in Schedule I of the WLPA in 2001, which means that there is a ban on their collection and trade. The main species of seaweed collected for commercial purposes are *Gelidiella acerosa*, *Gracilaria edulis*, *Ulva lactuca*, *Turbinaria* and *Sargassum*.

Table 2: Gulf of Mannar National Park and Biosphere Reserve

Protected Area		
Year of designation	1986	1989
Type of designation	National Park	Biosphere reserve
Area	560 sq.km, includes 21 uninhabited islands (includes the waters around these islands up to a depth of 3.5 fathoms on the bay side and 5 fathoms on the seaward side)	10 500 sq.km Core zone: national park Buffer zone: Immediate seas around the islands
Objectives	Protection of wildlife and the environment	To conserve representative samples of ecosystems, ensure long-term conservation of genetic diversity <i>in situ</i> , promote basic and applied research and monitoring, and disseminate the experiences gained for education and training.
Managed by	Chief Wildlife Warden Wildlife Warden's office, Department of Environment and Forests	Gulf of Mannar Biosphere Reserve Trust, Government of Tamil Nadu

Compiled from Rajagopalan, 2008

3.0 Management measures in Gulf of Mannar National Park and Biosphere Reserve

Wildlife regulations

In India, National Parks, Sanctuaries and Tiger Reserves are declared in coastal and marine areas under the WLP, 1972. Apart from protected areas designated under the WLP, there are biosphere reserves designated under the Man and Biosphere Programme (MAB) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). These biosphere reserves, notified by the Central government, upon approval by the State governments, are to conserve representative samples of ecosystems, provide long-term conservation of genetic diversity *in situ*, and promote basic and applied research, monitoring and dissemination of information. In most cases, the core zone of the biosphere reserve comprises the National Park or the Sanctuary, and the complete area is managed by the State Department of Forests. The WLP does not have provisions for extraction of resources within National Parks, thus making it a complete “no-take” area, with full protection for all the resources.

The WLP mentions that if any part of the territorial waters are to be included within a Sanctuary or National Park, prior concurrence is needed from the Central government, provided that the limits of the area of the territorial waters are determined in consultation with the Chief Naval Hydrographer of the Central government, and after taking adequate measures to protect the occupational interests of the local fishermen. There is also specific mention that the right of innocent passage of any vessel or boat through the territorial waters should not be affected by the notification of a Sanctuary. It is also worth noting that, in relation to prevention and detection of offences, the WLP states that where a fisherman, residing within 10 km of a Sanctuary or National Park, inadvertently enters the territorial waters in that Sanctuary or National Park on a boat not used for commercial fishing, such a boat shall not be seized. However, implementation of these regulations still remains a major challenge.

The 2002 amendments to the WLP have led to formation of the National Board of Wild Life (NBWL) and the State Board of Wild Life (SBWL), that have provisions for participation of other government departments, elected representatives, local self-government institutions and NGOs working in the area, for, among other things, designation and management of protected areas. The State Department of Fisheries are also part of the SBWL.

The WLP provides protection to specific endangered species listed in Schedules I, II, III and IV (especially against hunting), regardless of its location, and the protection of all species in designated PAs. The species listed in Schedule I, including marine species such as all five species of turtle found in Indian waters, ten species of sharks and rays, all species of seahorse, giant grouper, reef-building corals, black coral, organ pipe coral, fire coral, sea fan, and nine species of molluscs and sea cucumber, are prohibited from being hunted. All sponges are listed in Schedule III, and 15 species of molluscs are listed in Schedule IV, which are also prohibited from being hunted or captured, from 2001. These are also implemented in the GoM region.

Fishing Regulations

The Tamil Nadu Marine Fishing Regulation Act (MFRA), 1983, as amended in 2000, provides “for the regulation, restriction and prohibition of fishing by fishing vessels in the sea along the whole or part of the coastline of the State.” The Act defines a mechanized fishing vessel as a fishing vessel not less than 8 m and not more than 15 m in length, and using an engine of not less than 15 hp but not more than 120 hp. The Act has the power to regulate, restrict or prohibit fishing in any specified area. The regulations under the Act are listed in Table 3. These regulations are implemented by the Department of Fisheries, Tamil Nadu.

Table 3: State and District Fishing Regulation in Tamil Nadu

Tamil Nadu Marine Fishing Regulation Act (MFRA) and Rules	<ul style="list-style-type: none"> a) fishing gear with less than 10mm mesh size from knot to knot prohibited; b) mechanized, deep sea fishing vessels prohibited within three nautical miles from the coast; c) bottom trawling operations prohibited within three nautical miles from
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	<p>the coast;</p> <p>d) pair trawling and purse seine fishing prohibited in the territorial waters of the state to conserve fisheries resources;</p> <p>e) closed season for mechanized fishing vessels from 15 April to 29 May every year;</p>
District-level regulations	<p>a) "three-four day rule", under which mechanized fishing vessels are allowed to fish for only three days a week, and small-scale fishing vessels for four days, to avoid conflict;</p> <p>b) Vessels were not allowed to be fitted with outboard motors (OBM) in GoM for security reasons from 1995. In 2003, 25 vessels were permitted to use OBMs, according to the decision of the Joint Task Force on Coastal Security in 2003.</p>

4.0 Governance of GOMNP and GOMBR

The GOMNP and GOMBR differ not only in their legal status, but are also managed by different institutions. While GOMNP is managed by the Wildlife Warden's Office of the Tamil Nadu Department of Environment and Forests, GOMBR is managed by the Conservator of Forests, Virudhunagar. However, insufficient manpower in the Wildlife Warden's Office has impeded implementation. The Wildlife Warden's Range Office has only one or two foresters and forest guards to patrol the 21 islands.

Scientific management plans prepared with the participation of community members are mandatory according to the National Wildlife Action Plan (2002-2016). However, these are imperfectly implemented in both the GOMNP and the GOMBR. The first comprehensive management plan for the GOMNP and GOMBR was recently prepared and approved by the Department of Environment and Forests.

The United Nations Development Programme (UNDP)-Global Environmental Facility (GEF) endorsed a project in 1999 to protect GOMNP resources and raise awareness within fishing communities on the resources of the GOM. The project also initiated the setting up of the GOMBRT that implements eco-development schemes (including on alternate livelihoods, conservation awareness creation, etc.) in all of the 252 dependent coastal villages. The GOMBRT in its initial analysis has identified 109 villages in the region as high-threat villages causing potentially maximum destruction to the marine environment (Melkani *et al.* 2006). The trust has classified 109 villages as high threat, 80 villages as medium threat and 60 villages as low threat in the GoM region.

The organizational model of GOMBRT, one of the first of its kind in India for the management of MPAs, includes local civil society organizations and fishworker organizations as members. The recently developed management plan for GOMNP and GOMBR has been approved by the Tamil Nadu Government. However, only limited progress has been made in educating the fishing communities about the need to conserve resources, since there are constant conflicts between the officials and communities. Wildlife Department officials complain that the process of involving communities in management is time-consuming.

Limited participation of local communities in decision-making processes is one of the main issues facing the management of this MPA. Communities play very little or no role in the formulation of plans, but are expected to cooperate in their implementation. Multiple institutional structures and legal regulations for governance result in confusion.

5.0 Fishing communities

While there have been periodic estimates of the status of biological resources in the area, neither the Tamil Nadu Department of Environment and Forests nor the Department of Fisheries has any estimate about the total number of people dependent on the marine resources in the GOMNP and GOMBR. Rough estimates, compiled from different sources put the number of fishing villages in the GoM area, dependent on the fishery resources, including seaweeds and sea cucumbers, at 125 (Melkani *et al.* 2006, CMFRI 2006b). There are, however, a total of 252 villages in the wider coastal belt (10 km width) and their 150 000 inhabitants frequently also depend on marine resources.

During discussions with the Ramnad Traditional Fishworker's Union, it was suggested that this total population includes 35 000 small-scale fishers, and over 5 000 divers. Of the 35 000 fishers, there are 5 000 fisherwomen who directly depend on seaweed collection for their livelihoods.

Most of the fishing communities in the region have been traditionally fishing near the islands, and are dependent on seaweeds, other molluscs and ornamental shell resources for their daily earning. Traditional fishermen often use non-motorized plank-built canoes, propelled by rows and sails, to fish in the nearby seven islands. Current restrictions by the Forest Department in implementing the national park regulations prohibit the practice of staying overnight on the islands and returning the next morning with the catch. Lack of access to traditional fishing grounds has robbed the communities of their sources of daily livelihoods.

Women in the area have traditionally been collecting seaweeds and some even reach the seaweed grounds rowing the boats themselves. The women often need to submerge themselves in neck-deep water, with their backs bent for eight hours at a stretch, to collect seaweeds. Until recently, a few villages from the Keezhakarai area were using sharp metal objects as scrapers to collect seaweeds. The women wear goggles to protect their eyes, and tie a net around their waist to store the harvested seaweeds. They leave home at 6 a.m. and, depending on the distance of the islands from the villages, return in the late afternoon or evening. Typically, around 10-15 women go out early morning in a vallam to collect seaweed on all days of the week, apart from Fridays. The trip takes about three hours, and the women return by mid-day with 10-15 kg of seaweed per person. The price for the seaweeds varies from species to species—*G. acerosa* sells at Rs 4 (US\$0.1) per kg, while *Sargassum* spp., in wet form, sells for Rs 10 (US\$0.25) per kg, and Rs 15 (US\$0.38) per kg if sold in dried form. The species collected in large quantities are *Gelidiella acerosa* (marikozhundu passai), *Gracilaria edulis* (Agarophytes, Kanchi passai) and *Sargassum* spp. (kattakorai) *Turbinaria* (Alginophyte, pakoda passai) and *Ulva lactuca*. These species grow in the shallow waters around the 21 islands. With the declaration of the GOMNP, collection of seaweeds around the islands is seen as illegal. Restrictions on the number of days and area for seaweed collection has particularly affected the women, as their incomes have apparently reduced from Rs 2 000 per month to almost Rs 1 500 per month, thus pushing households below the poverty line. (Rajagopalan, 2008)

Gender-segregated baseline data on the population dependent on marine resources in and around the GOMNP is not available, thus affecting the monitoring of socio-economic impacts of PA management. Such profiles are important in decision-making process, as it helps in classifying fishers based on the dependence, and accordingly develop livelihood programmes based on their profiles, rather than a single package for all.

6.0 Livelihoods versus conservation conflicts

Fishermen through the local Ramnad Fishermen's Union have been protesting against the restrictions on fishing imposed in the GOMNP. Ironically, though these villages are categorized as "high threat" by the GOMBRT, the villagers have not been involved in the development of the park/reserve management framework, nor have they been actively involved in the eco-development schemes.

The fishers consulted argue that trawler fishing – which is largely conducted from landing sites outside the GOMNP area, has more impact on marine resources, and call for strict implementation of the Tamil Nadu MFRA. They allege that pollution, sedimentation and impacts from developmental and industrial activities in the larger region affect the fragile and unique ecology of the area, yet are virtually unregulated, while fishing is considered as a major threat.

The Department of Forests identified the use of prohibited fishing gear and techniques near the islands—including dynamite or blast fishing, pair trawling, purse-seining, use of roller nets and drag-nets and seaweed collection—as major threats, and has developed regulations for the same. There has been an increase in patrolling by forest guards of the

office of the Wildlife Warden to implement these regulations. The violators are often caught and asked to pay a fine on the spot or cases are booked against them. Table 4 provides a list of cases booked against the violators within and outside the GOMNP area..

The WLPA prohibits any habitation or wildlife extraction inside a national park and trade in endangered species. This is interpreted as no fishing within the boundaries of the national park, especially around the islands. In the case of sea cucumber harvesting, cases have been booked against both the divers and the traders dealing with these. Traditional fishing communities using non-motorized boats fishing around the islands, are often caught for illegal fishing, and asked to pay a fine of Rs 3 000. Till August 2010, almost 80 cases were booked only for harvesting sea cucumbers in the area. However, fishing communities' state that the fine amount paid is often higher than that mentioned on paper, and it also involves a lot of hardship as communities have to travel from their villages to the Wildlife Warden's office in Ramanathapuram.

Table 4: Cases booked

Year	Cases booked	Year	Cases booked	Year	Cases booked
1989-90	2	1996-97	25	2003-04	29
1990-91	5	1997-98	22	2004-05	11
1991-92	15	1998-99	39	2005-06	18
1992-93	94	1999-00	30	2006-07	13
1993-94	23	2000-01	50	2008-09	38
1994-95	20	2001-02	20	2009-10	42
1995-96	15	2002-03	23	Till August 2010	108

Source: Wildlife Warden Office, Ramanathapuram

The GOMBRT has made efforts towards providing alternate livelihood to some of the fishing communities living in villages classified as high threat to the ecosystem. However, fishing communities in certain villages have rejected the alternate employment package offered by the GOMBRT, as they were not seen as viable and sustainable. For example, Chinnapalayam and Thoopukadu, two of the villages considered "high threat" and located very close to the protected islands, are extremely dependent on marine resources. The inhabitants argue that other forms of alternative livelihoods, such as animal husbandry and tailoring, will not be sustainable in the long-term. In the recent period, GOMBRT has adopted measures to also help in marketing of fish through Eco Development Councils (EDCs). In February 2011, a fish market was opened in Pamban area to help women from nearby fishing communities to sell fish under hygienic conditions. The area for the fish market was selected by the EDCs while the Trust was involved in helping in the construction and setting up the market. There has been feedback that the fish market is located slightly interior from the main market area, hence not attracting too many customers.

In general, sustainable and acceptable alternative livelihood options are yet to be provided. In a 2009 workshop organized by ICSF in Chennai fishing communities emphasized that their rights to resources should not be compromised, and that alternative livelihoods should be seen as only one way of reducing pressure on the resources (ICSF 2009).

Fishing communities in the area suggest that they were not aware of the protected status of the islands until restrictions were imposed in 2003. Regular confrontations and conflicts between the fishing communities and forest guards have been reported since the implementation of regulations. Fishing gear and catch are often confiscated by the Forest Department officials, who subsequently demand bribe in return for gear and catch. The fishing communities perceive such behaviour as harassment.

Besides the regulations imposed by the Forest Department, fishing communities also face restrictions from state- and district-level fishing regulations as mentioned in Table 3. Fishing communities highlight that the proper implementation of the MFRA in the GoM Biosphere and National Park area, would help in conserving the ecosystem. Multiple restrictions and regulations enforced by different authorities leave very few options for

small-scale fishers. Dislocated from their traditional fishing grounds, these communities now try to fish in areas beyond the islands, which are often unsafe for fishers using small boats.

7.0 Community-based initiatives

Communities in the region have also taken up their own management initiatives. For example, two villages, Chinnapalayam and Thopukadu, have developed their own management regulations, partly in order to reduce conflicts with the Forest Department. Such community regulations include bans on the collection of protected species and destruction of coral, cutting of mangroves and wood in the islands, catching turtles, harvesting sea cucumbers, and restricting the number of days of seaweed collection to 12 days a month. Such regulations are enforced by a guard appointed from within the community by the villagers. While community regulations and initiatives are neither recognized nor supported by the Forest Department, community members are said to follow them strictly, as violation of these involves severe penalties from the village leaders.

Seaweed collection is an important livelihood activity in the area. Since June 2006, the Fishermen's Union in cooperation with other organizations in the area has banned the use of metal scrapers for collecting seaweeds and the sale of products harvested in this manner. A joint agreement (2006) initiated by GOMBRT between the Tamil Nadu government, fishing communities and other stakeholders has banned the collection of seaweeds from March to May every year. But affected communities have pressed for alternative livelihood options, including seaweed culture.

In the case of sea cucumber divers, the communities highlight that they have their own spatio-temporal restrictions and regulations. Divers do not collect sea cucumbers on Fridays. The maximum number of days for collecting sea cucumbers is roughly between 60-80 days. The divers are specific while collecting the sea cucumbers; they do not collect small-sized sea cucumbers and collect only those above 8 or 9 inches. The number of sea cucumbers collected per day is also limited, ranging from a minimum of 20 to maximum of 400 during peak season. It is pertinent to note that these divers also use only manual methods (no oxygen tanks), and hence cannot stay for long periods under water to harvest more than 100 sea cucumbers in a day.

Community-initiated self-regulations for conservation and sustainable use are generally still to be recognized and supported by government institutions. Traditional ecological knowledge systems, which underlie such self-regulatory behaviour are thus not utilized in formulating official plans and regulations.

8.0 Conclusions: Fishing communities and MPAs

India's marine and coastal ecosystems constitute important natural resources with millions of people dependent on them for their livelihoods. Yet, there is no integrated legislation for the management and conservation of marine resources and the designation of MPAs. The approach for MPAs has been the same as for the terrestrial ecosystem, focusing on conservation and top-down 'keeping people out' policies and not through a consultative process. Though there are policy spaces available for participation of local communities in the decision-making process, as seen in the 2002 and 2004 amendments to the WLPA, legal and institutional conditions block the implementation of livelihood-sensitive approaches to biodiversity conservation. A strong feeling of distrust and misconceptions on conservation are common, as fishers feel marginalized in the decision-making process. Some of the key issues are identified from a small-scale fishing community perspective are:

- Lack of gender segregated socio-economic data to estimate the number of people dependent on the resource
- Limited participation of community in the management of GOMNP and GOMBR
- Conflicts between fishing communities and implementing agencies
- Multiple governance structure with different institutions involved in implementation

- Lack of long-term viable options for livelihoods of fishing communities, including through sustainable use of resources
- Lack of recognition of community regulations for conservation of resources
- No attempt to address impacts from other non-fishery related development activities on the marine and coastal ecosystems.

Better implementation of existing fishing legislation, especially on destructive fishing activities such as trawling and purse-seining are arguably the first step towards conservation and management. Fishing communities perceive that their demand for better implementation of existing legislation remains unmet, and consider the restrictions on their relatively low-impact fishing practices to be unjustifiable. There is lack of coordination and cooperation between the different government departments and also at the various institutional levels. In addition, the complex regulations imposed by government are little understood. Often, lack of coordination with the Fisheries Department leads to ignorance on part of the Forest Department officials in dealing with fisheries issues and fishing communities.

Fishing communities have demonstrated their willingness to take up -- or have actually taken up -- management initiatives to minimize the impact of their fishing activities but these are neither officially supported nor legally recognized. It is important to recognize and support such initiatives.

It is equally important to regulate other activities such as industrial pollution, building of ports and shipping canals, oil and gas pipelines and tourist infrastructure, which pose an equally if not much more significant threat to the health of the ecosystem and to communities.

Participation of stakeholders in the decision-making process of MPAs is crucial for the success of the programme. Improved participation will increase the legitimacy of the decision-making process and the likelihood of better compliance with existing management measures and also reduce conflicts. Local communities must be consulted and made active participants in the development of the objectives, management plans, governance structure, implementation, monitoring and evaluation of MPAs. MPA design requires the involvement of fishing communities for rules to become legitimate (Pomeroy *et al.* 2006). Several studies have also highlighted the importance for community participation in management of MPAs (Dalton, 2004; Pollnac *et al.*, 2001; Mascia 2003; Christie and White, 2007b).

The GoM is undoubtedly a unique and fragile ecosystem, whose resources need to be protected and conserved, but it is also a region where thousands of people depend on its fisheries and marine resources for their livelihoods. The fishing communities in the area are hopeful that issues of participation and livelihoods will be taken more seriously in the future, so that both conservation and local livelihoods can benefit.

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Annexure 8**Ecosystem Approach to Marine Fisheries⁶****1.0 Introduction**

Ecosystem approach to fisheries (EAF) is an important complement to existing fisheries management approaches. Fish and fisheries are deeply embedded within ecosystems. The effects of marine ecosystems on fish and the effects of fishing on marine ecosystems have been widely recognized now. Fisheries are dependent on the productivity of the ecosystem, and fisheries have an effect on, and are affected by the ecosystem of the target species/group. It is, therefore, prudent that fisheries management should take account of the interactions between ecosystems and fisheries.

EAF calls for recognition of fisheries management and exploitation as an integral part of the marine ecosystem. EAF is defined by Ward *et al.* (2002) as "an extension of conventional fisheries management recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations, *e.g.* conserving critical habitats, reducing pollution and degradation, minimizing waste, protecting endangered species". EAF's main purpose is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems (FAO, 2005).

As far back as half a century ago, the UN Technical Conference on the Conservation of the Living Resources of the Sea recognized the importance of an ecosystem approach to fisheries management in 1955. However, the impetus to this approach was given only in 1995 in the FAO Code of Conduct for Responsible Fisheries. Since then, several countries have begun the process of adopting the ecosystem-based fisheries management.

2.0 Advantages of EAF over conventional fisheries management system

Conventional fisheries management tended to assume that the fishery and the target species existed in isolation from the rest of the ecosystem. As pressure on resources and ecosystems increased, the shortcomings of single-species approach became more obvious. We now know that fishing not only impacts on the target stock, but on other parts of the ecosystem as well. For example, fishing methods are never selective and in addition to the target species, other species are inevitably caught. Some of the so called bycatch may be valuable and retained, while some bycatch may be discarded. The fisheries bycatch can include endangered or threatened species such as sharks, seabirds, turtles and mammals. Another major weakness of the single-species approach is that the target stocks are not only affected by fishing; they are also affected by other factors such as loss of critical habitat (*e.g.* through coastal zone development or pollution). Further, they are also affected by changes in abundance of predators and prey which could be caused by other fisheries, and they can be heavily affected by climatic changes. It is being increasingly realized that most fishing is unsustainable under the existing management regime because (i) rapid growth of human population drives the demand; (ii) development of mechanized fishing technologies severely damages the environment and fisheries; and (iii) quicker transportation to fishing grounds makes even the distant fish populations vulnerable to exploitation. The EAF is not about managing or manipulating ecosystem processes, but is concerned with ensuring that fishery management decisions do not adversely affect the ecosystem functions and productivity, so that harvesting of target stocks is sustainable in the long-term (FAO, 2005). Traditional systems of management, which have tended to focus on individual stocks or species, have not achieved this objective.

⁶ Paper prepared by Dr E Vivekanandan, Madras Research Centre, Central Marine Fisheries Research Institute, Chennai, India. Email: evivekandan@hotmai.com.

The key objective of EAF is the sustainable use of the *whole system* and not just targeted species. EAF also recognizes that humans are an integral component of the ecosystem and that many (sometimes competing) interests of people in fisheries and marine ecosystems have to be addressed.

EAF represents the combination of two different perspectives, namely *ecosystem management* and *fisheries management*. As a result, while EAF is the responsibility of fishery agencies, its full implementation will require collaboration with and cooperation from those agencies responsible for managing other activities that impact on the aquatic ecosystem (*e.g.* coastal zone development, offshore mining, oil and gas extraction). For EAF to be fully realized, it is important that these agencies and stakeholders interact and work together.

3.0 Limitations of traditional fisheries management approach

The diversity of ecosystems along the Indian coast gives a high diversity of fish species and resources, as well as the objectives of exploitation, fishing strategies, tactics and methods. The diversities of fisheries range from industrial to artisanal with a diversity of species depending on the region and season. However, the existing management practices do not give due consideration to these diverse conditions, and are being exercised under the concept of the resource as a functional and self-regulating unit of nature. Management strategies are directed toward avoiding overfishing of recruitment or growth.

In India, for example, closed season is followed during different seasons and for varying duration along the east and west coasts. Whereas closed fishing season appears to improve the catch for a few months after the ban is lifted, there is no indication on the sustainability of fish stocks and long-term benefits (Vivekanandan *et al.*, 2010). In addition to closed season, executive orders are in place to conserve selected groups such as the sharks, lobsters and seacucumbers. Whereas conservation of endangered/vulnerable groups are very important, group-by-group management approach may not yield the desired result. For instance, protecting the sharks would increase the demand for prey leading to scarcity of food organisms. In the absence of adequate food supply, the shark population will not be sustained. Similarly, the seacucumbers are detritivores and polluted coastal waters and sea bottom will be deleterious to such detritivores.

In spite of scientific efforts, decline in fish stocks is not always explained by fishing activity. Natural catastrophic effects, long and short-term environmental effects, change in the relative abundance of fish populations for natural reasons are also some of the possible causes. In the Gulf of Mexico, the annual landings of the pink prawn *Farfantepenaeus duorarum* decreased from 25 000 t in the mid-1970s to less than 1 000 t in 2000 (Arreguin-Sanchez, 2001). The rate of recruitment continually declined during the period, while fishing increased by several times. However, it was found that seawater temperature accounted for more than 50 percent of recruitment failure, indicating that the environmental effect is often strong and decisive.

The living aquatic resources are an integral part of their ecosystem and management of the ecosystem is a prerequisite for the well being of fisheries resources. It has been widely recognized that fisheries management should adopt a broad-based spatial management strategy with the management of living resources and temporal restrictions such as closed fishing season appropriately integrated into the management regime depending upon the conservation needs of the ecosystem in question.

4.0 Approaches for EAF

A comprehensive EAF would require taking into account all the interactions in an ecosystem. However, such complete understanding of the ecosystems is unlikely to be achieved, and there is need for pragmatism. The EAF is not an instant replacement for traditional fisheries management, and the shift should be gradual. According to the

National Marine Fisheries Service (1998) and the National Research Council (1999) of the US, an EAF should take into account the following five aspects:

- (i) the interaction of a targeted fish stock with its predators, competitors and prey species;
- (ii) the effects of weather and hydrography on fish biology and ecosystem;
- (iii) the interaction between fish and their habitats;
- (iv) the effects of fishing on fish stocks and their habitats, especially how the harvesting of one species might have an impact upon the other species in the ecosystem; and
- (v) recognizing humans as components of the ecosystems they inhabit and use.

While EAF has been a major conceptual advancement, the practical problems raised by this recognition are immense. There is still uncertainty on how to implement an effective EAF in practice. Nevertheless, there are pragmatic ways to begin implementation and to deal with complex interactions of institutions and societies. The following steps may be taken for moving toward EAF (FAO, 2005):

- (i) Identification of relevant ecosystems, their boundaries and characteristics;
- (ii) Agreement of management objectives for each ecosystem by encompassing wider ecosystem factors and all stakeholders, and not just the target stock;
- (iii) Development of long-term and immediate objectives;
- (iv) Establishment of sustainability indicators such as reference points, targets and limits;
- (v) A decentralized approach enabling management measures to be taken that are appropriate to biologically distinct areas; these include technical measures, spatial management and fishing effort-related controls; and
- (vi) An effective enforcement capability.

Parallel to this must be an extensive research beyond the traditional single species stock assessment advice for a better knowledge of habitats, ecosystem interactions, fishing-related impacts, trophic interactions, monitoring of bycatch and discards to include information of non-commercial bycatch. Food web based modeling is an essential scientific tool for developing ecosystem approaches for fisheries management. Such models could examine factors that affect primary productivity and their interaction with all components of the ecosystem. These models provide an insight into the harvests of fish species in different parts of the food web, how top predators like the marine mammals, tunas and sharks are related to populations of prey species, and how much of the total primary production is required to sustain fisheries harvest from the ecosystem. Models such as Ecopath (Polovina, 1984; Pauly and Christensen, 1995) have provided insights into some fundamental ecosystem questions. Ecopath with Ecosim software system is designed to describe the trophic fluxes and variables in ecosystems. By using this software, more than 100 ecosystem models have been analysed worldwide. For different ecosystems along the Indian coast, models and simulations are needed.

An ecosystem approach could help manage fisheries in the following ways (Mathew, 2001):

- (i) Conservation of fisheries resources, protection of fish habitats and allocation to fishers are the three most important considerations in fisheries management. The vantage point to start from is the fishing gear group, because without its cooperation it would not be possible to adopt effective conservation measures and protect fish habitats from fishery-related stress. The ecosystem models estimate the carrying capacity of the ecosystems and the biomass at each trophic level by taking into consideration the weather and hydrography of the ecosystem and fish biology. It also quantifies the number of crafts and gear required for sustainable harvest from the given ecosystem. It helps bring about a greater control over large-scale operations of nonselective fishing gear.
- (ii) The approach can facilitate a better understanding of the trophodynamics in an ecosystem, and also the impact of fishing gear selectivity on marine living resources. Programs designed to conserve marine mammals and turtles may become counterproductive when these resources multiply in large numbers and compete with

fish stocks as well as fisheries. The fishermen of the Lakshadweep Islands complain about the proliferation of marine turtle population, which not only predate on fishes, but also cause damage to the fishing gear. Along the Kerala and Karnataka coast of India, fishermen complain about dolphins removing fish from the nets.

- (iii) The ecosystem approach can be applied to understand and to prevent land-based sources of pollution that have an adverse impact on plankton, which constitute the mainstay of the food of small pelagics. In addition, reduction of nursery grounds from destructive activities like construction and reclamation in coastal areas, mangrove deforestation, destruction of coral reefs, as well as the loss of marine biodiversity are the other vital issues that need to be dealt with seriously and effectively in the tropical waters.
- (iv) It would be helpful to understand the impact of natural factors such as weather and hydrographic factors on fish stocks. In the Pulicat backwaters (southeast coast of India), for example, the mullet and shrimp stocks perish if the salinity exceeds that of the sea due to evaporation, zero exchange of water (as a result of mud formation at the mouth), and zero discharge into the lagoon from rivers (due to upstream dams). Under such conditions, conservation of mullet and shrimp stocks is not possible just by refraining from fishing. The *padu* system, a system of rotational access to fishers to the shrimping grounds practiced in the Pulicat, does not mitigate the pressure on shrimp stocks because different groups, in a rotational basis, incessantly harvest the stocks.

5.0 Options for EAF

To date, the best known tool for ecosystem-based fisheries management (EBFM) is networks of fully protected marine reserves. Over the last 15 years, study of more than 100 reserves shows that reserves usually augment fish population numbers and the individual size of overexploited species. In the early 1990s, Canada's Atlantic cod fishery collapsed and thousands of people were put out of work. The conventional methods such as (i) restrictions on the season's total catch, (ii) controls on the number of days or weeks of fishing, and (iii) regulations on the kind of craft and gear, did not have the desired effect on the stocks. Therefore, a group of scientists proposed a radical idea. If all forms of fishing in certain area are banned altogether, the overall catch can be increased in a sustainable way. Since then, a plethora of studies have convincingly demonstrated that the creation of no-fishing reserves allows the rapid build-up of fish spawning stock biomass (Roberts and Polunin, 1991; Dugan and Davis, 1993; Allison *et al.*, 1998). The idea behind reserves is simple. If the fish are protected from fishing, they live longer, grow larger and produce an exponentially increasing number of eggs. It is observed that adult fishes tend to remain in the protected areas while their larvae help replenish adjacent fisheries. Overall (multispecies) levels of biomass per unit area can double in two years and quadruple in ten years of closure. In the Californian reserves, reproductive output of two rockfish species was estimated to be two to three times as great as in the fished areas. On the west coast of the USA, the reproductive output of the longcod in a reserve in Puget Sound was 20 times greater than outside, and for the copper rockfish 100 times greater (Palsson, 1998). These reserves showed average increases of 91percent in the number of fish, 31percent in the size of fish and 23 percent in the number of fish species present (Roberts, 1999). These increases occurred within two years of starting the protection scheme. Crucially, the beneficial effects spilled over into areas where fishing was still permitted. In St. Lucia, for example, a third of the country's fishing grounds were designated no-fishing areas in 1995. Within three years, commercially important fish stocks had doubled in the seas adjacent to the reserves.

No-fishing reserves will work well for migratory species also if the reserves are put in the right places. Reserves placed in nursery and spawning areas will protect the migratory species during critical life stages. For example, spawning haddock and groupers are protected in the Georges Bank and Virginia Islands, respectively as the spawning aggregations were fished to extinction. Some reserves will primarily benefit fisheries, some others conservation, but most will benefit both simultaneously.

There are strong evidences to suggest that reserves will work even better in the tropics. However, there is no direct experience of reserves in India barring the marine sanctuaries in the fragile coastal zones to protect coral reefs and mangroves. Considering that the concept of no-fishing zone is a good strategic tool, fisheries managers in India should start working on the questions about how much of the fishing grounds should be placed in reserves, how many are needed, and where should they be. There seem to be three principles, which govern no-fishing zones. According to the first principle, both biological and economic benefits can be maximized through closures ranging between 20 and 40 percent of fishing grounds. Recently the American Association for the Advancement of Science (AAAS), along with about one hundred scientists called for 20 percent of the world's oceans to be declared for no-fishing by the year 2020 (Roberts, 1999). The second principle is based on the expectation of maximization and equitable distribution of benefits through a subdivision of the 20 percent reserve area to represent both biogeographic and ecological diversities within the reserves. The third principle stems from the question whether the derivation of maximum benefits is from the permanent or rotational reserves. Considering the location of fishing villages close to each other along the Indian coast, the selection of areas for no-fishing and the logistical, economic and social implications of dislocating and rehabilitating the fishers to fishing areas away from the reserves call for pragmatism and extreme care in planning.

The fishing communities are dispersed all along the coastline in the countries bordering the Bay of Bengal and they are dependent on marine ecosystems that are close to them. The nature of the ecosystems is an important determinant of many cultural characteristics, including the social and economic organization and the fishing gear and technologies that are utilized. They develop intimate, detailed and function-oriented knowledge about the marine ecosystems. They are also easily vulnerable to resource depletion. The question is how we are prepared to adopt the EAF. The ecological considerations do not expect the halt of traditional management measures. However, the traditional approach will have to be embedded within the domain of the EAF by involving all stakeholders. A carefully planned protocol and implementation of EAF within a set time-frame is expected to contribute to the protection of marine biodiversity and fisheries.

6.0 Importance of adopting ecosystem approach in Bay of Bengal

The Bay of Bengal extends to an area of 6.2 million km². Eight countries border the Bay and a population of 450 million in the coastal areas of the Bay influence the BoB ecosystem and are in turn affected. Issues such as over-exploitation of fish stocks, habitat degradation and land-based pollution bring uncertainty whether the ecosystem will be able to sustain livelihoods in the future.

For the Bay of Bengal, adopting EAF is important for (i) ecological well-being, (ii) human well-being and (iii) better governance. The following activities are required under each approach (Hermes, 2011):

- *For ecological well-being:* (a) assessment of major shared fisheries resources; (b) improving management of critical habitats; (c) promoting MPAs and fish refugia; (d) pollution reduction; and (e) understanding large-scale environmental processes and health indicators.
- *For human well-being:* (a) community involvement in fisheries and habitat management; (b) alternative/sustainable livelihoods; and (c) improving resilience to extreme natural events.
- *For better governance:* (a) policy harmonization; (b) promotion of coastal management best practices; (c) multi-sectoral involvement; (d) enhanced communication; (e) developing capabilities and strengthening institutions, resource users and fisheries/environment agencies, and (f) strengthening bilateral and regional management.

Challenges in promoting EAF in the region

Understanding of EAF is limited in the region. There is confusion and uncertainties about tools available and applicable for implementing EAF. The major challenge is moving from theory to practice. The cross-cutting elements of the EAF in the region are as follows:

- (i) Development of shared assessment protocols; e.g. for fisheries resources, habitat status, ecosystem health;
- (ii) Development of common management approach;
- (iii) Perception of development agendas and coordinated and harmonized implementation within and among various government institutions (e.g. environment, fisheries, and others);
- (iv) Integration of science (e.g. through exchange and joint assessment of information on environmental issues and impacts, socio-economic data, trends over time);
- (v) Endorsement of the jointly developed Transboundary Diagnostic Analysis (TDA);
- (vi) Integration of language (improved communication: developing a common way of explaining and understanding concepts);
- (vii) Integration of governance (how management will be executed) and agreed mandates (institutional and financial sustainability);
- (viii) Ecosystem planning and applying Ecosystem Health Indicators, with sectoral coordinated implementation.

7.0 Indicators of ecosystem health

Ecosystem health is a concept of wide interest for which a single precise scientific definition is difficult. How to measure the health of an ecosystem? Ideally, a measurement should increase when things are getting better and decrease when things are getting worse. Catches and catch-per-unit effort, mean length of fish in catch are the widely used indicators to assess health of fish stocks. Another indicator of marine ecosystem health has been mean trophic level (MTL) in fish catches. Increases in MTL in catches have been assumed to indicate improving health in marine ecosystems. Catch MTL has been reported to decline when “fishing down the food web” occurs — *i.e.*, when fisheries first target top predators, depleting them and then sequentially deplete groups further and further down the food web (Pauly *et al.*, 1998). We should also focus on measuring the numbers and trends of species in the region.

Assessing the changing status of pollution and health of an entire Large Marine Ecosystem (LME) is scientifically challenging. The health paradigm is based on multiple-state comparisons of ecosystem resilience and stability, and is an evolving concept. To be healthy and sustainable, an ecosystem must maintain its metabolic activity level and its internal structure and organization, and must resist external stress over time and space scales relevant to the ecosystem (Costanza, 1992).

The pollution and ecosystem health module measures pollution effects on the ecosystem through monitoring. Other pollution indicators include its pathobiological examination of fish and fish tissue, estuarine and nearshore monitoring of contaminants and contaminant effects in the water column, substrate and selected groups of organisms. Where possible, bioaccumulation and trophic transfer of contaminants are assessed, and critical life history stages and selected food web organisms are examined for indicators of exposure to, and effects from, contaminants. Effects of impaired reproductive capacity, organ disease and impaired growth from contaminants are measured. Assessments are made of contaminant impacts at both species and population levels. Implementation of protocols to assess the frequency and effect of harmful algal blooms, emergent diseases and multiple marine ecological disturbances are few measures. Generally, a suite of five coastal condition indices, namely, water quality, sediment quality, benthic communities, coastal habitat, and fish tissue contaminants is monitored to assess pollution and ecosystem health.

8.0 Role of governments and institutions

As with conventional management, EAF requires institutions to ensure coordination, consultation, cooperation and joint decision-making - between fisheries operating in the same geographical area and between the fisheries and other sectors that interact with it. The development and implementation of EAF policy and legislation will most likely be undertaken by the national fisheries department or designated management agencies (at national level) and the regional fisheries management organizations at regional level. A key challenge in the development of EAF may arise from disparities between the ecosystem and existing jurisdictional boundaries. Any such disparities will need to be addressed. Examples include the following (FAO, 2005):

- In coastal areas, the sea-use and land-use planning administrations need to cooperate in developing integrated systems of information and governance capable of allocating resources and enforcing use rights.
- In the open ocean, the jurisdictional boundaries of the fishery organizations may not properly match the ecosystem boundaries *e.g.* the LME boundaries.
- In the context of conventional management, conflicts frequently arise between different interest groups, which tend to hinder the effective management of fisheries. Conflict will inevitably increase under EAF as the number of stakeholders and objectives increase. It may often be impossible to obtain voluntary compromise between competing stakeholders and higher-level decisions may be required. Institutional arrangements need to be established to reduce potential conflicts and to facilitate their resolution when they do occur.

EAF will require adherence to the same principles of transparent and participatory management as conventional management, and as such, relevant authorities will have to:

- Ensure the decentralization of decision-making and management responsibility to organizations or groups (*e.g.* to make use of traditional management practices);
- Build capacity at these new management levels;
- Ensure appropriate participation of stakeholders in decision-making;
- Improve transparency and dissemination of information;
- Establish appropriate systems of user-rights;
- Educating and informing stakeholders.

9.0 Scope for cooperation in information collation and research

Relevant areas of cooperation in information collation and research that would lead to improved ability to implement effective EAF include the following (FAO, 2005):

- Ecosystems and fishery impact assessments (collection of better information on ecosystem function and assessments of the impact of fishing on non-target species through bycatch and discarding).
- Socio-economic considerations (Investigations into the application of an integrated environmental and economic accounting framework to the assessment and analysis of the interactions between fisheries and other sectors of the economy).
- Assessment of management measures (further research on gear selectivity to reduce undesirable bycatches; identification of species suitable for restocking and stock enhancement programmes).
- Assessment and improving management measures (improvements in the compilation of data for management plans; research to further enhance and develop participatory processes).
- Monitoring and assessments (the development of simpler rapid appraisal methods (in the field and at the analytical level)).
- Identification of practical and feasible sets of indicators and reference points that could be used in EAF.

10.0 Conclusion

Although the principles of an EAF are not new, there is very little practical experience in their implementation. Translating high-level policy goals on EAF into operational objectives and actions is now the key challenge to sustainable fisheries. This major shift in management strategy needs support from all institutions and stakeholders.

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Details of Topics for Group Discussions

Group 1: Review of the existing management measures in the GoM and lessons learned from the past initiatives while identifying the concerned stakeholders and the role they are playing in the GoM ecosystem.	Group II: Identification of gaps in available information (biological and socio-economic) on the GoM ecosystem to delineate the status of the ecosystem and measures needed to address them.	Group III: Understanding trans-boundary importance of the GoM ecosystem and modalities to approach them.	Group IV: Strengthening bi-national cooperation in managing the GoM ecosystem and moving towards an Ecosystem Approach to Fisheries.
<ul style="list-style-type: none"> • List of existing management measures in GoM implemented by India and Sri Lanka. • Efficacy of existing management measures from the perspective of ecological livelihood security. • Preparation of a list of stakeholders involved with management and use of GoM in India and Sri Lanka, including local, national and international stakeholders and review of their existing role in GoM. • Implication of existing management practices and way forward. 	<ul style="list-style-type: none"> • Information necessary for determining the status of ecosystem <i>vis-a-vis</i> information available on GoM. • Quality of biological information availability on necessary parameters (<i>e.g.</i>, science in the method of collecting information; availability of time-series and cross section data; etc.) • Economic importance of GoM and availability of information for understanding economic importance of GoM. • Quality of socio-economic information availability on necessary parameters (<i>e.g.</i>, science in the method of collecting information, availability of time-series and cross section data, etc.). • Guidance for improving information system in GoM at national and regional level. 	<ul style="list-style-type: none"> • Identification of trans-boundary issues relating to GoM. • Analysis of root causes of the trans-boundary issues. • Review of the existing national and international mechanisms to deal with the trans-boundary issues. • Developing a roadmap for addressing the trans-boundary issues based on the analysis of their root causes. 	<ul style="list-style-type: none"> • Necessity for managing GoM from an ecosystem perspective. • Requirements for managing GoM from an ecosystem perspective. • Review of existing national policies to meet the above requirements. • Scope and degree of cooperation within existing national policies. • Preparation of guidelines for strengthening bi-national cooperation based on shared principles and commonalities in national policies.
<p>Participants</p> <ul style="list-style-type: none"> • B Vishnu Bhat • S Balaji • H H More • J Patterson Edward • Indra Ranasinghe • A R M Haleem • Arulanandam • A S Sosai • Ramya Rajagopalan • Shamen P Vidanage • Chandra Mohan • Y S Yadava 	<p>Participants:</p> <ul style="list-style-type: none"> • K Vijayakumaran • Shekhar Kumar Neeraj • G Gopakumar • K Vinod • B Johnson • Reena Selvi • G N Ganesha Moorthy • B S Miranda • K Arulananthan • Kumudini Ekaratne • A Hettiarachchi 	<p>Participants:</p> <ul style="list-style-type: none"> • C Thomson Jacob • S Sundaramoorthy • T T Ajith Kumar • R A R Premakumara • Rekha Maldeniya • P B Terney Pradeep Kumara • E Vivekanandan • Ranjith Mahindapala • N M Ishwar • Rudolf Hermes 	<p>Participants:</p> <ul style="list-style-type: none"> • J R Bhatt • Donny Michael • Vincent Jain • Anil Premaratn • K A I D Silva • Upali S Amarasinghe • Sevvandi Jayakody • Nishanthi M P Perera • A Sivakumar • J C Dhas • Chandrika Sharma

Report of Group I

Review of the existing management measures in the GoM and lessons learned from the past initiatives while identifying the concerned stakeholders and the role they are playing in the GoM

GROUP 1

List of existing management measures in GoM implemented by India and Sri Lanka

- **Sri Lanka**
- National Fisheries Act 1996
- Sea cucumber, chank, lobster – size restrictions, night diving – only for sea cucumber, SCUBA diving not allowed, no new permits are issued.
- Fauna and Flora Protection Ordinance – some species are restricted
- Coast Conservation Act, Marine Pollution Prevention Act,
- Declaration of Bar Reef Marine Sanctuary
- Surveillance is by Fisheries Department and Sri Lanka Navy and Coast Guard Department
- Promotion of alternative livelihoods
- Co-management plans for selected areas (Kalpitiya)

B. Efficacy of existing management measures from the perspective of ecological and livelihood security

Sri Lanka

- Lack of marine PA management capacity of the Department of Wildlife Conservation
- Inadequate baseline information for management
- Lack of coordination among various agencies
- Lack of local level capacity
- No viable marine species culture technology (for commercial and ecologically important species) for replenish depleted stocks
- Ineffective enforcement
- Enhanced capacity of Managers to manage marine reserves and conservation areas
- Above is applicable to Sri Lanka also, more studies are needed about the resource

List of existing management measures in GoM implemented by India and Sri Lanka

India

- GoM Marine National Park declared in 1986 - wildlife Department. It includes 21 islands and surrounding shallow waters covering 560 sq.km as the core area and buffer includes the land also.
- The national park was declared under the Wildlife (protection) Act 1972
- Since 1989, the Indian Part is a Biosphere Reserve covering a total area of 10,500 sq.kms – management is by the Forest Department. Board of GoMBR Trust help the Conservator of Forest and contributes towards livelihoods of communities, involving communities in the management process and developing management plans.
- Marine Fisheries regulation Act 1983 and Rules
- Local fisheries regulations – three –four day fishing regulation, OBM regulations
- Environmental Protection Act 1986,- Coastal Regulation Zone Notification, 2011
- Biodiversity Act 2001
- Surveillance is by Forest Department Fisheries Department, Coast Guard and Coastal/Marine Police
- GOMBRT supporting non fishery alternative livelihoods
- Community-led management initiatives
- Formation of wildlife crime control bureau under Min of Environment and forests
- Creation of centralized Wildlife crime data base

B. Efficacy of existing management measures from the perspective of ecological and livelihood security

India

- Due to vast area, inadequate financial/human resources, technical capacity among implementation and enforcement agencies – hinders proper implementation of regulation
- Lack of awareness among communities about different regulations
- Lack of community consultation/participation in developing and implementing management measures
- Lack of baseline data for management especially other than fisheries,
- Lack of proper zoning (besides just buffer zone and core zone) within the biosphere reserve and national park
- Focus is only limited to Rameshwaram to Tuticorin, other areas in the GoM is lacking attention
- Not knowing the sustainable harvest levels for species
- Not having economic valuation of resources
- Importance of Livelihood aspects have not been translated into management plans. Diverse components of livelihoods need to be considered, including migrant labour issues
- Lack of coordination between agencies – intra and inter
- Species and area based management no holistic approach
- No viable marine species culture technology (for commercial and ecologically important species) for replenish depleted stocks

C. Preparation of a list of stakeholders involved with management and use of GoM in India and Sri Lanka, including local, national and international stakeholders and review of their existing role in GoM.

[Table](#)

India	
Local	National
Fishing communities – dependent on fisheries for livelihoods	Ministry of Environment and Forest Department, Wildlife Crime Control Bureau
Non-fishing communities	Ministry of Agriculture – DAHD&F
Fisheries Department – involved in developing, implementing and enforcing fisheries regulations	Coast Guard – involved in enforcing wildlife regulations
Forest Department – involved in implementing and enforcing wildlife and forest regulations	Navy - involved in enforcing wildlife regulations
Marine Police – involved in enforcing wildlife regulations	Customs – involved in enforcing trade regulation of Wildlife (Protection) Act, 1972
Local NGOs involved in developing socio economic components of projects	Research Institutes – ZSI, CMFRI, CSMCRI and others
Research Institutes/Universities, SDMRI,- scientific data collection and research	Ministry of Earth Science – National Institute of Ocean Technology
District Administration – implementation of district level regulations, and law and order issues	Ministry of Science and Technology
GoMBRT – involved in providing alternative livelihoods, and helping the forest department	Ministry of Shipping –registration of fishing vessels
Village based community and religious institutions	Ministry of External Affairs- Indian Maritime Boundary Line
Harbour based fisheries organizations	Ministry of Home Affairs – National Security
Boat owner organizations	
Traders	

Sri Lanka	
Local	National
Divisional and District Secretariats – local level interagency and community coordination, facilitation of approval process	Ministry of Fisheries, Ministry of Environment, Ministry of Defence, Ministry of Agrarian Services and Wildlife – Plan and policy formulation, enactment of legal provisions and regulations, facilitate funding .
Fisheries Corporative Societies, Fisheries Federation, CBOs, Local NGOs – bring community perspective into management framework	Fisheries Department, Coast Conservation Department, Archeology Department - Enforcement and implementation of regulations, monitoring and surveillance overall management of the GoM. NARA – research and monitoring Sri Lanka Navy – surveillance MEEPA – monitoring of marine environmental quality IUCN/MFF – funding, linking communities with agencies, providing a neutral platform for dialogue between stakeholders (Government and other) Universities – research and awareness raising Ministry of External Affairs – Enhancing bilateral cooperation National Science Foundation – coordination of the Mannar Biosphere nomination to MAB

International Organisations

Agency	Possible role
UNDP	Funding of conservation initiatives.
GEF	Funding of conservation and livelihood initiatives.
SACEP	Regional organizations – training and information dissemination.
BOBP-IGO	Sea safety, creating awareness about code of conduct for responsible fisheries, developing transboundary management plans.
BOBLME	Transboundary ecosystem management and cooperation.
CORDIO	
MFF	Funding of coastal biodiversity research
Wetlands International	Research funding
GCRMN	Capacity building and research publications
IUCN	Research funding
FAO	Projects in the region

D. Implementation of existing management practices and the Way forward

Immediate

- Complete baseline inventories on biological resources
- Gender segregated Socio-economic profile
- Coordination between two countries in ecological data collection, management planning and implementation (including marine species under protected list)
- Capacity building of stakeholders in the relevant areas (eco friendly fishing, biodiversity identification, SCUBA diving etc.) for effective management practices.

D. Implementation of existing management practices and the Way forward

Immediate

- Diversify fisher livelihoods with their participation to reduce pressure on the GoM
- Zonation of critical habitats
- Common platform for information and data sharing
- Mutual respect for IMBL and exploitation of fishery resources in GoM
- Need to develop better equitable benefit sharing from conservation initiatives
- Stricter provisions /stringent rules for invasive species introduction, with effective EIA

D. Implementation of existing management practices and the Way forward

- **Medium to long term**
- Use holistic approach of fisheries management (EAPFP included)
- Harmonization of legal statutes and policy measures to the extent possible (joint management for sea cucumber, sea horse and Dugong etc.)
- Economic valuation of ecosystem goods and services on both sides of GoM
- Explore the potential for nature based low impact tourism development
- Bottom trawling to be phased out and operations to be strictly monitored and regulated
- Ecosystem health indicators developed and regularly monitored
- Comprehensive long term monitoring of key habitats
- Efforts to declare Trans-boundary biosphere reserve for GoM
- Development of viable breeding and culture technologies for commercially important and ecologically important marine species (including transfer and standardization of technology)

D. Implementation of existing management practices and the Way forward

- Ecosystem restoration initiatives wherever intervention is needed
- Centralized database for wildlife crime control bureau being planned
- Recognize access rights of communities towards traditional fishing grounds and resources
- MoU between India and Sri Lanka on fisheries management
- Need for proper GIS based mapping of the complete Gulf of Mannar – identifies the various critical habitats, and uses of the area
- Full and effective participation of communities in developing and implementing management plans, options for co-management to be included in management plans
- Strict regulations to be developed and implemented for developmental activities and pollution- prone industries /sewage-based along GOM

Report of Group II

The importance of scientific information in management of Gulf of Mannar

If you can't measure it, you can't manage it!

Any system which has deviated from the expected or desired state or is exhibiting unacceptable behavior due to human intervention may need management interventions. These interventions would require change in behavior of the players, which would culminate in the desired system behavior or state. The case of the Gulf of Mannar (GoM) ecosystem is a typical example where the state of the health and integrity of the system has moved away from sustainability due to various anthropogenic activities.

The basic requirement for corrective action in this case is a measure of the magnitude and direction of the deviation and the forces that has caused the deviations. The required information can be generated only by scientific studies essentially measuring the parameters and indicators describing the state of the system and the cause-effect interrelations. There are situations where interventions were made based on precautionary principles. This could be a short-term measure. In the long run the system should move to a state where decisions and interventions are based on sound scientific information. In other words all future policy decisions should be based on scientific data and information. All future initiatives must incorporate the works already conducted, whether in terms of research or development.

Management of a system whose boundaries extend into the political boundaries of the two states (India and Sri Lanka) inevitably needs the following:

- Information from both countries on similar parameters on similar denominators;
- A uniform or standard protocol for generation of information in time and space;
- A collaborative mechanism for analyzing the information on an ongoing basis; and
- A joint mechanism to implement the plan of action and monitor the results.

Information needs:

1. An updated inventory of the existing resources, both flora and fauna of GOM.
 - In India, some information is available, but need further refined and updated information.
 - In Sri Lanka limited information is available and need further detailed studies.
 - Initiate country level exercise with collaboration and consolidate information.
2. A rapid appraisal to assess the status of critically threatened species (*Dugong dugon*, dolphins, whales, green turtle, olive ridley turtle, sea horse, molluscs listed under Schedule I of the Indian Wildlife Protection Act, *Balanoglossus*, etc.) This is required in both sides of the GoM.
3. Data on the hydrological, geophysical, climatological regime of the GoM. In India scattered information is available on various aspects, but in Sri Lanka not much information is available.
4. Establish systems on both sides of GoM to generate data on various parameters on continuous basis. If the existing systems are generating data, it should be made available in public domain.
5. Pollution related data (industrial, agriculture, etc.). Identification of pollution sources and collection of data on pollution.
6. Detailed scientific Information on biology and life history of holothurians, sea cow, sea horse, dolphins, sea turtles, whales, important gastropods and bivalves and corals, etc.

7. Collaborative research initiatives on both sides (both *in situ* and *ex situ*) on prioritized species.
8. To generate information on the impact of existing management measures in both the sides and evolving sustainable levels of exploitation of various fishery resources in the entire GoM.

Collaborative programmes/research activities by both the countries:

- Developing a database for evolving management strategy for EAF in the region.
- Generation of data on coral restoration in selected/identified areas of depletion. Quantitative and qualitative information on the fishery and by-catch.

Initiate collaborative programmes on:

- Data on destructive and illegal fishing practices, especially on sea-cucumber.
- Information on alternate livelihood options (especially small scale mariculture) for the fishermen.

Data collection and sharing:

- Comprehensive data on middlemen, traders, exporters etc. Information on the channels of trade from boat to the consumer.
- Data on various livelihood options and impact of restrictions and prohibitions on the livelihoods of fishermen.
- Data on sea weed culture activity as livelihood and on the invasiveness of the seaweed species on coral reefs.
- Site-specific studies and share primary information on socio-economic status of fishermen who are dependent on the fishery resources of the GoM.
- Collaborative programmes on both the sides on the economic valuation of ecosystem services of GoM.
- Joint data collection exercises on the impact of climate change on the coral reef ecosystem on both sides of GoM for evolving appropriate mitigation measures.
- Investigations on impacts in a collaborative mode and sharing of information on molecular taxonomy of critically endangered groups of organisms on both sides of GoM.
- Collaborative studies on DNA barcoding using internationally accepted methodologies
- Information on community initiatives in conservation and management of resources and ITKs on both sides of GoM.

Programmes and Time-scale

Short-term programmes can be undertaken under the aegis of BOBLME Project:

- Initiate a mechanism of standardization/harmonizing the research methodologies on both sides.
- Establish sharing mechanism on a regular basis of scientific and management data generated on both sides of GoM.
- Prepare a compendium of all research information and make it available in a public domain.
- Prepare a common interactive website as a platform for continuous dialogue and interaction; all newly generated information must be disseminated through this website.



Long-term programmes can be undertaken under the aegis of BOBP-IGO

- Collaborative research on areas of immediate concern.
- Joint survey and monitoring programmes.
- Institutional mechanisms for long-term management.

Report of Group III

<p>Understanding Trans-boundary importance of the GoM ecosystem and modalities to approach them</p> <p>Group III</p>	<p>Issue: <u>Weak governance of the shared ecosystem</u></p> <p>Root Causes</p> <ul style="list-style-type: none"> • Insufficient appreciation of ecosystem services and products. • Absence of mechanisms on resolving transboundary issues. • Weak implementation of current national laws and regulations. • No easy access/sharing of technical and other information. • Lack of recognition and use of reliable data in decision making.
<p>Issue: <u>Weak governance of the shared ecosystem</u></p> <p>Solutions</p> <ul style="list-style-type: none"> • Formation of high level Joint advisory committee <ul style="list-style-type: none"> • Scientific, • Socio-economic • Identify, share and promote best practices from other countries • Review and strengthening laws and regulations to address other country's concern • Mechanism for information sharing • Capacity building <ul style="list-style-type: none"> • Bilateral training programmes • Raising the profile of GoM 	<p>Issue: Shared fishery resources currently not managed for sustainable use</p> <p>Root Causes</p> <p style="text-align: center;">Governance</p> <ul style="list-style-type: none"> • Overfishing – greater in Indian GoM than Sri Lankan GoM • Transboundary Fishing (poaching !!!!) • Prevalence of illegal, destructive (cyanide/dynamite) and poaching fishing practices <p style="text-align: center;">Solutions</p> <ul style="list-style-type: none"> • Need for greater education & awareness • Strengthening/ monitoring - International Maritime Boundary <ul style="list-style-type: none"> • <i>e.g. vessel monitoring system</i>
<p>Issue: Habitat degradation and Biodiversity loss</p> <p>Root causes</p> <ul style="list-style-type: none"> • Fishery practices – lead to loss and degradation • Common understanding on approaches towards biodiversity conservation is absent ; conservation/protection approaches in two countries differ with regard to biodiversity. <p>Solutions</p> <ul style="list-style-type: none"> • Identify, share and promote best practices from both countries • Joint strategy for conservation & sustainable use of commercially important species (e.g. sea cucumber, chunk) • Joint strategy for protection of species like dugong , sea turtles, whale shark • Study on illegal trade on marine resources e.g. Sea cucumber... plus others • Raise awareness on the importance of conserving habitats and preventing biodiversity loss including the potential impacts of climate change. 	<p style="text-align: center;">Issue: Pollution</p> <p>Root causes</p> <ul style="list-style-type: none"> • Industrial, sewage and solid waste. • Unplanned industrialization, urbanization and settlements. • Land based sources – river runoff. • ineffective implementation of laws and regulation. <p>Solutions</p> <ul style="list-style-type: none"> • Identify, share and promote best practices from both countries. • Joint monitoring of coastal pollution <ul style="list-style-type: none"> • developing common indicators, • identify hotspots. • Awareness creation .

Report of Group IV

 <p>Group 4</p> <p>STRENGTHENING THE BI- NATIONAL COOPERATION</p>	<p>NECESSITY FOR MANAGING GOM (1/3)</p> <ul style="list-style-type: none">• Common ecosystem only divided by political boundaries• Resources being used by both parties• Species migrate between both countries• Uniqueness, biodiversity and the endemics
<p>(2/3)</p> <ul style="list-style-type: none">• The evidence of human settlement for a longtime and human dependency• Inter related and inter connected ecosystems (both aquatic and terrestrial)• To ensure sustainability	<p>(3/3)</p> <ul style="list-style-type: none">• Lack of awareness regarding policies and regulations between two countries• Conflicts in resource use• Common anthropologic and natural disturbances• Being signatory to regional and international treaties
<p>REQUIREMENTS FOR MANAGING GOM</p> <ul style="list-style-type: none">• Baseline data for bench marking• Bilateral collaborations for shared resource use• Quantitative data (both socio-economic and biological) for developing predictive models for at least some key species	<ul style="list-style-type: none">• An understanding between two countries regarding current and future directives for wildlife, environment conservation and fisheries resource management including other resource uses 

- ⊕ Enhanced communication and sharing of patrolling data
- ⊕ Capacity development and institutional strengthening
- ⊕ Identification of abilities of communities and other non governmental organizations in resource management
- ⊕ Enhanced awareness among all stakeholders
- ⊕ Greater research on under exploited and non exploited resources

- ⊕ Gear wise data and data on landing sites
- ⊕ Under water monitoring and assessment



- SPECIFIC REQUIREMENTS FOR ECOLOGICAL MONITORING**
- ⊕ Assessments of vulnerability
 - ⊕ Assessment of compatibility of existing policies between two countries
 - ⊕ Quality assessment of water and edible fish
 - ⊕ Data on siltation , stake holder interests and other activities happening in GOM

- EXISTING NATIONAL POLICIES**
- ⊕ India
 - ⊕ Six Acts and ordinances
 - ⊕ Sri Lanka
 - ⊕ Seven Acts and ordinances

- ⊕ Both the countries are signatory to relevant treaties
 - ⊕ CITES
 - ⊕ RAMSAR
 - ⊕ CMS
 - ⊕ Ballast water
 - ⊕ CBD
 - ⊕ MARPOL

- MONSOON BAN IN INDIA**
- ⊕ 15 April -31May
 - ⊕ only traditional fishery is allowed



- LOBSTER**
- ⊕ Regulations in Sri Lanka for carapace length, gravid females and also a closed system

- SEA CUCUMBER**
- ⊕ Banned in India
 - ⊕ Export is allowed with permits in Sri Lanka



FISHING GEAR AND METHODS

- Monofilament nets are banned and restrictions on import also in place in Sri Lanka
- Less than 10mm mesh size is banned in India
- Pair trawling and purse seining in India

DYNAMITE FISHING

- Banned in both countries

MARINE ORNAMENTAL FISH

- Schedule species from wildlife act -India
- FFPO and Fisheries act in SL

TURTLE

- Capture is banned in both countries and conservation measures in place

INVASIVE REGULATION

- Ballast water management?
- CEA regulations
- Customs Act



DISCHARGE OF EFFLUENTS

- EPA 1991 /water act
- CEA regulations
- Capacity, enforcement and political will
- EIA/IEE

LIGHT FISHING

- Banned in Sri Lanka except in kraals (purse seine)
- Allowed with any type of fishery in India

COMMUNITY INVOLVEMENT

- Policy in place to involve communities in Sri Lanka
- No such mechanism in India



PREPARATION OF A GUIDELINE FOR STRENGTHENING BI-NATIONAL CORPORATION

- ⦿ Step 1 An agreement between two countries for the necessity of managing GOM for ecologically sound management
 - **Activities**
 - facilitating agencies and funding agencies are identified from two countries
 - Respective ministries are identified
 - An inter ministerial steering committee is appointed
 - A management committee with respective stakeholders and a scientific committee is established with TOR

- ⦿ Step 2 Feasibility study and preparation of action plans
 - **Activities**
 1. Scientific committees provide inputs for ecological and socio economical baseline data (current status review and expected outcomes from management)
 2. Management committee provides inputs on current regulatory mechanisms after performing SWOT analyses and feasibility analyses of existing policies and regulations
 3. Based on recommendations from two committees intergovernmental steering committee produce the first MOU

- ⦿ Step 3 Implementation of action plan on ecosystem Approach to Fisheries and coastal resource management
 - **Activities**
 1. Identification of short term and long term capacity development needs (training/ awareness)
 - Intra structure development and procurement (marine research laboratory facilities/ infrastructure for deep water monitoring etc.)
 - Mechanism for acquiring shared data for developing predictive models etc.

- ⦿ Step 4 pilot testing of the action plan
 - **Activities**
 1. Both countries agree on a pilot area
 2. Facilitators, funding agencies, ministries identified
 3. Intended outcomes and indicators for assessing the outcomes identified
 4. Timelines and activity plans developed
 5. Monitoring and reporting
 6. Pilot study assessment and recommendations

CAPACITY DEVELOPMENT

- Training and awareness programmes on
 - ecosystem approach to fisheries and coastal resource management at various levels including school children
 - Deep and coastal water species identification
 - Diving and snorkeling
 - Coastal health monitoring
 - GIS and remote sensing
 - Basic oceanography
 - Community engagement and livelihood development, participatory approaches
 - Post harvest management
 - Marketing and value addition and link development
 - Joint fishermen forums
 - Monitoring and petrolling

INFRA STRUCTURE

- Marine lab and equipment for continuous assessment
- Cold storage facilities and improved fish landing sites
- Infra structure for data recording and retrieval
- Naval/Coast Guard facilities for sea monitoring

THANK YOU





Participants at Dhanushkodi



Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project and to lay the foundations for a coordinated programme of action designed to improve the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The Food and Agriculture Organization (FAO) is the implementing agency for the BOBLME Project.

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For more information, please visit www.boblme.org



Sida



Norad

