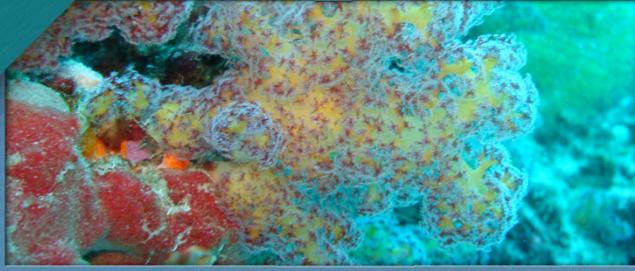




Bay of Bengal Large Marine Ecosystem Project



Report of the
**Second bi-national stakeholder consultation on sustaining
the Gulf of Mannar ecosystem and its resources**
18-20 June 2012 • Jaffna, Sri Lanka

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

18 – 20 June 2012, Jaffna, Sri Lanka

Report

**Bay of Bengal Programme
Inter-Governmental Organization**

2012

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ABBREVIATIONS

BMP	Best management practices
BOBLME	Bay of Bengal Large Marine Ecosystem
BOBP - IGO	Bay of Bengal Programme - Inter Governmental Organization
CMFRI	Central Marine Fisheries Research Institute
EEZ	Exclusive Economic Zone
FSA	United Nations Fish Stocks Agreement
GEF	Global Environment Facility
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographical Information System
GPS	Global Positioning System
GoM	Gulf of Mannar
IOTC	Indian Ocean Tuna Commission
IUCN	International Union for Conservation of Nature
IUU Fishing	Illegal, unreported and unregulated fishing
MFARD	Ministry of Fisheries and Aquatic Resources Development of Sri Lanka
MFF	Mangroves for the Future Programme
MPAs	Marine Protected Areas
RFMAC	Regional Fisheries Management Advisory Committee
SAARC	South Asian Association for Regional Cooperation
SACEP	South Asia Cooperative Environment Programme
SAP	Strategic Action Programme
TDA	Trans-boundary diagnostic analysis
UNCLOS	United Nations Law of the Sea Convention

EXECUTIVE SUMMARY

The Second Bi-National Stakeholder Consultation on Sustaining the Gulf of Mannar Ecosystem and its Resources was held from 18 – 20 June 2012 in Jaffna, 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). Forty eight participants representing governmental agencies; research institutes and universities; fishermen associations of both India and Sri Lanka and concerned regional and international organizations took part. The aim of the Consultation was to carry forward the recommendations of the First Consultation held in Rameshwaram, India during September 2011 including: (i) developing necessary collaborative projects and programmes, (ii) identifying and defining the scope of action of concerned agencies (BOBLME Project and its partners), and suggesting institutional arrangements for fostering bilateral cooperation between India and Sri Lanka in the Gulf of Mannar (GoM).

The Consultation, spread in four sessions, comprised two technical presentations on outcome of the first meeting and criteria for collaborative arrangements under the BOBLME Project. This was followed by seven thematic presentations covering need for assessment of water quality in the GoM, collaborative efforts on conservation and management of charismatic species, capacity building and training needs, possible areas for collaboration and mechanisms for education and awareness building including networking. The issues raised in thematic papers were further evaluated through three Working Groups. The Working Groups were constituted with the following mandates: (1) Developing projects and programmes; (2) Scoping for BOBLME Project and its Partners (organizations associated with the BOBLME initiative on GoM) and (3) Guidelines for institutional arrangements for collaborative action in the GoM. Based on the outcomes of the group discussion, group reports were prepared on identification of collaborative projects and programmes for the GoM area, framework of action for the BOBLME Project and its partners, and a roadmap to develop institutional arrangements for collaborative action between India and Sri Lanka.

Based on the group reports, a set of recommendations were also presented in the plenary. It was agreed that the BOBP-IGO will consolidate the proposals suggested by the Groups and will develop the concepts for implementation as full-fledged projects. Based on their priority, some of the proposed projects will also be developed into fast track mode and implemented during the inter-sessional period. Also, a comprehensive report on the GoM will be prepared. It was further proposed that the organizers in consultation with the concerned key research institutes will work out modalities for setting up of a website/portal on the GoM.

On fostering collaborative programmes, BOBP-IGO was requested to draft Memorandums of Understanding (MoUs) on the proposed bi-national committees/teams identified during the Consultation. These draft MoUs will be further considered and finalized during the third and final Consultation. Towards this the Consultation agreed that the concerned countries nominate four focal points from each country representing their fisheries and environment ministries, research institutions and national level NGOs. It was also agreed that the next Consultation will be held in India subject to the approval of Government of India. Along with the main event, the participants also visited the Thalai Mannar locality in the GoM and interacted with the fishers.

REPORT

A. Background

1.0 The Gulf of Mannar (GoM) is an ecologically important critical habitat that is shared by India and Sri Lanka. Within the framework of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project – a cooperative project is under implementation by eight countries bordering the Bay of Bengal, *i.e.* Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand with the aim of improving the lives of the coastal population of the respective countries through improved management of the environment and fisheries of the Bay of Bengal - 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 a collaborative arrangement will help ensure that decisions are made on the use of the GoM resources with due consideration to both ecological sustenance and human well-being without compromising on the needs of future generations.

2.0 The First Bi-National Stakeholder Consultation under this Project was held from 5 to 6 September 2011 in Rameshwaram, Tamil Nadu, India. At the First Stakeholder Consultation, status of the GoM ecosystem was reviewed and the participants arrived on an understanding on the need of bi-national cooperation in management of the GoM and continuation of in-country and inter-country activities towards this. The Consultation was jointly organized by the BOBLME Project and the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO). Fifty four (54) participants representing governmental agencies, research institutes and universities, fishermen's associations of the two countries and concerned regional and international organizations took part in the Consultation.

3.0 The Second Bi-National Stakeholder Consultation was held in Jaffna, Sri Lanka on 18 – 20 June 2012 for the purpose of reviewing the outcomes of the First Consultation, developing areas of collaborative action identified during the First Consultation into projects and programmes, identifying and defining the scope of action of concerned agencies (BOBLME Project and its partners), and developing institutional arrangements for bilateral cooperation between India and Sri Lanka. The prospectus and agenda of the Consultation is given in Annexure 1. The detailed programme is given in Annexure 2.

B. Opening Session (Session I)

4.0 The Bi-National Stakeholder Consultation was inaugurated by lighting the traditional oil lamp. Dr Damitha de Zoysa, Secretary, Ministry of Fisheries and Aquatic Resources Development (MFARD), Government of Sri Lanka chaired the Consultation. A total of 48 participants representing various governmental agencies; research institutes and universities; fishermen associations of both India and Sri Lanka and concerned regional and international organizations, including the Organizers took part. The list of participants is given in Annexure 3.

5.0 Dr Rudolf Hermes, Chief Technical Adviser, BOBLME Project welcoming the participants said that objective of the Consultation was to build on the findings and recommendations from the earlier Consultation and also charting a way forward. Dr Hermes said that the two countries share this remarkable ecosystem, the Gulf of Mannar, its habitats and resources, but also the existing problems and issues. It is the common, shared and 'transboundary' concerns for this resource that has brought us here. He said that the BOBLME Project has constituted a Regional Fisheries Management Advisory Committee (RFMAC), which can advise the project-countries

of the BOBLME on management of important commercial species.

He hoped that similar arrangements could be considered for the GoM during the Consultation. Drawing attention of the delegates to the timing of the Consultation, Dr Hermes said that in the period following the Consultation, important global events on sustainable utilization of resources would take place to reaffirm global commitment on sustainability. He expressed hope that this commitment would be put into action in the GoM, for the benefit of the coastal people in India and Sri Lanka. He wished the delegates a productive and successful Consultation.

6.0 Dr Yugraj Singh Yadava, Director, BOBP-IGO extended a hearty welcome to the participants and thanked them for travelling to Jaffna to attend the Consultation. He thanked the Government of Sri Lanka for agreeing to host the meeting in the beautiful city of Jaffna and also thanked Dr Damitha de Zoysa, Secretary, MFARD for personally ensuring the successful arrangements for the Consultation. Dr Yadava said that the First Consultation held from 5 to 6 September 2011 in Rameshwaram was attended by 54 participants and the agreements arrived at that Consultation were a great achievement. He hoped that the Second Consultation, attended by officials, experts and academics, NGOs and fishery associations of the two countries, will also achieve the intended objectives.

7.0 Dr G Syda Rao, Director, Central Marine Fisheries Research Institute (CMFRI) welcomed the participants on behalf of the Government of India. He congratulated the BOBP-IGO and BOBLME Project for organizing the Second Consultation in Jaffna. Dr Rao drew attention to the issue of livelihoods and said that sustainability is for development of human civilization and not for any other purpose. He said that conservation does not mean prohibition as there are alternative production technologies called green technologies, which could be applied to the GoM for enhancement of its resources. Dr Rao said that natural enhancement of resources has been successfully carried out in Tamil Nadu, India. These include use of artificial reefs, aquaculture, sea-ranching, etc. Most of these are being currently practiced in the GoM also. He emphasized on promotion of integrated solutions that address both livelihoods and biodiversity conservation needs. Highlighting the research work of CMFRI carried on the GoM, Dr Rao said that the Institute has so far produced over 2500 scientific papers on the GoM and its resources. He said that these papers were freely available for download from the CMFRI website and welcomed the researcher to take advantage of the available literature. He also informed that the CMFRI has developed medicinal products from seaweed, which would enhance the value of seaweeds and encourages seaweed farming, which in turn could further aid in carbon sequestration and help as a mitigation option for climate change.

8.0. Dr Zoysa, Secretary, MFARD delivered the welcome and inaugural address. Welcoming the participants on behalf of the Government of Sri Lanka, she said that India and Sri Lanka share both living and non-living resources in the GoM and the two countries have to work together to conserve, develop and manage these resources. Dr Zoysa said that both India and Sri Lanka are party to several international treaties, such as the United Nations Law of the Sea Convention and the UN Fish Stocks Agreement that concern management of marine fisheries and ecosystems, and therefore the two are bound to implement the provisions of such treaties. Article 63 of the Law of the Sea Convention requires that when the same stock or stocks of associated species occur in the Exclusive Economic Zones (EEZs) of two or more coastal States, such States should either directly or through appropriate regional or sub-regional organizations seek to agree upon conservation and management measures for such shared stocks. Therefore, it is the duty of the two countries to work together to conserve and manage the GoM resources.

Elaborating on the commitment of Sri Lanka to sustainable development of her fisheries and aquatic resources, Dr Zoysa said that one of the objectives stipulated

in the national fisheries and aquatic resources policy was to promote responsible fisheries and ensure long-term sustainability of the resources, while implementing strategies for increasing the national fish production. She said that the role of the GoM in socio-economic development of both Sri Lanka and India cannot be over-emphasized as the resource contributes immensely to the nutrition, food security and employment of the masses living not only on the coast bordering the GoM, but also in the hinterland and interior areas of both countries. Therefore, it is a pressing need to arrive at a common action plan for conservation and management of the ecosystem and living resources in the GoM. Dr Zoysa said that she was hopeful that during the Consultation all the participants will work actively to achieve the objectives set for the Consultation. She wished the participants a pleasant stay in Jaffna. The full text of the inaugural address of Dr Zoysa is given in [Annexure 4](#).

C. Technical Session (Session II)

9.0 The Technical Session comprised nine presentations. In the first presentation, Dr Yadava detailed the outcome of the First Consultation and objective of the present Consultation. He said that during the First Consultation, focus was on status of the GoM ecosystem and availability of information on the GoM. Based on the deliberations, five activities were agreed upon for implementation with the support of the BOBLME Project. These activities are (i) collaborative efforts in conservation and management of charismatic species; (ii) capacity building and training in stock assessment, water quality monitoring and the use of GIS and remote sensing; (iii) education and awareness building; (iv) strengthening of data collection and processing mechanisms, and (v) sharing of information and networking. Dr Yadava said that the main objective of the Second Consultation was to develop projects and programmes in the identified priority areas. Explaining the procedure of the Second Consultation, he said that thematic papers would be presented on the identified action points, which would be then further processed through focused group work and finally based on recommendations of the focused groups, a set of decisions would be presented in the plenary for adaptation. A report of the First Consultation is placed as [Annexure 5](#).

10.0 Dr Rudolf Hermes in his presentation on 'Criteria for Collaborative Arrangements under the LME Concept' outlined the structure and activities of the BOBLME Project. He said fisheries management requires balancing different societal goals and one way to achieve that is through ecosystem approach to fisheries (EAF). Dr Hermes said that the BOBLME Project is active in four trans-boundary critical habitats in the Bay of Bengal, viz., the Gulf of Mannar, Mergui/Myeik Archipelago, the Sundarbans and the Malacca Strait. Elaborating the objectives of the Consultation, he said that the participants may explore the scope of establishing an institutional arrangement comprising committees for different identified activities supervised by a technical advisory committee and a planning committee under an executive committee. The executive committee may include policy makers, senior officials and representative stakeholders from both the countries. He also proposed a set of considerations for the participants, which include: (1) agreement on collaborative action (work-plan) which BOBLME and partners can fund and contribute to; (2) consider first small activities which are easy to implement, easy to monitor and having high chances of success; (3) consider not only how to ensure biodiversity conservation (habitats, iconic species, MPAs, pollution) but also fisheries and livelihoods through joint and national programmes; and (4) how the activities proposed for the GoM can act as supplementary or complementary processes in the activities of the India-Sri Lanka Joint Working Group (JWG) on Fisheries. Dr Hermes further said that it was, however, the responsibility and privilege of the participants to design a path for making progress towards ensuring sustainability of the GoM. The presentation made by Dr Hermes is placed as [Annexure 6](#).

11.0 Dr Sewwandi Jayakody, Senior Lecturer, Wayamba University, Sri Lanka made a presentation on "The Need of Assessment of Water Quality in Gulf of Mannar". Emphasizing on the need of assessing water quality in the GoM, Dr Jayakodi said that by far the greatest volume of waste discharged to the marine environment is sewage and it affects a wide variety of aquatic environments including coastal waters, wetlands, estuaries, rivers and reefs creating a serious health risk for wildlife and humans. She said that there are several rivers draining to the GoM and work carried out so far has indicated the pollution levels in certain areas of the Gulf. However, most studies were from the Indian side of the Gulf and so far no joint study has been conducted to evaluate the present status of the entire Gulf. Sewage contamination has also been studied in certain locations such as East, South-west and West coast of India but no comprehensive microbial assessment has been done for the GoM water. Both the coast, mid sea and rivers draining into the GoM need to be tested for the microbial loadings as such work elsewhere has indicated edible fish being contaminated.

Dr Jayakodi said that the one important type of pollutant that has been least studied is flotsam of the GoM. Since both the sides of the GoM have no proper/adequate garbage disposal system, a heavy load of flotsam is gradually accumulating (personal observations) in this region and both point and non-point sources need to be studied and management options developed for controlling and monitoring. On the scope of existing mechanisms for water quality monitoring, she said that both the countries have government established institutions entrusted with a mandate of monitoring water quality of coastal zones. Several research organisations and universities as well as non-governmental organisations (NGOs) were also involved in water quality related research. However, one drawback identified for both countries is the insufficient accredited laboratory facilities available for reliable water quality monitoring as well as absence of protocols. She suggested developing common protocols for sample collection, analysis, data storage and interpretation. She said that India has sea-going research vessels and can assist Sri Lanka in developing capacity in collecting and analysing water on board. She also suggested a set of parameters that could be targeted to monitor water quality in the GoM. Concluding her presentation, Dr Jayakody said that such procedure should result in Best Management Practices (BMPs) that could be adopted for sustainable management of the GoM. Dr Jayakody's presentation is placed as Annexure 7.

12.0 Dr G Gopakumar, Principal Scientist, CMFRI presented the thematic report on 'Collaborative Efforts on Conservation and Management of Charismatic Species - Considerations for India'. He said that the GoM is a unique ecosystem characterized by its rich biodiversity with different types of ecosystems that include coral reefs, seagrass, seaweeds and mangroves and a rich assemblage of fauna. However, over a period of time, the stock of some of the species had dwindled at an alarming rate, necessitating immediate attention for their conservation and management. The conservation of charismatic (flagship) species in the GoM has indeed become more challenging with the changing scenario like increase in human population, pollution of coastal waters, use of destructive fishing gear and over-exploitation of resources coupled with the changing climatic conditions. He detailed bio-physical characteristics of various charismatic species such as coral, sea-cow, sea turtles, dolphins and whales and sea-cucumber. He also explained various processes affecting them and the measures adopted for their protection in India. Advocating a review of the hard-line approach to conservation, he proposed that in the case of sea-cucumber an in-depth study is necessary to ascertain the status of the stocks of different species and if required a species-specific ban could be imposed instead of the current blanket ban, which has affected the livelihoods of a few thousand fishers and their families. He also proposed several regulatory measures such as minimum legal size for capture, effort control and monitoring, 'no-take zones' within Marine

Protected Areas (MPAs), seasonal and short-term closures for fishing, rotational harvest closures, catch quotas and market chain licensing and reporting.

Dr Gopakumar said while there is a multitude of capable institutions in India undertaking research and implementing various management measures, they work in isolation. He suggested that information should be made available on a common portal which can be shared by all the concerned institutions in India and Sri Lanka. In-depth scientific studies on different charismatic species are imperative. This has to be done by national and bi-national joint inter-institutional projects. He also said that conservation programmes will not be successful unless the local communities are involved in the conservation processes. Traditional knowledge of the communities should be given due importance when the conservation plans are prepared. *Annexure 8* contains Dr Gopakumar's presentation.

13.0 Dr PBT Pradeep Kumara, Head, Department of Oceanography and Marine Geology, Ruhuna University, Sri Lanka presented the thematic paper on "Collaborative Efforts on Conservation and Management of Charismatic Species - Considerations for Sri Lanka" jointly prepared with the International Union for Conservation of Nature (Sri Lanka Country Office; IUCN-Sri Lanka). Dr Kumara said that the GoM contains the single largest coral reef system in Sri Lanka and is known for the abundance and variety of its marine charismatic species. Explaining the notion of 'charismatic species', he said that the charismatic species concept is a popular tool for conservationists as they easily attract public attention and act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause. By focusing on and achieving conservation of such species, the status of many other species with which it shares the habitat – or are vulnerable to the same threats - may also be improved. However, they may or may not be keystone species and may or may not be good indicators of biological processes.

Dr Kumara said that the biodiversity and the resources in the GoM are of much importance to Sri Lankan economy and the country is in a process to proposing a part of GoM as a 'Man and Biosphere Reserve' in order to manage its resources. Sri Lanka has formulated some more management tools to control illegal activities and promotion of the sustainability driven initiatives such as Fauna and Flora Protection Ordinance, Coast Conservation Act, Fisheries and Aquatic Resource Act No 2 of 1996 and the Wild Life Act. Dr Kumara said that the management of charismatic species in the GoM needed a collaborative approach from Sri Lanka and India. Linking available tools and institutions to formulate a holistic approach to manage this common resource is also necessary. A separate tool for each resource, a common act to fisheries management, a common coastal scientist and manager's forum and a common database are some of the possible options. However in all cases, the identity of two countries, respect to the International Boundary Line (IBL), recognition to fishers rights and the sustainability of marine resources should be ensured. Dr Kumara's presentation is placed as *Annexure 9*.

14.0 Dr G Syda Rao presented the thematic report on "Capacity Building and Training Needs in Areas Identified during the First Consultation – considerations for India". He said that the current management measures are adopted without a realistic and robust database on the status of the resource. Such type of management measures create lot of livelihood issues and thus become redundant. A realistic long-term database is not yet developed for the major resources of the GoM ecosystem. Dr Rao said that another vital aspect is to review the quality and availability of resources and ecosystem services after the implementation of management measures in order to compare it with the pre-management scenario. Marine resource assessment is a process where lots of assumptions are made to estimate the stock. However, the methodology adopted should be scientifically well accepted. Dr Rao said that a participatory conservation approach is needed based on

the principles of the EAF. The EAF strives to find a satisfactory balance between biodiversity consideration, stock productivity and socio-economic issues, with focus on providing food and income for people's livelihoods by managing fishing activities. He suggested a series of measures for capacity building comprising identification of the agencies involved in research, which would then work together to identify the capacity needs and assets and might also designate their personnel for specific tasks. Once the capacity building process is completed and evaluated, information would be collected on the GoM to develop an EAF based management framework. Dr Rao also presented a detailed roadmap concerning candidate agencies in the Indian context, their capacity building needs and measures to address them. Dr Rao's presentation is placed as Annexure 10.

15.0 Dr K Arulanathan, Head, Oceanography Division, National Aquatic Resources Research & Development Agency (NARA) presented the thematic report on "Capacity Building and Training Needs on Areas Identified during the First Consultation – Considerations for Sri Lanka". Dr Arulanathan said that the last comprehensive survey on the fishery resources of Sri Lanka was conducted over 25 years ago and apart from the information obtained from a few *ad-hoc* studies carried out by (NARA), not much information is available on the current status of the fish stocks. He said that NARA was in the process of developing a geo-database and intended to publish an atlas to disseminate the findings. On the scope of collaboration with India on stock assessment in the GoM and establishment of a common database, Dr Arulanathan said that such collaboration would help NARA scientists to acquire on-the-job training while working with Indian scientists. On monitoring water quality, he said that although there were several institutions monitoring water quality for various purposes, the information available was diffused. He also provided a list of software packages available for stock assessment and water quality monitoring. With regard to utilizing remote sensing and GIS for monitoring of resources in the GoM, he said that NARA has the required hardware and software to process different satellite imageries. Dr Arulanathan's presentation is placed as Annexure 11.

16.0 Dr JK Patterson Edward, Director, Suganthi Devadason Marine Research Institute presented the thematic report on "Possible Areas of Collaboration and Mechanisms for Education and Awareness Building including Networking for Sustainable Utilization of Gulf of Mannar – Considerations for India". He said that the GoM ecosystem is degrading fast owing to various anthropogenic impacts. Education and awareness building in fishermen will result in significant reduction of destructive activities. Citing the change in perception of the fishermen after the 2004 Indian Ocean Tsunami, he said that in earlier days there was high coral mining in the GoM. However, after the 2004 Indian Ocean Tsunami fishermen believed that their villages were protected by the presence of coral reefs and islands leading to substantial decline in illegal coral mining. He suggested that different levels of stakeholders such as the local community, school children, college students, conservation staff, NGOs, administrators, judiciary and political leaders be provided with education and awareness in biodiversity conservation for sustainability. Education and awareness building could be done through distribution of pamphlets, booklets, posters and signboards, conducting workshops, print and electronic media, nature camps and cultural programmes. Annexure 12 contains Dr Edward's report.

17.0 Dr A S Sosai, Senior Lecturer, Department of Geography, Jaffna University presented the thematic report on 'Possible Areas of Collaboration and Mechanisms for Education and Awareness building including Networking for Sustainable Utilization of Gulf of Mannar – Considerations for Sri Lanka'. He said that since marine resources are a common property, an approach that integrates all stakeholders is necessary to conserve and manage the resources. He identified fisher community organizations, fish traders, the Catholic Church, government departments and agencies involved in research, education, conservation and

management, universities, defense forces, divisional and district administration, local bodies and financial institutions as the important stakeholders. He further identified coast conservation, conservation of marine ecosystems/resources that include coral reefs and seagrass beds as areas for development of education and awareness. He listed a number of institutions at the local, regional national and international levels, which could be included to carry out education and awareness building programmes on the GoM ecosystem. He also said that networking amongst institutions involved in conservation and management of the marine ecosystem is necessary and national institutions should facilitate local level institutions in utilizing GIS, remote sensing and GPS methods. [Annexure 13](#) contains Dr Soosai's report.

18.0 Post presentation of the theme papers, in the Plenary Session, the Consultation welcomed the suggestion that legal measures should not be arbitrary, rather a case-by-case approach may be necessary to conserve the GoM ecosystem and species threatened therein to minimize impact on livelihoods. It was also suggested that there should be continuous monitoring and research on impact of conservation measures. The Consultation further suggested that awareness building measures should be initiated at the school level to develop responsible citizenry around the GoM and the BOBLME Project may share the experience of institution building processes in other ecosystems under the Project.

19.0 Prior to the conclusion of the proceedings of Day 1, the participants were divided into three groups and each group was assigned with a topic to work on. The topics are as follows:

- Group 1: Developing projects and programmes
- Group 2: Scoping for BOBLME Project and its partners
- Group 3: Guidelines for institutional arrangements for collaborative action in GoM

The composition of each group, points given for their consideration and guidelines given for discussions and preparation of group reports are given in [Annexure 14](#).

D. Field Visit and Group Discussion (Session III)

20.0 On Day 2 the participants visited Mannar Island and the associated areas in the mainland that border the Palk Bay and GoM to see the fishing activities and interact with the fishing community. They also visited a few sites of cultural and historic importance and observed some ecological processes in the area. The Report of the Field Visit is given in [Annexure 15](#).

21.0 The three Groups worked through Day 3 and presented their recommendations, which were discussed in the plenary.

22.0 The report of Group 1 was presented by Dr Arjan Rajasuriya (Sri Lanka). The Group identified three key research areas: (1) large marine mammals and other ecologically important species and key habitats; (2) water quality and coastal erosion and (3) fisheries management in the GoM. The Group suggested that programmes can be short-term (<1 year); medium-term (1-3 year) and long-term (>3 year). The Group further identified areas for survey, which included sirenians, cetaceans and turtles; assessments of habitats that included coral reefs and seagrass tracts; water quality and coastal erosion monitoring; fisheries research; capacity building and awareness building. The Group was of the opinion that politicians, policy makers and the international community should also be addressed in awareness programmes, in addition to managers and the local community. On data sharing the Group suggested that Memorandums of Understanding (MoUs) should be signed between the concerned institutes on sharing of information and synchronization and validation of methodologies and areas covered. The Group also advocated that mechanisms should be in place to avoid plagiarism of information

collected, data storage and use and to allow data sharing between the two countries with modes of access screened to ensure proper use.

23.0 Following the presentation, it was suggested that socio-economic and cultural mapping and infrastructural requirement should be included in the research agenda. It was also suggested that research on habitat could be the entry point, but focus should be on developing measures for resource conservation. It was also suggested that impact of climate change should be considered while developing awareness building programmes. However, the plenary observed that due to lack of long-term data on impact of climate change in the region, awareness building could be done on precautionary basis by identifying the possible impacts from desk reviews. The plenary was also of the view that gender dimensions should be given due consideration while designing the research projects. The plenary also recommended that the time-frame of the project was not required to be tied up with the lifecycle of the BOBLME project as such project(s) could be passed on to the institutions emerging from the BOBLME Project. Annexure 16 contains report of Group 1.

24.0 Dr Arulananthan (Sri Lanka) and Dr Selvam (India) presented the report of the Group 2. This Group identified various agencies at the regional level, at the national level and at the local level that could play a suitable role in furthering the cause of the GoM ecosystem. At the regional level, the Group identified the BOBP-IGO, Mangroves for the Future (MFF), Food and Agriculture Organization of the United Nation (FAO), South Asian Cooperative Environment Programme (SACEP) and IUCN as potential partners in sustainable management of the GoM. The Group suggested that these organizations can play an important role in awareness building at the highest level, coordination, documentation of activities, implementation of cooperative projects and provision of technical inputs. At the national level, the Group identified concerned ministries, research organizations and universities who could play a role in project development and implementation, undertaking field research and monitoring. At the local level, the Group suggested that local NGOs and fisher organizations should be empowered to carry out awareness programmes and assisting in project and programme implementation. The Group also considered the potential role that funding agencies such as Global Environment Facility (GEF) could play in management of the GoM.

25.0 Following the presentation, the Consultation discussed the possible funding mechanisms to support the research activities. It was suggested that corporate houses engaged in eco-tourism and in agri-business may be approached for funding. It was also suggested that local level governments such as village *panchayats* in India should also be part of the process. The plenary also discussed mechanisms to develop coordination with environmental programmes of the South Asian Association for Regional Cooperation (SAARC). The report of Group 2 is placed in Annexure 17.

26.0 The report of Group 3 was presented by Mr Shamen Vidanage (IUCN-Sri Lanka). Group 3 observed that both India and Sri Lanka are signatories to various regional and international agreements and are also parties to several programmes, which make them binding to sustainably manage the GoM resources. The Group identified conservation of marine resources and protection of marine ecology as the safe entry point for trust-building exercises between the two countries. To ensure success of such trust-building exercises, the Group suggested that all stakeholders should be given opportunities to understand and take part in activities and policy making up to grassroots level and then such success stories may be utilized for building consensus on other issues of more complex nature. The Group also suggested developing of a multi-level bi-national umbrella committee comprising various action-specific committees and a technical advisory group to ensure the progress of work in the GoM.

27.0 Following presentation of the report by Group 3, the plenary observed that project-based institutional mechanisms could be ineffective in the long run and suggested setting permanent mechanisms. It was also suggested that focal points from both the countries could be identified and trusted with coordinating activities. The plenary also suggested involving the Intergovernmental Oceanographic Commission (UNESCO-IOC) and the Indian Ocean Global Ocean Observing System (IOGOOS) in the process to deal with the oceanographic factors. The report of Group 3 is given in Annexure 18.

E. Adoption of Recommendations and Conclusion (Session IV)

28.0 After considering the recommendations made by the three Groups, a set of recommendation were prepared by the Secretariat and presented in the plenary. The plenary discussed the recommendations and agreed on the following:

- (i) Consolidation of the proposals suggested by the Groups and development of full-fledged projects for implementation. Some of the proposed projects may also be developed into fast track mode for implementation during the inter-sessional period.
- (ii) Preparation of a comprehensive report on the GoM. This report will include among other things, the modalities for setting up of a dedicated website or a portal in the websites of key research institutions of the two countries.
- (iii) Draft MoUs will be prepared on the proposed bi-national committees/teams.
- (iv) BOBP-IGO would carry out the above activities with the cooperation from other concerned agencies.

29.0 The Consultation also agreed that funds will be sought for surveys and assessments and research programmes from donors/partner organizations. Donors and private sector representatives (*e.g.* tourism sector) will also be invited to the next Consultation. Names will be invited for four focal points from India and Sri Lanka representing the fisheries and environment ministries, research institutions and national level NGOs for follow-up activities. In the inter-sessional period, BOBP-IGO will prepare proposals with the support of these focal points for submission to the Third Consultation.

30.0 In concluding remarks Dr Rudolf Hermes suggested that the institutional structure be put in place during the Third Consultation for implementation of the proposals. The BOBLME Project, BOBP-IGO, IUCN, MFF, SACEP, and SAARC should be involved in the institutionalization process. He further suggested that the Third Consultation be held before the end of the year (2012).

31.0 Presenting the vote of thanks, Dr Yadava thanked Dr Zoysa, Secretary, MFARD for her participation in the Consultation and the wholehearted support to the process. Dr Yadava also thanked the MFARD staff for efficient coordination work and the Sri Lankan Navy for the excellent hospitality during the field visit. He also thanked the BOBLME Project for funding support and the participants for their active participation in the Consultation. He hoped that all the participants will be able to attend the next Consultation proposed to be held in India. On behalf of the participants, Dr K Arulananthan thanked the Director, BOBP-IGO and his staff for the excellent organization of the Consultation.

32.0 The recommendations of the Second Bi-National Stakeholder Consultation on Sustaining the Gulf of Mannar Ecosystem and its Resources were confirmed during the closing session on 20 June 2012 in Jaffna.

Prospectus

1.0 The Second 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.

Towards this, the First Consultation was held from 5 - 6 September 2011 in Rameshwaram, Tamil Nadu, India. At the First Consultation, status of the GoM ecosystem was reviewed and the participants arrived on 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 Consultation was jointly organized by the BOBLME Project and the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO). 54 participants representing governmental agencies; research institutes and universities; fishermen associations from India and Sri Lanka and concerned regional and international organizations took part.

2.0 Objectives

The overall objectives of the Bi-national Consultation are as follows:

- 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.

Within the framework of the overall objectives, the specific objectives of the Second Bi-National Consultation are as follows:

- Review the outcomes of the First Consultation;
- Develop areas of collaborative action identified during the First Consultation into projects and programmes.
- Identify and define the scope of action of concerned agencies (BOBLME Project and its partners: BOBP-IGO and Mangroves for the Future- MFF).
- Develop institutional arrangements for bilateral cooperation between India and Sri Lanka.

3.0 Date and venue

The Second Consultation will be held from **18 – 20 June 2012** at Hotel Tilko Jaffna City Hotel, No: 70/6, K.K.S. Road, Jaffna, Sri Lanka (<http://www.cityhoteljaffna.com>). Representatives from concerned Governmental agencies of India and Sri Lanka, research organizations, NGOs and representatives of the primary users (mainly the fishermen) will participate in the Consultation.

4.0 Expected outputs and outcomes from the Consultation:

- A report on the outcome of the Consultation.
- Project and programmes for collaborative research and action on GoM.
- 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.

5.0 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 BOBLME Project to lay the foundation 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 (FAO) of the United Nations 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 subcomponent 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 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 fishermen 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 organizations 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.

6.0 Report of the First Consultation

The aim of the First 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 transboundary 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 the 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 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; 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; understanding trans-boundary importance of the GoM ecosystem and modalities to approach them; and strengthening bi-national

cooperation in managing the GoM ecosystem and moving towards an Ecosystem Approach to Fisheries.

Based on the recommendations made by the Groups, five activities were agreed as priority areas: (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. The Consultation further agreed that these activities will be developed into projects and programmes at the next consultation, to be held in Sri Lanka in early 2012. Once developed, these projects and programmes will be finalized at the final consultation to be held later in the year. 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 MFF.

It was also agreed that during the Second Consultation institutional arrangements for bilateral cooperation between India and Sri Lanka will be developed. These will be finalized at the Third Consultation.

7.0 The format of the Consultation

The Consultation will comprise technical presentations, highlighting key issues regarding areas of cooperation and action programmes identified for GoM. Following technical presentations, the participants will engage in group discussions on key issues and formulation of suggestions. The Consultation will be conducted in English. The Agenda of the Consultation is given in **Annex I**.

8.0 Participants

The following organizations are expected to participate in the Consultation:

India	Sri Lanka	International/Regional Organizations/NGOs
1. Ministry of Environment and Forests;	1. Ministry of Fisheries and Aquatic Resources Development;	1. <i>International Collective in Support of Fishworkers</i> ;
2. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture;	2. Department of Fisheries and Aquatic Resources;	2. Mangroves for the Future;
3. Ministry of External Affairs;	3. Ministry of Environment and Natural Resources;	3. International Union for Conservation of Nature;
4. Department of Fisheries, Government of Tamil Nadu;	4. Ministry of External Affairs;	4. South Asia Cooperative Environment Programme (SACEP);
5. Indian Coast Guard ;	5. Ministry of Tourism;	5. Food and Agriculture Organization of the United Nations;
6. Department of Environment & Forest, Government of Tamil Nadu	6. Central Environment Authority;	6. BOBLME Project; and
7. Fishery Survey of India;	7. National Aquatic Resources Research and Development Agency;	7. BOBP-IGO.
8. Gulf of Mannar Biosphere Reserve Trust (GOMBRT);	8. Department of Coast Conservation;	
9. Zoological Survey of India;	9. Mannar District Secretariat;	
10. Centre for Advanced Study in Marine Biology, Annamalai University;		

11. Central Marine Fisheries Research Institution, Kochi; 12. MS Swaminathan Research Foundation; 13. Suganthi Devadasan Marine Research Institute; 14. <i>South Indian Federation of Fishermen Societies</i> ; and 15. Representatives of fishermen associations.	10. University of Ruhuna; 11. University of Kelaniya; 12. University of Jaffna; 13. Wayamba University of Sri Lanka; and 14. Representatives of fishermen associations.	
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9.0 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. Detailed notes on travel arrangements will be communicated to the delegates once their nominations are received.

Insurance

The organizers will not provide any insurance. The participants are advised to have sufficient travel/health insurance at their own cost.

10.0 Contact

For any further information or clarification on the Second Bi- National Consultation, please contact:

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Programme

Date	Time (Hours)	Activity	Note
June 16, 2012 (Saturday)	All day	Arrival of outstation participants	Pick-up has been arranged at the airport. Please look for your name or BOBP placard. The Hotels will arrange airport pick up.
June 17, 2012 (Sunday)	0800	Boarding the bus to Jaffna Boarding points: • For participants from India and Thailand: Hotel Clarion. • For participants from Sri Lanka: Ministry of Fisheries and Aquatic Resources Development; Hotel Clarion and en-route.	
	1000	Tea and snacks	
	1230	Lunch	
	1600	Arrival in Jaffna	Venue: Anuradhapura Lodging at Hotel Tilko/Hotel Green Grass.
June 18, 2012 (Monday)	0830-1800	Consultation (Day I)	Conference Hall, Hotel Tilko.
	0830-1000	Session I: Opening Session	
	0830-0900	Registration	
	0900-1000	Opening Ceremony	
	0900-0905	Introductory and welcome remarks: BOBLME Project	
	0905-0910	Introductory and welcome remarks: BOBP-IGO	
	0910-0915	Introductory and welcome remarks: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.	
	0915-0920	Introductory and welcome remarks: Ministry of Fisheries & Aquatic Resources Development, Government of Sri Lanka.	
	0920-0930	Inaugural address: Secretary, Ministry of Fisheries & Aquatic Resources Development, Government of Sri Lanka.	
	0930-0940	Introduction by the participants	
	0940-1000	Group Photograph; Tea/Coffee	
	1000-1230	Session II: Technical Session	
	1000-1020	Report of the first Bi-National Consultation: BOBP-IGO.	
	1020-1040	Criteria for collaborative arrangements under the LME Concept: BOBLME Project.	
	1040-1100	Report on Water Quality of Gulf of Mannar-Wayamba University of Sri Lanka.	
	1100-1130	Report on collaborative efforts on conservation and management of charismatic species - Considerations for India: Central Marine Fisheries Research Institute.	
	1130-1200	Report on collaborative efforts on conservation and management of charismatic species - Considerations for Sri Lanka: University of Ruhana & International Union for Conservation of Nature (Sri Lanka).	Conference Hall, Hotel Tilko.
1200-1230	Discussion		
1230-1400	Lunch		

Date	Time (Hours)	Activity	Note
June 18, 2012 (Monday)	1400-1430	Capacity building and training needs in areas identified during the First Consultation- Considerations for India: Central Marine Fisheries Research Institute.	
	1430-1500	Capacity building and training needs in areas identified during the First Consultation - Considerations for Sri Lanka: National Aquatic Resources Research and Development Agency.	
	1500-1530	Discussion	
	1530-1600	<i>Tea/Coffee</i>	
	1600-1630	Possible areas of collaboration and mechanisms for education and awareness building including networking - Considerations for India: Suganthi Devadasan Marine Research Institute.	
	1630-1700	Possible areas of collaboration and mechanisms for education and awareness building including networking - Considerations for Sri Lanka: Department of Fisheries and Aquatic Resources & University of Jaffna.	
	1700-1730	Discussion	
	1730-1800	Session III: Group Work and Field Visit	
	1730-1800	Formation of Groups and Setting up of Group Tasks: BOBP-IGO.	
	2000 -	<i>Dinner</i>	
June 19, 2012 (Tuesday)	All day	Consultation (Day II)	
	All day	Field Visit: Travel to Mannar District for field visit and discussions with Mannar District officials, fishermen and other stakeholders.	
June 20, 2012 (Wednesday)	0900-1800	Consultation (Day III)	Conference Hall, Hotel Tilko.
	0900-1100	Group Discussion (Three groups)	
	1100-1300	Preparation of Group Reports	
	1300-1400	<i>Lunch</i>	
	1400-1530	Group Presentations (20mins x 3 Groups and discussion)	
	1530-1600	<i>Tea/Coffee</i>	
	1600-1800	Session IV: Plenary and Conclusion	
	1600-1800	Plenary: Adoption of the recommendations & conclusion (way forward).	
2000 -	<i>Dinner</i>		
June 21, 2012 (Thursday)	0700-	Departure from Jaffna	Stay at Hotel Golden Beach Resort in Negombo (Outstation participants)
June 22, 2012 (Friday)	All day	Departure of outstation participants.	

List of Participants

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Inaugural Address of Dr Damitha de Zoysa, Secretary, Ministry of Fisheries and Aquatic Resources Development of Sri Lanka

I wish to commence this inaugural address by briefly referring to the national fisheries and aquatic resources policy of Sri Lanka. Sri Lanka is committed to sustainable development of her fisheries and aquatic resources, and one of the objectives stipulated in the national fisheries and aquatic resources policy is to promote responsible fisheries and ensure long-term sustainability of fishery resources, while implementing strategies for increasing the national fish production. An objective given in the Fisheries Sector Development Strategy is to ensure compliance with international treaties and the United Nations Law of the Sea Convention (or UNCLOS) in development of fisheries.

Sri Lanka is a party to several international treaties that concern management of fisheries. These include the UNCLOS, which Sri Lanka is a party to since 1994, the UN Fish Stocks Agreement (or UNFSA, party since 1996), and the Indian Ocean Tuna Commission (or IOTC) to which it is a party since its inception in 1994. In addition, Sri Lanka is a party to two other treaties, which although are not directly related to management of fisheries, but contribute to sustainability of resources through the prevention or control of marine pollution and prevention of over-exploitation of fauna and flora species for commercial purposes respectively.

As per the 23 March 1976 agreement between Sri Lanka and India on the Maritime Boundary, the Gulf of Mannar (GoM) has been equitably divided between the two countries. The Sri Lankan side of GoM consists of the historic waters that have been declared as a part of the territorial waters of Sri Lanka and the Exclusive Economic Zone (EEZ) as given in the President's Proclamation dated 15 January 1977 made under the Maritime Zones Law, No. 22 of 1976. The continental shelf of the country extends over most parts of GoM and hence GoM is a comparatively highly productive fishing area.

I wish to figure out the relationship of our present exercise with the international commitments we have made in respect of conservation and management of fisheries resources. UNCLOS does not prescribe any specific provisions in regard to management of fisheries resources in the territorial waters as territorial waters come under the territorial sovereignty of the country. However, the 1995 FAO Code of Conduct for Responsible Fisheries requires States and users of living aquatic resources to conserve aquatic ecosystems, and fisheries management to promote the maintenance of the quality, diversity and availability of fishery resources in sufficient quantities for present and future generations in the context of food security, poverty alleviation and sustainable development. These principles are applicable in respect of all fisheries including those in territorial waters.

I wish to further state that UNCLOS (Article 56) provides that in the EEZ, although a coastal State has sovereign rights, these rights are limited to, among other things, exploring and exploiting and conserving and managing the fisheries resources. UNCLOS (Article 61) requires coastal States to determine the allowable catch of the living resources in their respective EEZs and take appropriate conservation and management measures to ensure that the living resources in the EEZs are not endangered by over-exploitation. As I said earlier UNCLOS (Article 63) requires coastal States to cooperate with each other either directly or through a regional fisheries management organization to conserve and manage shared stocks. Although UNFSA mainly deals with the conservation and management of highly migratory and straddling fish stocks in high seas, some provisions of it are also relevant to management of fisheries in national jurisdictions. For instance UNFSA

(Article 6) requires the application of the precautionary approach widely to conservation, management and exploitation of the stocks while Article 8 requires that the conservation and management measures established for the high seas and those adopted for the areas under national jurisdiction are compatible.

We are also bound to adhere to relevant resolutions adopted by the IOTC, which number over 50 since the inception of the Commission. The resolutions concerning IUU fishing are the most relevant to our present exercise. Fishing or related activities in contravention with IOTC management and conservation measures, such as catching undersized fish, fishing during closed season and in closed areas, joint fishing with vessels in the IUU list, unauthorized fishing in areas under national jurisdiction of coastal States are treated as IUU fishing according to the IOTC definition. We do not deny the fact that some Sri Lankan fishing vessels have engaged in IUU fishing in the EEZs of other countries. But these cases are few and far between and we have taken action against them within the present legal framework. However, we admit that we have not been successful in totally preventing such unacceptable fishing activities. We do not want to condone such activities and now are in the process of bringing in new legislation to deter them.

In the above context, it is necessary that we arrive at a common action plan for conservation and management of the ecosystem and its living resources. The role of GoM in socio-economic development of both Sri Lanka and India cannot be over-emphasized. It contributes immensely to the nutrition and food security and employment of the masses living not only in the coastal areas of GoM, but also in interior areas. From the Report of the First Bi-National Consultation I understand that over 50,000 fisher families in Tamil Nadu are directly dependent on fishing in the GoM for their living. Similarly over 7500 fisher families in the Northern Province of Sri Lanka obtain their living from fishing in GoM. Although figures are not available, perhaps a larger number of families maybe dependent for their living on fishery related activities in GoM, such as collection and distribution of fish catch, processing, curing and drying of fish, construction and repair of fishing craft, supply of fishing gear, ice and provision of other services required for fisheries. GoM also contributes to foreign exchange earnings of the two countries by serving as a source of valuable fishery products and also as an area of tourist attraction.

The GoM consists of a variety of terrestrial, littoral and oceanic ecosystems such as terrestrial forests, agriculture lands, estuaries and lagoons, sand dunes, mangrove forests, sea-grass beds, mudflats and coral banks, with a very high biodiversity. These ecosystems provide valuable services such as protection of land from wave and wind action, prevention of floods, and sustenance of fisheries by feeding and providing habitats for many animal species.

We do not know the allowable catch in GoM and whether the current fishing pressure is a threat to the sustainability of its fishery resources. Both countries have taken different measures to prevent over-exploitation of the fishery resources in GoM. These measures should be compatible. It is our duty to bring in new approaches to ensure the sustainability of the GoM ecosystem and its living resources.

Before closing, I wish to mention that Sri Lanka is confronted with an issue of large-scale poaching of her fishery resources in GoM and the Palk Bay to the detriment of the sustainability of the resources in these ecosystems and livelihoods of the fisher community in the Northern Province. I agree that this not the forum to discuss this issue. However, we do not understand how to ensure the sustainability of fishery resources in GoM in such a scenario. If both countries do not support each other in conservation and management of these resources our exercise will be futile. With this I conclude my inaugural address.

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

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.

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 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.

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.

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.

Mr 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. Pappamodдай 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, Mr 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.

Mr 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.

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.

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.

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.

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.

Group I: 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).

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.

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.

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.

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.

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.

Transboundary Critical Habitat Management: Criteria for Collaborative Arrangements*




**Bay of Bengal Large Marine Ecosystem Project –
Transboundary Critical Habitat Management:
Criteria for Collaborative Arrangements**

Dr. Rudolf Hermes
BOBLME Chief Technical Advisor

**2nd Bi-National Stakeholder Consultation on
Sustaining the Gulf of Mannar Ecosystem
and its Resources**

Jaffna, Sri Lanka, 18-20 June 2012



Bay of Bengal Large Marine Ecosystem Project



Some Facts

- 8 countries
- 6.2 million km²
- 450 million people affected

Transboundary issues

- over exploitation of fish stocks
- habitat degradation
- land based pollution

*Eight countries, connected by one ecosystem,
working together to secure its future.*





10 Major Areas of Work in Environment and Fisheries



- Transboundary Diagnostic Analysis (TDA) and Strategic Action Plan (SAP)
- Integrated Coastal Management
- Policy Harmonization
- Fisheries Resources Assessment and Management
- Transboundary Critical Habitat Management**
- Ocean Dynamics, Productivity and Climate Change
- Marine Protected Areas / Fish Refugia
- Ecosystem Health Indicators
- Land-Based Sources of Pollution
- Communications

Expected Outputs of the BOBLME Project



- ❑ Transboundary Diagnostic Analysis (TDA)
- ❑ Establishment of an institutional arrangement which is financially sustainable
- ❑ Commitment from the BOBLME countries to implement a Strategic Action Programme (SAP)



Expected Outcomes of the BOBLME Project



- **Stronger governance:**
 - Improvements in policy development
 - Processes for planning and dialogue
 - Enhanced mechanisms for regional collaboration
 - Ecosystem Approach to Fisheries
- **Better knowledge of:**
 - Fisheries for hilsa shad and Indian mackerel
 - BOBLME's large-scale processes and ecology
 - Likely effects of climate change
 - Basic ecosystem health indicators in the BOBLME
- **Improved resource management:**
 - Better understanding of small-scale fisheries issues
 - Co-management - Multi-sectoral involvement
- **Healthier habitats and ecosystems and sustainable fisheries contributing to improved well-being of coastal communities**



* Presentation made by Rudolf Hermes, Bay of Bengal Large Marine Ecosystem Project, Phuket, Thailand. Email: Rudolf.hermes@boblme.org

BOBLME **FAO**

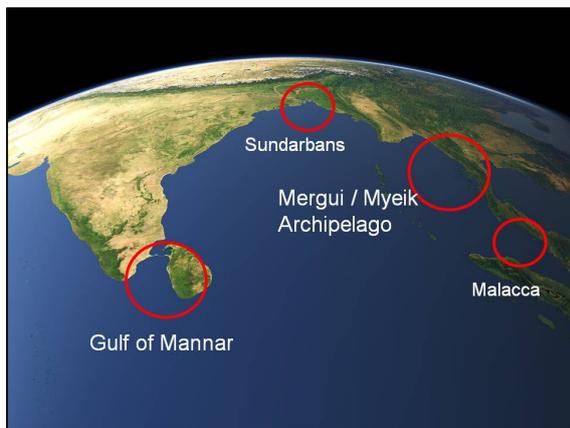
The Ecosystem Approach to Fisheries (EAF) is the approach BOBLME uses to promote sustainable development

Sustainable Development (EAF)

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

FAO **BOBLME**

FAO guidance on EAF



BOBLME

Collaborative Critical Habitat Management

Sundarbans

Mergui / Myeik Archipelago

Malacca

Gulf of Mannar

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

BOBLME

Collaborative Critical Habitat Management: Gulf of Mannar

Objectives of GoM Consultation Sep. 2011:

- 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.

BOBLME

Collaborative Critical Habitat Management Gulf of Mannar

- Develop a mutually acceptable roadmap / framework for continuing dialogue and undertaking activities to enhance cooperation for sustaining the GoM ecosystem and its resources
- Develop institutional arrangements for bilateral cooperation between India and Sri Lanka
 - Community, government, civil society, industry, NGOs, universities, regional organisations ...
 - Advisory / management structure, workplan activities (seagrass, dugongs, MPAs, pollution, fisheries, mackerels, sharks, ...)
 - Capacity development, monitoring and evaluation, communication

BOBLME

Collaborative Critical Habitat Management Gulf of Mannar

Elements of a collaborative structure and function:

- **Activity Teams:**
 - Implementation of collaborative activities
 - (Team coordinator, subject specialists, reporting, oversight)
- **Scientific and Technical Advisory Group:**
 - Multi-stakeholder, broad-based, technical experts
 - (e.g. members of BOBLME Task Force)
- **Planning and Management Committee:**
 - Developing 3-6 - monthly workplans;
 - Holding regular planning and review meetings;
 - Developing frameworks and guidelines for M&E
- **Executive Committee:**
 - Decision-makers from appropriate level in each country (central, state, province, district)
 - Establish and monitor strategic direction of collaboration





Collaborative Critical Habitat Management Gulf of Mannar

- **Activity Teams** are composed of people from both countries whenever possible
- **Scientific and Technical Advisory Group** could be university and NGO led, and will include natural and social science expertise
- **Planning and Management Committee** would have ideally 6 members per country – a larger group will have problems to reach consensus; should promote collaboration with local and regional partners in the GoM area; priority to obtain mandate and formalize operation
- **Executive Committee** could be drawn from Department (not Ministry) level officers – a clear prerogative of the countries



Collaborative Critical Habitat Management Gulf of Mannar

Some considerations:

- › Agreement on collaborative action (“workplan”) which BOBLME and partners can fund and contribute to
- › Start with small activities, easy to implement, easy to monitor, high chances of success
- › Consider *biodiversity conservation* (habitats, iconic species, MPAs, pollution), but also *fisheries and livelihoods*, and *awareness* raising on issues and possible solutions (can be jointly or national activities on either side)
- › Supplementary or complementary process to India-Sri Lanka Joint Working Group (JWG) on Fisheries; confidence building measures

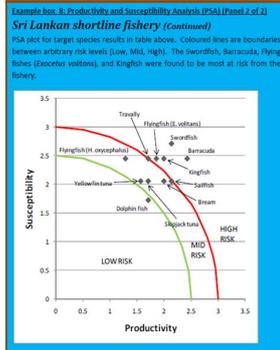


Collaborative Critical Habitat Management Gulf of Mannar

Fisheries Assessments and Fisheries Improvement Plans

Productivity and Susceptibility Analysis (PSA)

- life-history features, trophic level, fecundity;
- availability, encounterability, selectivity, post-capture mortality;



Collaborative Critical Habitat Management Gulf of Mannar

Consider to build on results of these two recent projects:

- › **Capacity enhancement of NARA for marine resource surveys and stock assessments in coastal waters of Sri Lanka (GCP/SRL/054/CAN):**
 - Communication, consultation, management planning
- › **Fisheries Management and Sustainable Livelihoods Project in Tamil Nadu and Puducherry, India (UTF/IND/180/IND):**
 - Rights and responsibilities of stakeholders, participatory processes, capacity building, review of welfare measures



Thank you for your attention
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Water Quality in Gulf of Mannar: Status, Needs and Requirements for Collaborative Research *

1.0 Introduction

Asia is one of the main regions in our planet experiencing fast changes in human growth, economic status and land use. Many Asian civilisations have evolved in and around river catchments and later they expanded to adjacent coastal areas for commerce, trade and fisheries. At present Asian seas experience human presence in several ways. Resource exploitation mainly for fin and shell fish and marine flora, crude oil and other natural elements, habitat alternation and fragmentation for development and settlement, introduction of alien species and release of both organic and inorganic chemical compounds to water are some of the main concerns regarding the human impact (Shahidul Islam and Tanaka, 2004).

Since sea is widely considered as the universal sink for effluents in Asia, no concern was raised until recent years regarding this continuous inflow mainly because of the belief that seas are large enough to bear the impact. However work carried out by (Herrera-Silveira and Morales-Ojeda, 2009; Kuwabara et al., 1989), has indicated contrasting findings raising fears about the health and safety of marine and near coastal ecosystems.

Agricultural activities are reported to contribute about 50% of the total pollution source of surface water by means of the higher nutrient enrichment, mainly ammonium ion (NH_4) and NO_3 derived from agricultural inputs. Ammonia constitutes a major contributor to the acidification of the environment, especially in areas with considerable intensive livestock farming (Hooda et al., 2000; Samsunlu and Akça, 1999). Wastes, manures and sludge, through biological concentration processes, can supply soils with 100 times more hazardous products than do fertilizers for the equivalent plant nutrient content (Liu et al., 2011; Zhou et al., 2007). The huge increases in fertilizer use worldwide over the past several decades are well documented (Joly, 1993). Manure produced by cattle, pigs and poultry are used as organic fertilizer worldwide. To this is added human excreta, especially in some Asian countries where animal and human excreta are traditionally used in fish culture as well as on soils (Hanjra et al., 2012).

Among the different sources for these effluents, coastal farming (shrimps, fish and other live organisms) and human occupation (hotels and houses) has raised environmental concerns due to intensive nutrient accumulation due to culture systems and lack of effective waste treatments (Funge-Smith and Briggs, 1998; Pruder, 1986, 2004), The nutrients and organic matter, if not treated before disposal, may potentially result in low dissolved oxygen (DO), hyper-nutritification, eutrophication, altered bacterial compositions as well as sedimentation in receiving waters (Harji et al., 2010).

By far the greatest volume of waste discharged to the marine environment is sewage (Daby et al., 2002). Sewage effluent contains industrial waste, municipal wastes, animal remains and slaughterhouse wastes, water and wastes from domestic baths, utensils and washing machines, kitchen wastes, faecal matter and many others. Huge loads of such wastes are generated daily from highly populated cities and are finally washed out by the drainage systems which generally open into nearby rivers or aquatic systems (Dhage et al., 2006). Also, faecal contamination of

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marine environments from urban development and animal farming is increasing worldwide at an alarming rate. Such water quality degradation affects a wide variety of aquatic environments including coastal waters, wetlands, estuaries, rivers, and reefs (Cañigral et al., 2010; Chua, 1999; Comeau et al., 2008) creating a serious health risk for wildlife and humans.

Many synthetic organic chemicals (e.g. organochlorines, organophosphates, Polycyclic Aromatic Hydrocarbons (PAHs) and organometals) are of growing environmental concern in oceans too, because of their high toxicity and high persistence in the environment and in biological systems (Agarwal, 2009; Binelli and Provini, 2003; Choudhary and Routh, 2010). Furthermore, the high lipophilicity of many of these xenobiotics greatly enhances their bio concentration / biomagnifications, thereby posing potential health hazards on predators at higher trophic levels (including human beings). Nowadays, persistent xenobiotic compounds have been found in every part of the ocean: from Arctic to Antarctic, and from intertidal to abyssal.

Similarly oil pollution has been receiving increasing attention since the middle of the 19th century with the increase in tanker operations and oil use and frequent marine tanker collisions and accidents resulting in oil spills (Baawain et al., 2011). Under still conditions, the oil traps, silts and other suspended matter sinks to the bottom where it is deposited. Coastal refineries are another obvious risk of continuous oil pollution because millions of gallons of crude oil and its fractions are processed and stored there (Emara, 1990).

Heavy metals and trace elements are by-products of many industrial processes, contributing varying amounts of different metals and trace elements and as such are discharged as waste into the marine environment (Agoramoorthy et al., 2008; Amaraneni, 2006; Aydin Onen et al., 2011; Balachandran et al., 2005). They enter the marine environment through atmospheric and land based effluent sources.

2.0 Water quality studies in Gulf of Mannar

There are several rivers draining to the Gulf of Mannar and work carried out so far has indicated the pollution levels in certain areas of the gulf. However, most studies are for the Indian side of the Gulf (Ayyamperumal et al., 2006; Burns and Smith, 1981; Jonathan and Ram Mohan, 2003; Rao et al., 2006; Santhiya et al., 2011) and so far no joint study has been conducted to evaluate the present status of the entire Gulf.

Heavy metal accumulation in the Gulf of Mannar has been studied by Ganesan et al. (1991); Jonathan and Ram Mohan (2003); Rao et al. (2006); Selvin et al. (2009) and particularly Rao et al. (2006) has attempted using sponge *Petrosia testudinaria* as a biomarker of heavy metal contamination in GoM. Radionuclide contamination in the Gulf of Mannar has also been studied in molluscs (Feroz Khan and Godwin Wesley, 2012) and the results indicated a hazard quotient for molluscs lesser than the global bench mark dose rate. However, in terms of heavy metals and other pollutants the need for coordinated long term research that could support management has been stressed (Ramakrishna Rao, 1993) and though this paper is not highlighting such research extending to countries sharing Indian Ocean water, it is vital to have link research for areas such as the Gulf of Mannar and Palk Strait.

Sewage contamination has also been studied in certain locations such as East, South-west and West coast of India (Clark et al., 2003; Rodrigues et al., 2011; Umesha et al., 2008) but no comprehensive microbial assessment has been done for the Gulf of Mannar waters. Both the coast, mid sea and rivers draining into the Gulf of Mannar need to be tested for the microbial loadings because work elsewhere has indicated edible fish being contaminated.

Another important type of pollutant that has been least studied is flotsam of GOM. Since both the sides of the Gulf of Mannar have no proper/adequate garbage disposal system a heavy load of flotsam is gradually accumulating (personal observations) in this region and both point and non point sources needs to be studied and management options developed for controlling and monitoring .

Man made pollutants such as PCB and PAH levels in the Gulf of Mannar and connected coastal areas have also been quantified and the results indicate presence of these harmful chemicals as well as bio accumulation in marine biota (Guzzella et al., 2005; Srinivasa Reddy et al., 2005). The gradual bioaccumulation of these compounds in birds (Kunisue et al., 2003) as well as humans (Devanathan et al., 2009; Devanathan et al., 2012) indicates the need for quantifying these pollutants in the Gulf of Mannar and implementing necessary management measures to curb their entry.

Nutrient pollution, mainly nitrogen and phosphates, is associated with industrial and agriculture discharges in the Indian Ocean (Atapattu and Kodituwakku, 2009; D'Costa and Anil, 2010; Verlecar et al., 2006). Despite the fact that scientific institutions in both sides of the Gulf of Mannar have been monitoring basic water quality parameters in relation to nutrient enrichment (presentations at the Gulf of Mannar second consultation) the outcomes have not been made public hindering action.

3.0 Assessment of existing mechanisms for water quality monitoring

At present both the countries have government established institutions entrusted with a mandate of monitoring the water quality of coastal zones. In Sri Lanka, Department of Coastal Conservation (CCD), Marine Environmental Protection Agency (MEPA), National Aquatic Research Agency (NARA) are some of the key establishments while in India Central Marine Fisheries Research Institute (CMFRI), Department of Fisheries, Central Salt and Marine Chemicals Research Institute can be named as the main governmental institutions. In addition to these agencies, several institutions indirectly measure water quality such as Ministry of Environment, Ministry of Fisheries and Aquatic Resources Development in Sri Lanka and in India, Department of Animal Husbandry, Dairying and Fisheries, Ministry/Department of Environment and Forest, Government of India could be named. Several research organisations and universities (*e.g.* CMFRI, Suganthi Devadasan Marine Research Institute, Institute of Fundamental Studies, Universities of Wayamba, Kelaniya and Ruhuna of Sri Lanka, Madurai Kamaraj University) as well as nongovernmental organisations (*e.g.* IUCN, IWMI) have been involved with water quality related research. Industrial Technology Institute of Sri Lanka has state of the art facilities for advanced water quality monitoring with accredited laboratories, while in India the Central and State Pollution Control Boards have the responsibility of monitoring and maintaining the water quality. One drawback identified for both countries is the insufficient accredited laboratory facilities available for reliable water quality monitoring as well as absence of protocols. Accordingly the need to develop common protocols for sample collection, analysis, data storage and interpretation is emphasised. Similarly, use of international accepted equipment and test kits is also vital.

India has research vessels and other facilities for deep sea research belonging to Zoological Survey of India that could be used to sample water in mid sea but at present Sri Lanka has no such facilities hence sharing of resources for the Gulf of Mannar is encouraged.

4.0 Scope of collaboration in capacity building in water quality assessment

Collaboration for water quality assessment and related capacity building is the way forward for the Gulf of Mannar as it is shared resource. Additionally two countries have their own strengths in terms of capacity building.

- Indian research vessels have been collecting and analysing water on board and they could potentially develop the capacities of Sri Lankan counterparts.
- Similarly, two countries could collaborate in establishing common protocols for water assessment.
- Collaboration for instrument use, calibration and data recording training.
- Collaboration for data analysis training.
- Review of current legal frameworks for water management.
- Benthic sampling and sediment assessments.

5.0 Parameters for construction of a water quality index for the Gulf of Mannar

Following parameters are considered as vital for construction of a water quality index:

- Salinity profiles
- DO
- pH
- Chlorophyll a
- Temperature
- COD and BOD
- Conductivity
- Heavy metals
- PAH, HCH, HCP, PCB and other man-made toxic compounds
- Microbial assessments such as total and fecal coliform
- Nutrients such as nitrite, nitrate, orthophosphate, ammonia
- Turbidity, Total suspended solids,
- Plastic and other forms of solid waste

6.0 Availability of information on water quality index parameters

Information on protocols and sampling procedures used for above mentioned water quality tests are available in both countries as standard approaches according to EPA, USA are being adopted by both countries. Currently, the accepted methods are given in Standard Methods for the examination of water and waste water (APHA 21st Edition), In addition historical data (in both published and unpublished form) are available at CMFRI and NARA and in published literature some mentioned in this report.

7.0 Identification of software packages needed for water quality monitoring

Software used in water quality monitoring could be of four types, firstly software required for parameter estimation such as in Flame Spectrophotometers come with the equipment. Secondly software required for spatial mapping such as Arc GIS are needed for both countries. Thirdly software for data analysis such as R, Genstat, SigmaPlot are needed. Fourth software requirement is for water quality modelling such as Water Quality Analysis simulation (WASP), TDML and SMS.

8.0 In-house training facility for water quality monitoring and identification of suitable agencies for provision of training

Most universities and research institutions of both the countries are capable for providing in house training and few such agencies are mentioned below:

CMFRI, India

SDMRI, India

DMCS, India

NARA, Sri Lanka

Wayamba, Kelaniya, Ruhuna, Moratuwa and Peradeniya Universities of Sri Lanka

IFS, Sri Lanka

ITI, Sri Lanka

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Collaborative efforts on conservation and management of charismatic species – Considerations for India*

1.0 Introduction

The Gulf of Mannar (GoM) is very unique characterized by different types of ecosystems like the coral reefs, seagrass, the seaweeds and mangroves, and rich assemblages of flora and fauna. However, over a period of time, the stock of some of the species has dwindled at an alarming rate which calls for an immediate attention for the conservation and management of these species. The sea cow, the marine turtles, some of the sharks, corals, sea horse, pipe fishes, some of the mollusks etc. have attracted the researchers, the environmentalists and the general public alike in the context of conservation. Although there have been various studies on different ecosystems and resources of the GoM, a comprehensive information on the resource status is still lacking mainly due to the isolated non-collaborative efforts taken by many of the research institutions. A collaborative effort between the institutions is essential to formulate meaningful management strategies aimed at conservation of species.

The conservation of charismatic (flagship) species in the GoM has indeed become more challenging with the changing scenario like the increase in human population, pollution of coastal waters, use of destructive fishing gears and over-exploitation of resources; all of these coupled with the changing climatic conditions. Conservation of a species, in the real sense, does not necessarily mean the conservation of the species alone; since it should also essentially address the conservation of the habitat of the species concerned. A multitude of factors are generally responsible for the vulnerability and decline in stock. Conservation of the charismatic species therefore requires concerted collaborative efforts between the various institutions involved in research and development. Conservation efforts should also give due considerations to the socio-economic and livelihood aspects of the local communities who are either directly or indirectly dependent on the resources of the GoM.

2.0 The Gulf of Mannar Ecosystem: A Marine Protected Area

The GoM is a unique ecosystem characterized by its rich biodiversity including the corals. 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 concerns given its diversity and special multiple use management status. As it is a first Marine Biosphere Reserve declared in India, this area has long been a National priority.

The Gulf of Mannar Biosphere Reserve (GOMBR) is the first Marine Biosphere Reserve not only in India, but also in all of south and south-east Asia. The GOMBR extends over 10,500 sq km and includes a chain of 21 islands. The core area of GOMBR (560 sq km) has been declared as National Park. 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,

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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 bottom of the inshore area around the islands is carpeted with seagrass beds which serve as a rich nursery and feeding ground of many important species. The Exclusive Economic Zone (EEZ) of GoM is about 15,000 sq km in which, commercial fishing is carried out in about 5,500 km² up to a depth range of 50 to 200m.

3.0 Faunal and floral diversity in GoM-India

The GoM is a home for diverse type of flora and fauna. A review of literature on the works conducted in the GoM points out to the presence of over 3 600 species of flora and fauna which includes 117 species of corals, 147 species of seaweeds, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes apart from the seasonally migrating marine mammals like whales, dolphins, porpoises and turtles. GOM is also a home to an endemic organism called *Balanoglossus (Phychodera fluva)*, a unique living fossil that links vertebrates and invertebrates.

4.0 Status of conservation of charismatic species in GoM

The GoM is an ecologically important critical habitat and is known for the rich coral reef which is threatened due to natural factors as well as anthropogenic pressures. The population of sea cow *Dugong dugon* has gone down to critically low level and there is an immediate need for their conservation. The region is also well known for dolphins, marine turtles and whales, all of which are listed under the schedule of the Indian Wildlife Protection Act (1972). All the species of sea cucumbers have been listed in the schedule thereby attracting scientific management measures for their conservation. The GOM being a coral reef area, the region is very rich in wide varieties of coral associated fauna, including the ornamental fishes which have a very good potential for foreign exchange earnings.

Corals

All the islands of the GoM are bordered with fringing reefs. So far 82 species of hermatypic corals belonging to 27 genera are reported from GOMBR. There is always a threat to this fragile group from fishing operations, sedimentation, pollution etc. besides the natural factors like the warming up of ocean. The destruction caused to the corals indirectly results in the destruction of innumerable organisms which are very closely associated with the coral reef ecosystem. Table 1 gives the factor responsible for degradation of coral and existing management measures.

Dugongs

The sea cow *Dugong dugon* is the only species in the genus *Dugong*. They inhabit shallow coastal waters and are herbivores feeding only on marine plants and seagrasses. They are slow-moving and have little protection against predators. It is the only extant species in the Family Dugongidae. It is listed as vulnerable to extinction at a global scale by The World Conservation Union (IUCN). Throughout its distribution range, the dugong is represented by relict populations separated by large areas where its numbers have been greatly reduced

Distribution and abundance

In most countries in the dugong's range, our knowledge of dugong distribution and abundance is known only from anecdotal information. Generally shoreline surveys conducted provide minimum counts on dugong. Extensive quantitative aerial surveys

using transects across the shoreline depth gradient have resulted in a more comprehensive knowledge of dugong distribution and abundance

Life history

Dugongs are long-lived with a low reproductive rate, long generation time, and a high investment in each offspring. Females do not bear their first calf until they are at least ten and up to 17 years old. Gestation period is about 13-15 months. The calf suckles for 14-18 months or so, and the period between successive calvings is spatially and temporally variable; estimates range from 2.4 to 7 years. Dugongs start eating seagrasses soon after birth, but they grow rapidly during the suckling period when they also receive milk from their mothers. Population simulations indicate that even with the most optimistic combinations of life-history parameters a dugong population is unlikely to increase more than 5% per year.

Table 1: Factors responsible for degradation of corals and management measures

Charismatic species	Conservation status	Factors responsible for degradation	Management measures needed	Agencies responsible for restoration
Corals	Schedule I, Part IVA, of the Indian Wildlife (Protection) Act, 1972 - Endangered	Fishing operation, Sedimentation Coastal pollution, Warming up of ocean	1. A realistic assessment of the status of coral reef. 2. Regulation of destructive fishing methods. 3. Abatement of pollution. 4. Coral restoration programmes (propagation /transplantations).	1. Central Marine Fisheries Research Institute (CMFRI). 2. Zoological Survey of India (ZSI). 3. The Fisheries College and Research Institute, Tuticorin (FCRI). 4. Centre for Advanced Studies in Marine Biology, Annamalai University (CAS-MB). 5. Madurai Kamaraj University (MKU). 6. Sugandhi Devadason Marine Research Institute, Tuticorin (SDMRI). 7. GOMBRT. 8. SHGs and fisherfolk.
Measures needed for coral propagation and restoration			Measures needed for restoration of reefs	
Propagation of hermatypic corals.			Coral propagation and transplantation	
Cement structures/ reef balls can be used as substratum.			Artificial reefs	
Attachment of propagated corals on to suitable substratum			Reef ball technology	
Restoration of coral reefs in degraded areas.				

Diet and habitat

Dugongs are seagrass specialists and frequent coastal waters. Major concentrations of dugongs tend to occur in wide shallow protected bays, wide shallow mangrove channels and in the lee of large inshore islands. The dugong's fecundity is very sensitive to the availability of its seagrass food. When dugongs do not have enough to eat they delay breeding, making habitat conservation a critical issue.

Anthropogenic influences

The seagrass ecosystems on which dugongs depend are very sensitive to human influence. Seagrass beds may be destroyed directly by mining and trawling or lost through the effects of disturbances such as dredging, land clearing and land reclamation. Accidental entangling in mesh nets and traps set by fishers is a major cause of dugong mortality in many countries. Dugongs are culturally significant to communities throughout their range. Dugongs are caught for meat, oil, medicaments, amulets and other products.

Distribution and abundance of Dugongs in India and Sri Lanka

Dugongs occur along the west coast of Sri Lanka, and in India in the Gulf of Kutch (Lal Mohan, 1963; Frazier & Mundkur, 1990), GoM and Palk Bay (Jones, 1967a ; 1967b; 1980; James 1985; Lal Mohan, 1976; Frazier & Mundkur, 1990) and in the Andaman and Nicobar Islands (Das & Dey, 1999).

Concerns

Habitat Loss and Degradation

Deforestation has also increased silt loads of rivers opening into the GoM and Palk Bay. Extreme weather events such as cyclones and high energy tidal storms may also contribute to loss of seagrasses in the region. It is suspected that a cyclone in 1954 had a significant impact on dugong populations and seagrass habitat in Palk Bay. The cyclone was accompanied by heavy rains, which flooded the region. According to reports from local fishers, large numbers of dugongs were found washed ashore and dead. Trawl nets also degrade seagrass beds in the Palk Bay-GoM region by uprooting rhizomes (*Silas & Bastion-Fernando 1985*).

Fishing pressure

Dynamite-fishing was introduced in 1981 in Palk Bay. It is realised that it could also be used to kill dugongs (*Silas & Bastion-Fernando, 1985*). Gill nets are believed to have had a significant negative impact on dugong populations around Palk Bay and the GoM. *Nair et al.* (1975) reported an average of 40 dugong deaths per year in gill nets set in Palk Bay.

Indigenous Use and Hunting

Between April 1983 and August 1984 more than 250 dugongs were reported caught and killed in the Kilakkarai-Tondi region bordering the GoM and Palk Bay (*Nair et al. 1975*). In the fishing villages bordering the GoM (Pudumandam, Vedalai) and Palk Bay (Karangadu, Nambutalia, Morepanai and Mullimuani), killing dugongs for consumption also occurs in great secrecy. The price of dugong meat is high and therefore the meat is much sought after.

Existing conservation initiatives

Legislation

Dugongs are protected in India under Schedule 1 of the *Indian Wildlife Act 1972* which bans the killing and purchasing of dugong meat. Dugongs became protected in Sri Lanka in 1970 under the *Fauna and Flora Protection Amendment Act No. 1 1970*, which bans killing of dugongs and the sale of their meat.

Research

Study was conducted to identify seagrass habitats for conservation. An osteological study on two dugong skeletons from the GoM was conducted.

Management

The GoM Marine Protected Area (9°07'N, 79°36'E) was designated in 1986 and comprises 623 ha.

Suggested conservative initiatives

Research

Determining dugong distribution and abundance

The most informative technique would be to use large-scale aerial surveys, preferably based on the quantitative techniques developed for large remote areas in Australia. GoM–Palk Strait region could be surveyed as a collaborative initiative between India and Sri Lanka.

Habitat mapping

During aerial surveys, it is important to locate seagrass beds for subsequent mapping and studies of community composition.

Management

If key dugong habitats are identified as a result of the large-scale surveys advocated above, consideration should be given to using these habitats as foci for community-based management and education initiatives, using the dugong as a “flagship” species. These initiatives may include the development of dugong sanctuaries if the community wishes and has the resources to implement them effectively. It will be important for such initiatives to address land management practices to prevent deforestation and soil erosion which contribute to the loss of seagrass.

There are no quantitative data on the status of dugongs or the extent or nature of seagrass communities along the coast of the Indian subcontinent or the associated offshore islands. In the absence of conservation measures to reduce the high mortality rates in the wild, there is a danger that dugongs will become locally extinct in this region (Table 2).

Table 2: Factors responsible for degradation of *Dugong dugon* and management measures

Charismatic species	Conservation status	Factors responsible for degradation	Management measures	Agencies responsible for restoration
Sea cow, <i>Dugong dugon</i>	Schedule I, Part I of the Indian Wildlife (Protection) Act, 1972 - Endangered	1. Habitat loss/destruction (sea grass beds) due to coastal pollution, indiscriminate fishing activities (particularly trawling in coastal areas) 2. Strangulation in fishing gears	1. Assessment of sea cow stock (surveys using standard methodologies) 2. Protection of its habitat (sea grass). 3. Regulation of destructive fishing practices	1. CMFRI 2. FCRI 3. CAS-MB 4. MKU 5. SDMRI 6. SHGs and fisherfolk

Sea turtles

All the five species of sea turtles viz., the olive ridley (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*) and the leatherback turtle (*Dermochelys coriacea*) are found in the GoM. A survey in 1977 by CMFRI found turtle nesting in Puluvinichalli, Nallathani, Anaipar, Valiamunai, Appa, Valai, Mulli, Hare, Manoli, Manoli-Putti and Pullivasal islands. However, the incidental catches; exploitation of meat and eggs by humans and the developmental activities in the coastal areas has affected the population of sea turtles considerably. The once reported sea turtle nesting the beaches of GoM islands have become a foregone era. Also, there have been no detailed studies on their stock, distribution, foraging grounds and their migratory behavior in the recent past to plan any management measures for their conservation (Table 3).

Table 3: Factors responsible for degradation of marine turtles and management measures

Charismatic species	Conservation status	Factors responsible for degradation	Management measures	Agencies responsible for restoration
Marine Turtles	Schedule I, Part II, of the Indian Wildlife (Protection) Act, 1972 - Endangered	1. Degradation of their natural habitats. 2. Strangulation in fishing nets	1. Assessment of the population of sea turtles 2. Protection of natural habitat 3. Use of Turtle Exclusion Device (TED) by fishing gears. 4. Studies on migration pattern/behavior by tagging 5. Protection of nesting grounds	1. CMFRI. 2. Central Salt and Marine Chemicals Research Institute (CSMCRI). 3. FCRI 4. CAS-MB 5. MKU 6. SDMRI 7. GOMBRT 8. Department of Fisheries, Government of Tamil Nadu (DoF-TN) 9. NGOs like the MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation 10. SHGs and fisherfolk

Dolphins and whales

Types of dolphins and whales observed include Spinner dolphin, Bottlenose dolphin; Saddleback dolphin; Humpback dolphin; Risso's dolphin; Toothed whale; Sperm whale; Pigmy sperm whale; Cuvier beaked whale, Baleen whale; Blue whale; Sei whale; Humpback whale; Bryde's whale; Mink whale and Australian whale.

Factors responsible for degradation of dolphins and whales and management measures

Charismatic species	Conservation status	Factors responsible for degradation	Management measures	Agencies responsible for restoration
Dolphins and Whales	Schedule I, Part I, of the Indian Wildlife (Protection) Act, 1972 - Endangered	1. Increase in the number of fishing fleets	1. Assessment of the species wise abundance of dolphins and whales 2. Regulation of destructive fishing gears	1. CMFRI 2. FCRI 3. CAS-MB 4. MKU 5. SDMRI 6. GOMBRT 7. DoF-TN 8. SHGs and fisherfolk

Sea cucumber

The sea cucumbers are an interesting group of purely marine animals. They are a delicacy for the Chinese, Japanese and Koreans. They are consumed 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*. The Ministry of Environment and Forests, Govt. of India brought all sea cucumbers under Schedule I of the Wildlife Protection Act, 1972 and strictly banned their collection in 2001.

Conservation and management of sea cucumber

All sizes were indiscriminately collected – without giving a chance for the animals to breed at least once during their life. Hence, Govt. of India imposed a ban in 1982 on the export of material which is less than 75 mm in length. But illegal trade of under-sized sea cucumbers continued.

Livelihood vs. conservation

The ban has affected the livelihood of a few thousand fishing populations. Many of them do not have an alternate livelihood avenue. A scientific in-depth study to understand and ascertain the present status of population of different species of sea cucumbers is needed in this respect, which, then, can decide on the species-specific ban (if required) – instead of a blanket ban on all the species.

Proposed regulatory measures

- Implementation of “minimum legal size for capture”.
- Effort control and monitoring.
- Inclusion of “no take zones” within the Marine Protected Areas.
- “Seasonal and short-term closures” of fishing.
- Implementing “rotational harvest closures”.
- Fixing of “catch quotas”.
- Market chain licensing and reporting.

5.0 Major impediments in conservation

With increase in coastal population and the developmental activities taking place in the coastal areas, there has been a serious threat to the fauna and flora of the GoM. The discharges from the industries are posing serious threat to many organisms and the larval and juvenile stages of various organisms are likely to be more affected which ultimately reflect on the recruitment. The fragile and unique ecology of the GOM needs to be protected involving all the concerned stakeholders.

Unregulated and indiscriminate fishing practices have been a serious threat to the GoM ecosystem. The use of destructive gears not only affects the resources but also the ecosystems like the sea grass and coral considerably. Although, some of the fishing gears like the pair trawl, drag net, roller net and purse seine are banned, some of the gears are still in practice causing a serious threat to the ecosystems and biota. The strict enforcement of fishing regulations, following the best-fishing practices and strictly observing the closed fishing seasons are also very essential for the sustainability of the ecosystem.

Conservation of any species becomes ineffective and meaningless, unless the local communities are fully involved in every stage of management. Limited participation of local communities in decision-making processes is one of the main issues facing the management of GoMBR. The communities play very little role in the formulation of plans, but are expected to cooperate in the implementation.

6.0 Collaboration needs for conservation and management

The scientific management and conservation of the GoM ecosystem as well as the vulnerable and threatened charismatic species is a need of the hour. However, an individual or an organization alone cannot plan the management processes. In the Indian side, the major strength is the multitudes of institutions with tremendous capacities to plan and implement various management measures. However, the various research institutions work in isolation and the information/data generated are generally not shared with their counterparts. The information should be made

available on a common portal which can be shared by all the institutions around the GoM, both in India and Sri Lanka. The research institutions and the developmental agencies should join their hands and work together in order to come out with meaningful conservation strategies.

In-depth scientific studies on various charismatic species are imperative. Although some information are available based on the previous studies conducted in GoM on many species, the present stock status of these species in the GoM is to be known. Also, a detailed investigation on their biology and behavior is important. This can be done by joint inter-institutional projects by various research institutions around the GoM. Even bi-national collaborative research projects involving the two nations, India and Sri Lanka would enable to share the scientific information, ideas and views between the nations which would help in a better understanding of the ecosystem.

The decline in stock of many of the charismatic species and also the fragile ecosystems like the mangroves, sea grass and corals are mainly due to the unregulated and harmful fishing practices. The development agencies should take necessary steps for the strict implementation of fishing regulations, so that the ecosystem and the resources are sustainably exploited. These agencies should work in close association with the research institutions as well the community.

The conservation programmes will not be successful and effective unless the local communities are fully involved at every stage of conservation actions. They should be educated and made aware of the consequences of biodiversity loss. The traditional knowledge of the communities with regard to the fishery and other allied subjects need to be given due importance and should be validated and incorporated in the conservation plans. The community-initiated self-regulations for conservation and sustainable use are to be recognized and supported by government institutions.

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Collaborative efforts on conservation and management of charismatic species in Gulf of Mannar*

1.0 Introduction

The meaning of the word Mannar is 'the deer river' or 'silt river', clearly indicates the characteristics of its water. The Gulf of Mannar is a large, shallow bay lies between the southern tip of India towards the west coast (Figure 1). Its northern boundary is a chain of sandy islands called Adam's Bridge, also called Ramsethu. The Adam's Bridge separates Gulf of Mannar from the Palk Bay which is again a shallow bay extends up to the Palk Strait. The southern boundary extends up to Laccadive Sea in the Indian Ocean. The Kala Oya and Moderagam Ara of North-western Sri Lanka and the Thamirabarani River of South-Eastern of India drain into the Gulf contributing a high productivity in this area supporting a diverse marine life.



Figure 1: Location of the Gulf of Mannar between the Indian subcontinent and Sri Lanka

The Gulf is known for its high level of biodiversity with number of marine and coastal ecosystems and globally endangered animal species. The gulf harbors over 3,600 species of flora and fauna, making it one of the richest coastal regions in Asia.

Sea turtles are frequent in the Gulf of Mannar consisting of three species of globally threatened marine turtles. The predominant species is the Olive Ridley (*Lepidochelys olivacea*), followed by the Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Erytmochelis imbricata*). Olive Ridley migrates annually to the beaches of Orissa through the Gulf of Mannar, which is known to be their largest known nesting site in the world. Therefore this area is important as foraging site and a migratory route for the Olive Ridley population inhabiting the South Asian marine region.

The Gulf of Mannar contains the single largest coral reef systems in Sri Lanka (The Bar reef ecosystem), which consist of true coral reefs and sandstone reef habitats with 117 recorded hard coral species. Sharks, Rays, Dugongs, whales and Dolphins are recorded frequently from this area. 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 gulf is known for its sea grass diversity which amounts to 13 species; of which *Enhalus acoroides* is considered to be endemic to this area. More than 300 reef and reef associated fish species have been recorded from the Bar Reef Marine Sanctuary with more than 40 species of marine and brackish water fish species have been recorded from the Kalpitiya North, the southern boundary of the Gulf of Mannar. Further, 731 species of molluscs, 641 species of crustaceans and 441 species of fin fishes and 147 species of seaweeds were recorded from the area.

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Lagoons, estuaries and shallow sand banks of the Gulf of Mannar are extremely important for annual bird migrants. Birds visit the country through three migratory routes, the western route, eastern route and the Andaman route (Figure 2). The western route extend from the west coast of Indian peninsular, the extreme south of India, Palk strait, Mannar and western coast of Sri Lanka towards the Deep south. A total of 166,300 water birds were recorded from this region in 2003, during the annual water bird census conducted by the Ceylon Bird Club (CBC). The island habitats of this area are of high ecological significance for at least 100 bird species, including several nationally threatened species.

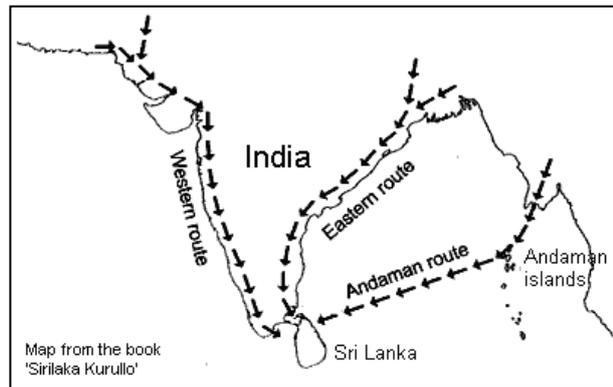


Figure 2: Three major migratory routes of birds to Sri Lanka

2.0 The status of charismatic species in the Gulf of Mannar

Charismatic species concept is widespread popular that environmental activists use in conservation and management goals in the field of ecotourism and environmental activists. These species exercise compelling charm which inspires devotion in others, especially animal species with a great appeal to the public. Therefore environmental activists often use the leverage provided by charismatic and well known species to achieve more subtle and far-reaching goals in species and biodiversity conservation. 'Charismatic' species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause. By focusing on, and achieving conservation of that species, the status of many other species which share its habitat – or are vulnerable to the same threats - may also be improved. It may or may not be keystone species and may or may not be good indicators of biological processes. The Gulf of Mannar is known for the abundance and the variety of its marine charismatic species. Whales, dolphins, dugong and turtles are the widely spread charismatic megafaunal groups. Other bottom critters such as sea urchins, star fish, sea cucumber and corals widely show its charisma, but are not referred as charismatic fauna.

2.1 Marine Mammals

Marine Mammals which include seals, whales, dolphins, dugongs and walruses, form a diverse group of 128 species that rely on the ocean for their existence. They are warm-blooded, air-breathing animals that feed their young on milk like all other mammals. They are exclusively aquatic, live during their entire life in an aquatic environment. Limited cetacean surveys that have been conducted in these areas, baseline data on the populations in the Gulf of Mannar and Sri Lanka as a whole is lacking.

Sixtee species of marine mammals have been documented within this region of which four species are globally threatened (Table 1). Many of these records are from the vicinity of the Bar Reef Marine Sanctuary, which is located in the Southern Gulf of Mannar. Of particular significance is the population of the globally endangered Dugong (*Dugong dugon*) which has been documented within the extensive seagrass beds north of the Kalpitiya peninsula. A recent survey of the Bar Reef Sanctuary indicated that it possesses year round abundance and species richness of marine mammals and suggests that the northern and central area may be considered a cetacean 'hotspot'.

Table 1: Marine mammals of the Gulf of Mannar checklist (Illangakoon, 2002; de Vos et al., 2003)

Scientific name	Common name	Global Red List Status*	Depth at which sighted (m)
<i>Balaenoptera musculus</i>	Blue whale	EN	2000
<i>Balaenoptera acustorostrata</i>	Minke whale	LC	
<i>Megaptera novaeangliae</i>	Humpback whale	LC	
<i>Physeter macrocephalus</i>	Sperm whale	VU	80-1500
<i>Kogia sima</i>	Dwarf Sperm whale	DD	
<i>Lagenodelphis hosei</i>	Fraser's dolphin	LC	1500-1900
<i>Pseudorca crassidens</i>	False Killer whale	DD	
<i>Peponocephala electra</i>	Melon-headed whale	LC	1800
<i>Sousa chinensis</i>	Indo-Pacific Humpback dolphin	NT	
<i>Delphinus delphis</i>	Common dolphin	LC	
<i>Stenella longirostris</i>	Long-snouted Spinner dolphin	DD	
<i>Stenella attenuata</i>	Pan-tropical spotted dolphin	LC	1500-1800
<i>Stenella coeruleoalba</i>	Striped dolphin	LC	1450
<i>Tursiops truncatus</i>	Bottlenose dolphin	LC	1800
<i>Orcinus orca</i>	Killer whale	DD	
<i>Dugong dugon</i>	Dugong	VU	

* Global Red List Status from www.redlist.org where EN = Endangered, LC = Least Concern, VU = Vulnerable, DD = Deficient, NT = Near Threatened.

Cetaceans

The 16 species of marine mammals recorded in the GoM region which consists of eight species of whales, seven species of dolphins and one dugong species (Table1).

Whales

Whales are very large animals which can grow up to 100 ft. or more in length. They can weigh up to 200 tons or more. Whales live in families called pods. These pods vary in numbers and consist of family members and family friends. Whales live in these families their whole life. Group living is safer when other whales or sharks

attack. It also makes it easier to find food. Whales are always migrating. They travel to find food, breed and have young.

Dolphins

Dolphins are marine mammals closely related to whales and porpoises. There are almost forty species of dolphin in 17 genera. They vary in size from 1.2 m (4 ft) and 40 kg (90 lb) (Maui's dolphin), up to 9.5 m (30 ft) and 10 tonnes (9.8 long tons; 11 short tons) (the orca or killer whale). They are found worldwide, mostly in the shallower seas of the continental shelves, and are carnivores, eating mostly fish and squid. The family Delphinidae is the largest in the Cetacean order. It has been claimed that dolphins are among the most intelligent animals, and their often friendly appearance, an artifact of the "smile" of their mouthline, and seemingly playful attitude have made them very popular in human culture (<http://en.wikipedia.org>).

Dugong (*Dugong dugon*)

The dugong prefers warm coastal and island waters in over 40 countries in the Indo-Pacific. Dugong (*Dugong dugon*), is commonly known as the 'sea cow'. It is a large, long-lived marine mammal that feeds almost exclusively on sea grass and also lives in mangrove habitats. Dugong plays a significant ecological role in the functioning of coastal ecosystems.

Dugongs are long-lived – average up to 70 years, and are slow to mature and breed. Females start breeding when they are between six and 17 years old and bear one calf after a pregnancy which lasts about 14 months. Afterward, it produce calves only once every 2.5 –5 years. Dugong populations are vulnerable and take a long time to recover because of this slow breeding rate.

In Sri Lanka Dugong was abundant and widely distributed along coastal waters of Sri Lanka particularly in the coastal waters of Gulf of Mannar-Palk Bay region up until late in the 20th century. Its distribution and numbers are limited. Populations declined dramatically and sightings are now rare in most areas of Sri Lanka. The threats are numerous across their range, including incidental capture in fishing nets, loss of habitat, boat collision and unsustainable hunting practices. Dugong face a high risk of extinction in the medium-term future, hence is given high levels of legal protection in South Asia through national legislation in countries including Sri Lanka and India.

Conservation groups can raise the awareness and the support for the protection of Dugong and the management of the entire ecosystem of which it is a part. Due to the size of the dugong's range and their declining population, it is classified as 'Vulnerable to Extinction' under International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Therefore a coordinated international effort is crucial to the conservation of this threatened marine mammal.

Sea turtle

Turtles are long lived believed to live more than 80 years. They are highly migratory, moving between breeding, nesting and feeding grounds. They are ocean dwellers; only leave the ocean when the females come ashore to nest. Out of a total of seven living species of turtles in the world, five are reported to nest along the coastal belt of Sri Lanka. They are Loggerhead (*Caretta caretta*), Green turtle (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), Leatherback (*Dermodochelys coriacea*) and Hawksbill turtle, (*Eretmochylus imbricata*) (Amarasooriya and Dayaratne, 1997).

Three species of marine turtles have been recorded in the Gulf of Mannar region and considered to be globally threatened. The predominant species is the Olive Ridley (*Lepidochelys olivaceae*) while the Green Turtle (*Chelonia mydas*) and the Hawksbill

Turtle (*Erytmochelis imbricata*) are recorded in comparatively low numbers. The Gulf of Mannar area is known to be an important foraging site and a migratory route of the Olive Ridley population inhabiting the South Asian marine region (Kapurusinghe and Cooray, 2002). The coastal waters close to the Kalpitiya Peninsula (part of the Gulf of Mannar) have been identified as a foraging ground of the Olive Ridley turtles nesting along the Orissa coast of India (Pandav et al.1994). However, the nesting sites have not been properly documented in the Sri Lankan coast of the Gulf of Mannar resulting data scarcity.

2.2 Threats

Gulf of Mannar is famous to harvest demersal fish for the local market. However, shrimp, sea cucumber, chank (*Turbinella pyrum*) and a bulk of spiny lobsters are harvested for the foreign market. Further, reef fish are collected for the ornamental fish trade. Reef and reef-associated fisheries are the main economic use of reefs in Sri Lanka. Reef fish production fluctuates yearly, but yields an average annual catch of around 10,000 tons, which constitutes about 72% of total marine fish production. Gill nets and trawl nets are the major fishing gear used in the area where demersal and semi-demersal fish and shrimp are the target species. According to a survey conducted three decades ago, there are some offshore areas in the northwest, which may be capable of sustaining trawling operations for deep-sea lobsters, shrimp and a few commercially important species of fish. However the increased number of trawls and the increased frequency of trawling caused complete destruction to the soft bottom dwelling faunal and floral communities. Coupling with the resulting bycatch, this fishing method certainly lead to resource extinction through its operation.

Pearl oysters were abundant in the pearl banks off the northwest coast, south of Mannar Island and contributed to a major fishery until about 50 years ago. In 1958, 4.5 million pearl oysters were fished out from a stock of about 258 million. Chanks are also collected and exported annually from the Palk Bay area. However excess exploitation rate, resource depletion, disease spread and the population expansion of shell boring organisms lead this fishery a complete stand still.

After analyzing the seismic survey, Sri Lanka started oil exploration activities in the western, north western sea areas of the country (Figure 3). The seismic surveys, frequent well drilling activities, deposition of oil well cuts, excess ship movements and heavy maneuvering of larger ships, cable, tube laying, pollution can cause a tremendous damage to the biodiversity of the area. Feeding, breeding, spawning grounds and habits will be damaged due to these activities. However without having a proper baseline data source, this task has become a wasteful one.

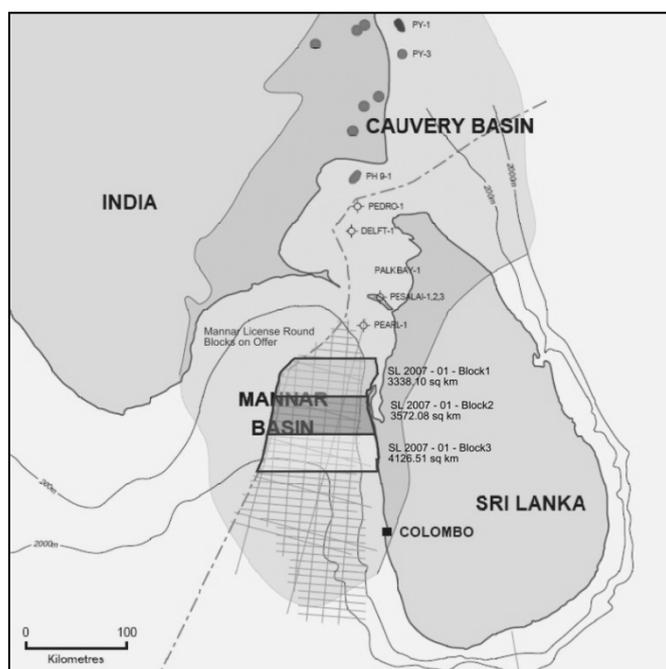


Figure 3: Map indicating the drilling blocks

Source : NELP oil exploration maps

In the year 2005, the Indian government took a decision to proceed with the Sethusamudram Shipping Canal Project (SSCP) that would dredge a deep canal linking the Gulf of Mannar to the Bay of Bengal. The canal allows the deep draft ships to cross the shallow Gulf of Mannar, Adam's bridge, Palk bay and Palk Strait while connecting the major seaports of the area Colombo Sri Lanka and Thoothukudi (Tuticorin) in Tamil Nadu. In spite of these direct benefits, this canal has a serious potential to damage the sea life and fisheries in the Gulf of Mannar, Palk Bay and Palk Strait. Especially the frequency of the collision of Dugongs and turtles with ships moving along the canal may increase. Environmental impacts of this project were enormous. The dredging activity could increase the water turbidity causing damage to coral species, sea grass species by reducing the light penetration depths, killing corals by smothering and impeding respiration efficiency in small pelagic and demersal fish species, reducing their foraging and breeding efficiency. Further, the frequent ship movement can cross migratory paths of whales, dolphins, dugong and turtle species while damaging them through direct collision. The marine pollution caused by ships may damage egg fertilizing efficiency, fecundity and larval stages of most of the marine organisms.

3.0 In-country institutional mechanisms for conservation of charismatic species

Man and Biosphere Reserve – Sri Lanka

The biodiversity and the resources in the Gulf of Mannar are an utter importance to its economy and future developments. Understanding that, the country is in a process to proposing a part of Gulf of Mannar as a Man and Biosphere Reserve (Figure 4) in order to manage the resources there. National Science Foundation (NSF) of Sri Lanka has taken the initiative of this program. The size of the proposed area is approximately 753,120 ha. The proposed core area (see map) includes the Bar reef sanctuary and the islands in Gulf of Mannar and Palk Bay region, and the coastline of the mainland. Parts of this proposed biosphere reserve falls under the existing protected area network, the Bar reef is an existing Sanctuary (30,670 ha) in Sri Lanka which is managed under the Department of Wildlife Conservation (DWLC). Also some parts of the coastal area extending from Kala-oya to Modaragam-ara falls within the Wilpattu National Park, administered by the DWLC. A

patch of mangrove located in Kuringnampitiya North (in Kalpitiya Peninsula) is a Forest Reserve managed under the Forest Department of Sri Lanka.

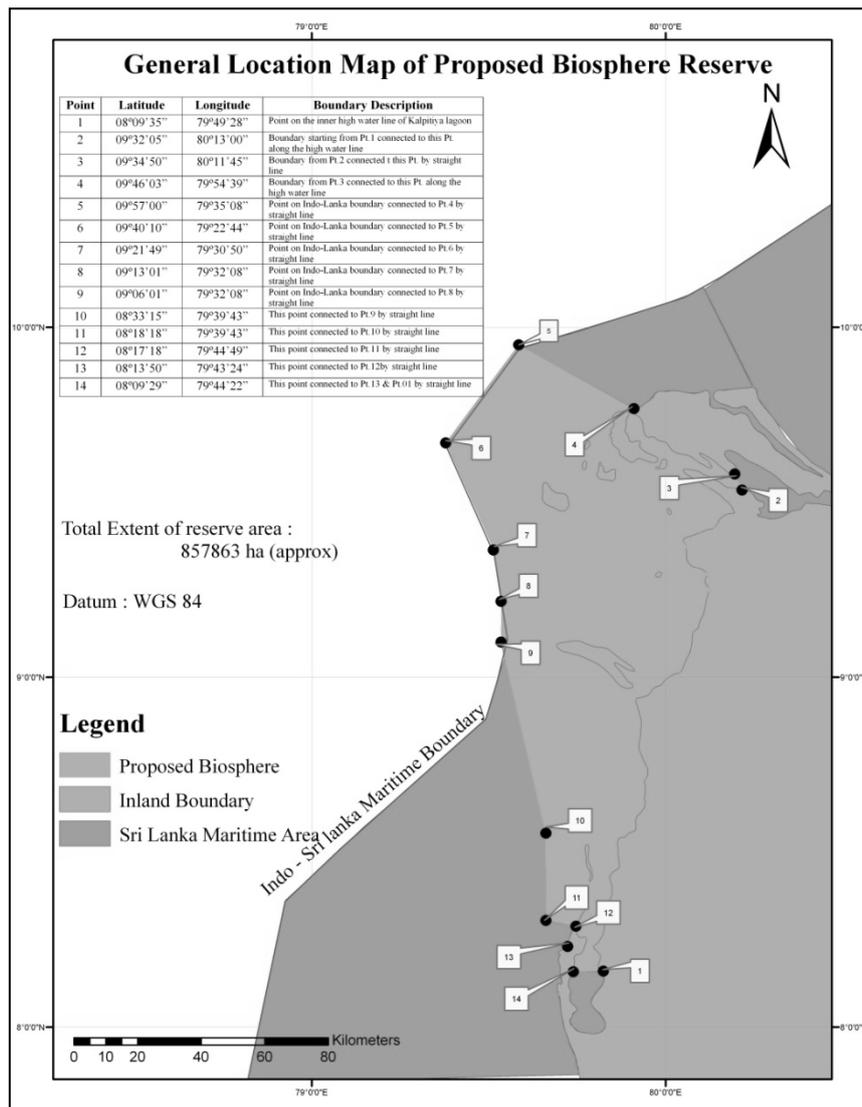


Figure 4: The proposed Man and Biosphere reserve

Proposed Man and Biosphere reserve of Sri Lanka and Gulf of Mannar marine national park are the two major initiatives dedicated to protect and manage the marine resource in the Gulf of Mannar. However these two entities work as separate units although they are for the same objective working on the same sea area, either side of the International Boundary line.

There is a proposed project on managing living resources in Gulf of Mannar Region between India and Sri Lanka through a two year project under the financial support from Mangroves for the Future Initiative (MFF).

4.0 In-country legal framework for conservation of charismatic species

Sri Lanka has formulated some more management tools to control illegal activities and promotion of the sustainability driven initiatives, such as Fauna and Flora Protection Ordinance, Coast Conservation Act, Fisheries and Aquatic Resource Act No2 of 1996 and the Wild Life Act.

Whales, Dolphins, dugong and turtles that inhabit Sri Lankan waters are protected under Fauna and Flora Protection Ordinance No. 2 of 1937 (FFPO). The Ordinance is also supplemented by several other enactments owing to the sectoral nature of the

present administrative system. Therefore, while the FFPO provides the overall framework for species conservation, provisions for the same also exist in several sectoral laws, particularly in the fisheries (Fisheries and Aquatic Resources Act, No. 2 of 1996), and coastal (Coast Conservation Act, No. 57 of 1981 and subsequent amendments) sector. Whale and dolphin watching in the Kalpitiya area of Gulf of Mannar is gaining popularity and the numbers of service providers are also increasing. The Department of Wildlife Conservation in collaboration with the Sri Lanka Tourism Development Authority has developed Guidelines/code of conduct for Whale and dolphin watching. These guidelines will soon be submitted for Cabinet approval thus will provide additional protection to these two groups of charismatic species.

5.0 In-country monitoring mechanism for charismatic species

The FFPO is implemented by the Department of Wildlife Conservation of Sri Lanka and the relevant officials in the branch offices posted in different islands ensure that the laws are not violated. Similarly the Department of Fisheries ensures that the sale of flesh of protected species is prohibited. The offenders are prosecuted under the relevant sections of the ordinance or Acts.

Sri Lanka Navy which patrols the Gulf of Mannar waters plays a vital role in monitoring the fishing and recreational boats to ensure that these charismatic species are not harmed. While they ensure that dugong caught in by-catch is released to the sea, they also play a vital role in monitoring the operational aspects of recreational boats that are involved with whale and dolphin watching tours.

6.0 Scope of collaboration with Sri Lanka within the existing legal framework for conservation

The management of charismatic species in the Gulf of Mannar needs a collaborative approach from Sri Lanka and India. However, the possible collaborations are limited to a very few numbers. Bay of Bengal Program Inter-Governmental Organisation (BOBP-IGO), Bay of Bengal Large Marine Ecosystem Project (BOBLME) and "Re-incooperating the excluded: Providing space for small-scale fishers in the sustainable development of fisheries of South Africa and South Asia (REINCORPFISH)" project are some of the very active initiatives promoting collaborative efforts to manage the Gulf of Mannar region.

Linking available tools and institutions to formulate a holistic approach to manage this common resource is needed. A separate tool for each resource, a common act to fisheries management, a common coastal scientist and manager's forum and a common database are some of the possible options. However in all cases, the identity of two countries, the respect to the International Boundary line (IBL), recognition to fishers rights, the sustainability of marine resources should be ensured.

7.0 Agreed international guidelines relevant to conservation and management of charismatic species

Sri Lanka has taken a step ahead on conserving Dugong becoming a signatory to the Memorandum of Understanding on the conservation and Management of Dugong habitats through their range (Dugong MoU). The Dugong MoU operates under two institutes, United Nations Environmental Program (UNEP) and Convention on Migratory species (CMS). The preliminary implementing will be undertaken by the Department of Wildlife Conservation and IUCN Sri Lanka. This will include the conducting of surveys to gather knowledge on dugong distribution, its abundance, and their hotspots and the main threats from incidental captures by net fishers.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of which Sri Lanka is a signatory (1973) also provides additional protection to these species.

8.0 Analysis of international guidelines and national legal framework and identification of gaps, positive points and contradictions

The Table 2 depicts a comparison of international guidelines and national legal protection provided for the 21 charismatic species recorded. The comparison rightfully reveals that the protection to these charismatic species is provided at both international and national levels.

Table 2: Comparison of international guidelines and national legal protection provided for the recorded 21 charismatic species

Species	International		National (FFPO)
	CMS	CITES	
<i>Balaenoptera musculus</i>	Y	I	Y
<i>Balaenoptera acutorostrata</i>	Y	I/II	Y
<i>Megaptera novaeangliae</i>	Y	I	Y
<i>Physeter catodon</i>	Y	I	Y
<i>Kogia simus</i>	Y	II	Y
<i>Lagenodelphis hosei</i>	Y	II	Y
<i>Pseudorca crassidens</i>	Y	II	Y
<i>Pennocephala electra</i>	Y	?	Y
<i>Sousa chinensis</i>	Y	I	Y
<i>Delphinus delphis</i>	Y	II	Y
<i>Stenella longirostris</i>	Y	II	Y
<i>Stenella attenuata</i>	Y	II	Y
<i>Stenella coeruleoalba</i>	Y	II	Y
<i>Tursiops truncatus</i>	Y	II	Y
<i>Orcinus orca</i>	Y	II	Y
<i>Dugong dugon</i>	Y	I	Y
<i>Caretta caretta</i>	y	I	Y
<i>Chelonia mydas</i>	y	I	Y
<i>Lepidochelys olivacea</i>	y	I	Y
<i>Dermochelys coriacea</i>	y	II	Y
<i>Eretmochylus imbricata</i>)	y	I	Y

Y = protected; Roman numeral against CITES indicates CITES Appendix Number. Appendix I include species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

9.0 Evaluation of collaborative research experience on Gulf of Mannar

Under the auspices of CMS, a survey on dugong catch/by-catch records was conducted in Sri Lanka from February – March 2012. The survey which was coordinated by IUCN Sri Lanka Office was conducted through a standardized questionnaire developed by CMS. About 200 fishermen from Kalpitiya, Mannar and Batticaloa areas were interviewed and in addition to information on catch/by-catch sightings, the interviewee's perceptions on dugongs were also recorded. The data is currently being analyzed and the findings will no doubt assist in protection of the fast dwindling population of dugong from Sri Lankan waters.

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Capacity building and training needs on areas identified during the first consultation – Considerations for India*

1.0 Introduction

The Gulf of Mannar (GoM) is very unique characterized by different types of ecosystems. However, over a period of time, the stock of some of the species has dwindled at an alarming rate which calls for an immediate attention for the conservation and management of these species. Most of the agencies lack in knowledge, skill and attitude towards the conservation and management of these species. Hence, there is a need for capacity building and training for the agencies involved in GoM for effective ecosystem based conservation and management of GoM.

The first 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. Central Marine Fisheries Research Institute was one of the agencies represented in the consultation.

Based on the recommendations made in the first consultation, five activities 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; (iii) Education and awareness building; (iv) Strengthening of data collection and processing mechanism; and (v) Sharing of information and networking. Among these activities one of the activities is capacity building and training. The areas identified during the first consultation are listed below:

Capacity building and training needs identified during the first consultation

1. Ecosystem Approach to Fisheries at various levels including school children
2. Species identification
3. Diving and snorkeling
4. Coastal health monitoring
5. GIS and remote sensing
6. Oceanography
7. Participatory approaches in fisheries management
8. Post-harvest management
9. Marketing and value addition
10. Stock assessment
11. Water quality monitoring

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2.0 Steps in capacity building process

- I. The agencies to be involved in the research, conservation and management of GOM ecosystem are to be specified.
- II. In a collective way these agencies will identify the capacity needs and assets.
- III. The individuals in each agency are identified for capacity building process in specialised areas.
- IV. The organisations which can impart training on specialised areas are identified.
- V. In first two years capacity building component will be completed.
- VI. Evaluations of capacity building is measured based on changes in performance based around the four main issues: institutional arrangements, leadership, knowledge, and accountability.
- VII. In the next three years based on the expertise, data will be generated on GOM ecosystem and effective management and conservation principles will be formulated.

3.0 Capacity building and training needs – consideration for India

3.1 Ecosystem Approach to Fisheries

Ecosystem Approach to Fisheries is to accommodate societal expectations and needs into management without threatening the options for future generations to gain from the goods and services of resource ecosystems (FAO, 2003). EAF strives to find a satisfactory balance between biodiversity consideration, stock productivity and socio-economic issues, which focuses on providing food and income for people's livelihoods by managing fishing activities. EAF is an emerging concept in fisheries; hence there is need for capacity building at individual, institution and societal level for managing the GoM ecosystem and its resources on a sustainable basis.

The current management measures are adopted without a realistic and strong database regarding the status of the resources. Such types of management measures create lot of livelihood issues and hence will become redundant. A realistic long-term database is not yet developed for the major resources of GoM ecosystem. Another vital aspect is to review the quality and availability of resources and ecosystem services after the implementation of the management measures in order to compare it with the pre-management scenario. Marine resource assessment is a process where lot of assumptions is made to estimate the stock. However, the methodology adopted and the samplings made should be scientifically well accepted. Ecosystem Approach to Fisheries strives to find a satisfactory balance between biodiversity consideration, stock productivity and socio-economic issues, which focuses on providing food and income for people's livelihoods by managing fishing activities. The current management measures in the region have not made any serious concern regarding the livelihood option. When a particular resource on which the livelihood of a group of fisherfolk are dependent, it is inhuman to put a total ban on the resource without regard to livelihood option. It is well known that for any management measure which is affecting the livelihood of a sector, it is better to have a participatory conservation approach. The current management scenario has not made enough scope for this vital aspect. The hard core conservation measures have to be reconsidered. The sustainable exploitation of resources from the area can be practiced whereas destructive practices have to be effectively curbed. On a global basis also, the coral reef ecosystem are permitted for sustainable exploitation. The policy of total ban should be resorted only when it is absolutely warranted based on the database created through careful scientific studies. Otherwise a lot of illegal exploitation of the resources is bound to happen, which is more disastrous and harmful to the ecosystem. Any awareness programme on the need of regulation of exploitation of resource is futile if an alternate livelihood option is not provided to the fisherfolk. In this context, small-scale mariculture practices have to be encouraged as alternate livelihood option. The fisherfolk are not having a mind-set for farming practices and hence a lot of Government incentives are initially needed

for adoption of the same. Certain areas of GOM can be demarcated as mariculture zone where farming practices can be adopted. 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.

Table 1: Agencies involved in capacity building for Ecosystem Approach to Fisheries

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Ecosystem Approach to Fisheries at various levels including school children	Central Marine Fisheries Research Institute (CMFRI) Central Salt and Marine Chemicals Research Institute (CSMCRI) The Fisheries College and Research Institute, Tuticorin (FCRI) Centre for Advanced Studies in Marine Biology, Annamalai University (CAS-MB) Madurai Kamaraj University (MKU) Sugandhi Devadason Marine Research Institute, Tuticorin (SDMRI) Gulf of Mannar Biosphere Reserve Trust (GOMBRT) Department of Fisheries, Government of Tamil Nadu (DoF-TN) NGOs like the MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation SHGs and fisherfolk	Food and Agricultural Organization (UN)

3.2 Species identification

Table 2: Agencies involved in capacity building for species identification

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Species identification	FCRI CAS-MB; MKU SDMRI	CMFRI ZSI CSMCRI

3.3 Diving and snorkeling

Table 3: Agencies involved in capacity building for diving and snorkeling

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Diving and snorkeling	CMFRI CSMCRI FCRI CAS-MB MKU SDMRI	PRIVATE AGENCIES like Barracuda, Goa

3.4 Coastal health monitoring, Oceanography and Water quality monitoring

Table 4: Agencies involved in capacity building for Coastal health monitoring, Oceanography and Water quality monitoring

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Coastal health monitoring Oceanography Water quality monitoring	CMFRI CSMCRI FCRI CAS-MB MKU SDMRI GOMBRT SHGs and fisherfolk	National Institute of Oceanography, Goa (NIO)

3.5 GIS and remote sensing

Capacity building at individual and institutional level on Remote Sensing (RS) and Geographical Information System (GIS) application in GOM ecosystem is the need of the hour. GOM ecosystem is witnessing increased anthropogenic activities like marine fishing, off-shore oil and gas, marine transport, dumping ground for waste disposals, etc all of which have been bringing about changes in the coastal environment. Natural resources are to be considered as capital assets and are to be preserved for posterity. Tools like Remote Sensing (RS) and Geographical Information System (GIS) could generate data required for micro and macro-level planning of GOM ecosystem and its resources management on a sustainable basis. GIS is a very useful tool in mapping, monitoring coastal resources and could help in assessing changes in coastal environmental conditions due to human interference. India has been engaged in the development and application of techniques and tools for using RS and GIS in its natural resource management since the eighties. It has successfully launched and operationalised satellites towards this purpose. Studies have shown that GIS and Remote Sensing could be used in creating baseline inventory of coastal wetlands, coral reef, mangroves, monitoring of protected areas, selecting sites for brackishwater aquaculture, detecting shoreline changes, studying coastal land forms, estimating suspended sediments concentration and assessing the impact of engineering structures on suspended sediment patterns, etc. Techniques have been developed and operationalised for Sea Surface Temperature (SST) retrieval and ocean colour sensing (measurement of chlorophyll pigments) using data from varying sensors for identification of potential fishery zones (PFZ). Increased catch per unit effort in PFZ than in non-PFZ showed validity of the techniques.

Applications of Remote Sensing in fisheries:

- Remote sensing data help in regular management of water resources.
- Remote sensing techniques are useful in finding different types of bio-resources.
- Remote sensing plays potential role in both rapid & comprehensive EIA.
- For detection and monitoring of the water pollution, remote sensing proves useful.
- Remote sensing is applicable in acquiring information regarding offshore engineering activities, fisheries surveillance, ocean features, coastal regions and storm forecast operations.
- Remotely sensed data provides the necessary spatial data on suspended sediments, dissolved organic matter, phytoplankton, algal blooms & oil slicks etc which will useful in management of fish stocks, monitor the water quality

and natural water pollution such as oil or algal blooms, which are harmful to aquatic life.

- Remote sensing techniques are giving necessary data needed for monitoring changes on coastal erosion, shoreline monitoring & management, loss of natural habitat, sea level rise, wetland mapping urbanization, sewage disposal and aquatic population etc.
- Remote sensing is very useful in identifying Potential Fishing Zones (PFZ). This data is very useful for fishermen because they came to know likely occurrence of fish shoals which helps them for getting more catch.
- Continuous monitoring of land use or land cover with remote sensing imageries have been of immense use in providing information on temporal & spatial changes in area under aquaculture, mangrove areas, coral reef mapping & other land use patterns.

Applications of GIS in Fisheries:

- Identification of suitable sites for freshwater & brackishwater aquaculture.
- Management of marine fisheries & coastal regulation zone.
- Study of land-use pattern including mangroves & forest cover of a particular area.
- Planning for water body resource zonation & mapping of aquatic species.
- Fish disease modeling & management.
- Study of temporal/spatial changes in fish production & consumption.
- Environmental Impact Assessment.
- Distribution of different fish species in relation to physical habitat characteristics.
- Study of spatial variations in demand / supply balance.

Applications of GPS in Fisheries GIS:

- It is a useful tool in providing cost effective data for creation & updating of GIS.
- Provide ground control points (GCP's) for remote sensing applications.
- The latest GPS equipment includes software which can allow for the capture of any attribute or feature data along with its GPS given position, so as to form a field mapping system. The data obtained can then be directly exported to GIS package.
- In marine fisheries, it would allow for a survey vessel to continuously monitor water quality along any transect while recording the exact location. The real time mapping of data could then be done.
- It is also possible to record trawlers location & also trawler catch data at a specified interval of time & at the end of a fishing trip, the vessel would have a complete record on disk of catch against location.

Owing to the above importance, there is a need for capacity building at individual and institutional level on Remote Sensing (RS) and Geographical Information System (GIS) which can lead to effective micro and macro-level planning of GOM ecosystem and its resources management on a sustainable basis. The expertise of Space Application Centre and National Remote Sensing Agency will be utilised.

Table 5: Agencies involved in capacity building for GIS and remote sensing

Capacity Building Areas / Areas where expertise needed	To whom	By whom
GIS and remote sensing	CMFRI CSMCRI FCRI	Space Application Centre, Ahmadabad & National Remote

	CAS-MB MKU SDMRI GOMBRT Department of Fisheries, Government of Tamil Nadu (DoF-TN) NGOs (e.g. MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation SHGs and fisherfolk	Sensing Agency, Hyderabad
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3.6 Participatory approaches in fisheries management

The self-imposed regulations initiated by few villages in Tamil Nadu were prohibition on collection of protected species, destruction of coral reefs, cutting of mangroves and collection of seaweeds only for 12 days in a month, alternate-day fishing regulations in the Gulf of Mannar and Palk Bay areas of Tamil Nadu. Further, the fishing communities along with the traders and Forest Department officials have also decided to ban collection of seaweeds using destructive methods. As a community initiative in Tharuvaikulam, Tamil Nadu fisherfolk do not use trawling methods instead they use only passive gears. These cases reflect the importance and success of participatory approach in effective fisheries management. Hence capacity building and training at individual, institution and societal level for participatory approach in fisheries management is very essential.

Table 6: Agencies involved in capacity building for Participatory approaches in fisheries management

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Participatory approaches in fisheries management	CMFRI CSMCRI FCRI CAS-MB MKU SDMRI GOMBRT Department of Fisheries, Government of Tamil Nadu (DoF-TN) NGOs (e.g. MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation SHGs and fisherfolk	Food and Agricultural Organization (UN)

3.7 Post harvest management, marketing and value addition

In marine fisheries sector with the available data it was found that approximately 70% of the catch is disposed of in fresh form; 7.5% in frozen and processed form; 12.5% is in cured form (which means dried, salted and smoked products); 0.25% in canned form; 6.0% is reduced to fish oil; 0.7% is reduced to fish meal and manures and 2.2% is used for other miscellaneous purposes. Fishermen's share in consumers' rupee varies from 38 % for low quality fishes to 81% for high quality fishes depending on consumer preferences and export demand. There is enough scope to increase marketing efficiency and enhancing the income of fisherfolk. Moreover to fully comply with international requirements in post harvest care of catch so as to achieve highest standards in food safety and to ensure the minimum post-harvest losses is great matter of concern. Post harvest management, marketing and value addition is vital areas where capacity building and training is very much needed to increase marketing efficiency, minimise post-harvest losses and to enhance the value addition in marine fisheries sector.

Table 7: Agencies involved in capacity building for Post-harvest management Marketing and value addition

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Post-harvest management Marketing and value addition	CMFRI CSMCRI FCRI CAS-MB MKU SDMRI GOMBRT Department of Fisheries, Government of Tamil Nadu (DoF-TN) NGOs (e.g. MS Swaminathan Research Foundation (MSSRF) and DHAN Foundation SHGs and fisherfolk	The National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT), Central Institute of Fisheries Technology, Kochi

3.8 Stock assessment

Table 8: Agencies involved in capacity building for stock assessment

Capacity Building Areas / Areas where expertise needed	To whom	By whom
Stock assessment <i>Coral</i> <i>Fish</i> <i>Molluscs</i> <i>Charismatic species</i> <i>Sea cucumber</i>	FCRI CAS-MB MKU SDMRI	CMFRI

4.0 Conclusion

India and Sri Lanka will come under a common platform. A common methodology suitable for both countries will be evolved for assessing the present status of the resources in GOM and by which suitable management and conservation measures will be formulated. The capacity building project will be implemented under the aegis of the BOBLME Project and its partner organizations such as BOBP-IGO and Mangroves for the Future. For the capacity building project the allocation of funds to each agency will be decided in collaborative meeting in consultation with BOBLME Project and its partner organizations such as BOBP-IGO and Mangroves for the Future. Project duration is for five years (2 years for capacity building and three years for data generation and implementation). An annual review workshop will be organized within the country with the respective agencies identified for the process in the country, once in two years and a concluding meeting will be organized at joint country level to evaluate the process.

Capacity building and training needs on areas identified during the First Consultation – Considerations for Sri Lanka*

1.0 Identification of suitable stock assessment methodology

Stock assessment is vital to obtain the bigger yield, value and profit of the resource for the benefit of the community, while guaranteeing conservation. The quantitative estimates of the status (abundance) of the fish stocks and of the intensity of fishing facilitate to formulate management strategies to appraise the sustainability of current and future harvest to maintain the fish populations at a level that permits their maximum sustainable catch and restore the stock, if the stock is not healthy.

The last comprehensive survey of the fishery resources was conducted over 25 years ago and other than from the few ad hoc studies done by NARA very little reliable information is available on the current status of the resources. This situation can be mitigated by improved knowledge and proper management based on resource surveys and stock assessment.

Resources Survey related to the Gulf of Mannar Region are:

- *R/V Optimist Survey – 1972*
- *Hoyo Maru Survey- 1975*
- *Fridtjof Nansen Survey -(1978 -1980)*
- *BOBP Fishing Trials-1986*
- *NARA Survey – 2008*

Most of the above exploratory fishing surveys were intended to estimate the biomasses and potential yield of high value species such as lobster, shrimp, crabs and sea cucumber. Bottom trawling is adopted except in the Hoyo Maru Survey, where drift nets, hand line and squid hand line are used. In the long term, existing data/information collection system of the respective coastal state shall be strengthened extended to the following parameters to facilitate projections of yield and catch per effort and long and short-term projections with different conditions (scenarios).

- Fisheries commercial statistics: total and by resource landings, catch per effort, fishing effort (number of trips, days, tows, time spent fishing, etc.), and characteristics of the gears used.
- Types of operation of the fleets and of its fishing gears, etc.
- Biological sampling in the landing ports.
- Biological sampling (and information about the fishing operation) on board commercial vessels.
- Biological sampling on board research vessels.

A comprehensive fisheries resource assessment shall be conducted to obtain a realistic picture of the status of the Sri Lankan fisheries resources to support, as far as possible, immediate decision-making, and to contribute to effective fisheries management based on sound resource assessments, in the longer term. The assessment shall facilitate to assess the state of the fishery resources and determine potential yield from selected stocks or fisheries, taking into consideration the biological characteristics of the stock and the environment, the harvesting strategy used, and the timing of fishing in relation to maturity and spawning.

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As an immediate measure, a combine acoustic/exploratory fishing survey shall be conducted to assess the biomass (by categories). In addition, oceanographic observations and plankton sampling shall be conducted to gain information on ocean environment and planktonic part of the biomass. In addition, visual surface observation shall be gathered to obtain indication on distribution of surface schooling fish, whales, birds, and fishing vessels. The long term activities shall include scientific fishing research and population dynamics studies, as well as the observation of climatic changes that may affect the stocks.

2.0 Assessment of human and financial resources (in both qualitative and quantitative terms) available nationally for stock assessment: gap analysis.

Marine Biological Resources Division (MBRD) of NARA is vested with the responsibilities of carrying out research towards Management, Development and Conservation of marine living resources and ecosystems in Sri Lanka. The division constitutes eleven scientists, including Survey biologist, Stock assessment specialist, fishing technologist. Among the scientists 3 of them hold Ph.D while others possess postgraduate Degrees.

NARA was able to gain technical assistance and institutional and logistics support through the project "Capacity enhancement of NARA for marine resource surveys and stock assessments in coastal waters of Sri Lanka – 2008-09" funded by the CIDA/IFAD. Thus, NARA is able to upgrade its resource survey and stock assessment capacities.

Furthermore, almost since its inception MBRD of NARA has been monitoring the landings of offshore multi-day boats and coastal boats in order to establish a reliable database for the management of large pelagic and bill fish fisheries. However, it is necessary to extend such monitoring to demersal and small and medium pelagics as well to other selected fisheries on which large numbers of fishers depend upon for their livelihood. However, due to budgetary constraints, the funding available for survey and stock assessment work is limited.

Available Human resources

- On job trained Survey biologist.
- Experienced staff on sampling methods for stock.
- Trained staff on fish stock assessment.
- Trained survey assistants to assist in the carrying out surveys.
- Experienced staff on planning, managing, assessing and reporting of commercial fishing operations.
- Staff trained on remote sensing and GIS applications.

3.0 Policy on sharing of information including raw information with other agencies including international, regional and agencies from other countries

Data collection and sharing was progressing among the national institutions slowly over the past decades; however no defined mechanisms for sharing data exist. Access to already collected data is limited; in majority of the institutions sharing is limited to selling of data. Data sharing is done with the following categories of institutions/individuals:

- Project collaborators
- Students/ researchers
- Development agencies
- Relevant stakeholders
- Institutions within the same ministry

NARA is in the processes of developing a geo-database and as one of the active users, intends to publish an atlas to disseminate its findings for coastal parts while taking initiatives to make geospatial technologies beneficial for end-users. The Agency has also proposed to establish a marine spatial data infrastructure.

In respect to the international joint surveys, generally an "Understanding" is reached among the participating parties and is expected that:

- The research activities are to be mutually agreed. In the event of any change due to unavoidable and technical, the "Understanding" shall be amended with the consent of both parties.
- Parties shall exchange scientific data and other information collected during the survey in soft and hard copies in standard versions. Data and information acquired during the research project shall be available to parties in best resolution.
- First publications involving participant from different states based on information and data collected within the waters of Sri Lanka shall be joint papers.
- All data acquired may be utilized only by participation of project personnel and may not be released to any third party or government without the prior permission.

4.0 Scope of collaboration within the mandate of agencies involved in stock assessment

The Gulf of Mannar is a single integrated ecosystem, though segregated by maritime boundaries. Most of the fisheries resources in the Gulf of Mannar form straddling stocks, and common stocks. Thus, recommended to conduct joint survey and establish common data base and conduct collaborative research.

The last comprehensive resource surveys (R. V. Fridtjof Nansen Surveys) were conducted in the early eighties and the present generation of NARA's researchers has hardly had any exposure to resource survey work. Thus, NARA, the research agency of the Ministry of Fisheries and Aquatic Resources requires technical assistance and institutional and logistics support to improve and upgrade its resource survey and stock assessment capacities.

Thus, by conducting collaborative surveys, Researchers of NARA shall get the opportunity to conduct resource surveys and stock assessments under the guidance of the Indian counter parts and thus acquire on-the-job training that will equip NARA with the required capacities to continue such work in the future. It is necessary that these vital gaps in terms of skills and resources be filled in order to obtain a more reliable resource data base.

5.0 Assessment of existing mechanisms for water quality monitoring

Responsible institutions for marine water resources are;

- Ministry of Environment/Central Environmental Authority (CEA)
- Responsible for water quality; discharge/ambient water quality std
- Coast Conservation Dept (CCD)
- Control/management of the coastal zone; 300 m landwards 2km seawards
- Marine Environment Protection Authority (MEPA)
- Control of marine pollution
- National Aquatic Resources, research and development Agency (NARA)
- Overall management of aquatic resources- collect, disseminate data, conduct research

Environmental Studies Division of NARA monitors water quality of inland and coastal waters, in addition to accumulation of heavy metals in aquatic fauna and flora, pesticides and agrochemical accumulation in water as well as fish and effects of

industrial activities on water quality. The Division is also capable of conducting Environmental Impact Assessment for development projects and chemical and microbiological analysis of water.

Water quality component is divided into two parts. Baseline surveys are conducted to provide an initial understanding of the water quality, and routine measurements are recorded at selected sites to identify and quantify trends in water quality and define the cause of observed conditions and trends. Base line surveys are completed for the most part of the waters to define the status of water quality.

Many labs have basic facilities (ITI, WRB, NWSDB, CEA, NARA, Universities)

- pH, EC, TDS, microbiological etc.,

Some labs have facilities to test toxic contaminants

- GC, HPLC, GC-MS for Pesticides, PCBs
- Flame & GF AAS for toxic metals

ITI have the facilities

- chemical (including pesticides & toxic metals) and microbiological parameters

6.0 Scope of collaboration in capacity building in water quality assessment

Comprehensive water quality data is lacking mainly due to diffused management responsibilities and lack of systematic monitoring. Many independent studies are conducted by NARA, WRB, NWSDB, NBRO, IFS, ITI, MOE, CEA, Universities, etc, however water quality analysis is complicated as data is scattered, unpublished or in unprocessed form.

The requirements include establishing systems to capture and generate data on quality and quantity of groundwater for planning, management, modeling and establishing Database on groundwater.

A marine laboratory shall be established to coordinate a monitoring program for pollutants in the GoM. Sustainable capability shall be built up through reliable measurements and assessment of pollutants such as radionuclides, trace elements, organic pollutants, nutrients and overall data management.

7.0 Identification of parameters for construction of water quality index for the Gulf of Mannar

Environmental Studies Division of NARA has conducted water sampling in 2005 to establish base line data of the Sri Lankan side of the GoM. All the parameters studied have shown acceptable levels for the marine and coastal water quality and the draft Environmental Quality standards and Designation of Water use in Sri Lanka.

The survey proposed the following key environmental indicative parameters for continuous monitoring. The regime is recognized as the tidally driven and the system is intermittently stratified, thus monitoring both the surface and bottom water quality and sediment quality is recommended.

- Physical parameters
 - *Temperature, pH, EC, Salinity, DO, Turbidity, Total suspended solid*
- Chemical parameters
 - *Oil & Grease, Nitrate, Nitrite, Ammonia, Phosphate, Sulphates & Chlorides and Heavy metals; Fe, Zn, Mg, Mn, Cd, Cr & Hg*
- Biological parameters
 - *Phytoplankton, Zooplankton, Macro & Micro benthic fauna & Chlorophyll*

8.0 Availability of information on water quality index parameters

Table 1 shows the average water quality of the GoM. However, it may be noted that the result is drawn from a rapid assessment survey, conducted in 2005.

Furthermore, water quality measurements are undertaken only at a part of the Gulf of Mannar. The survey shall be carried out at least for one year period to establish seasonal variability.

Table 1: Water quality in Gulf of Mannar Region

Parameters	Surface		3m below the sea surface	
	Value	±	Value	±
Temperature (0C)	28.62	0.31	28.65	0.12
PH	08.30	0.04	08.27	0.08
EC (mS)	48.93	1.72	48.95	1.91
DO (mg/l)	03.75	0.30	03.70	0.40
Salinity (ppt)	34.00	1.79	34.67	1.75
Total Suspended Solids (mg/l)	09.33	8.27	11.17	5.65
Phosphate phosphorous (mg/l)	00.01	0.01	00.01	0.01
Nitrate nitrogen (mg/l)	00.10	0.05	00.19	0.19
Nitrite nitrogen (mg/l)	00.02	0.01	00.04	0.04
Ammoniacal nitrogen (mg/l)	00.07	0.02	00.07	0.04

9.0 Identification of software packages needed for stock assessment and water quality monitoring

9.1 Software packages available for stock assessment

a) *Approaches, Rules and Techniques for Fisheries statistical monitoring (ARTFISH)*: a standardized tool adaptable to most fisheries in the developing countries.

b) *BEAM1 and 2 - Bioeconomic modeling of artisanal and industrial sequential shrimp fisheries*: a tool for bioeconomic modeling of artisanal and industrial sequential shrimp fisheries based on an age-structured Thompson and Bell (in Ricker, 1975) yield per recruit biological model and a simple input-output microeconomic model. BEAM1 gives its simulated results by age groups. BEAM2 gives them by standard commercial categories as used in the shrimp fishing industry.

c) *BEAM3 (Cochet and Gilly, 1990)*: a stochastic model that can handle up to four species (or two species by two sexes) and many fleets operating sequentially or simultaneously. The model aims at determining the optimum size, in the long term, of the level of fishing capacity corresponding to the management goals. It calculates the probability density functions of the outputs and their distribution among fleets and allows for the determination of the probabilities of occurrence of undesirable economic results.

d) *BEAM4 (BioEconomic Analytical Model)*: a tool to predict yield, value and a series of measures of economic performance as a function of fishery management measures such as fishing effort control, closed season, closed areas and minimum mesh size regulation.

e) *Experimental interactive software for choosing and fitting surplus production models including environmental variables (CLIMPROD)*: a tool to select the most appropriate model for a particular case, according to objective criteria. It resembles a simple expert system and uses artificial intelligence language.

f) *CLIMPROD-PLUS - Experimental interactive software for choosing and fitting surplus production models including environmental variables*: a tool to select the model corresponding to a particular case according to objective criteria. The basic inputs are annual data-series on catch and effort of a fishery on a single stock, and annual (or seasonal) data-series on an environmental variable known to influence the abundance or the catchability of this stock. At least 12 year's observations are required, or more in non-equilibrium (transition) situations.

g) *FAST - Fishing Activity Simulation Tool*: a Geographical Information Systems (GIS) based to create a model for the simulation of the spatial distribution of fishing effort.

f) *FISAT II - FAO-ICLARM Stock Assessment Tool*: a tool to the analysis of length-frequency data, but also enables related analyses, of size-at-age, catch-at-age, selection and other analyses.

g) *FishStatJ and FishStat Plus - software for fishery statistical time series*: a tool to access to fishery statistics. Any data having time series structure can potentially be stored and processed.

h) *NANSIS - Software for Fishery Survey Data Logging and Analysis*: a Survey Information System for logging, editing and analysis of biological and environmental data from marine research surveys.

i) *SPATIAL - Space time Dynamics in Marine Fisheries*: a tool to model the space-time distribution of fishing intensity includes a shortrun spatial bioeconomic model that represents the interdependencies of smallscale and industrial fleets from different ports of origin, harvesting a target species over several fishing grounds.

j) *Thompson and Bell Yield Analysis Using Excel Spreadsheets*: a tool to predict estimates of the likely yields, catch rates, mean individual weights of the fish in the catches, stock biomass, etc., from changes in the fishing effort (or fishing mortality), size at first capture, fishing season and fleet composition.

k) *VONBIT 2005 - Von Bertalanffy Iterative Approach*: a tool to evaluate growth function to data on size at age is also directly applicable to tag and recapture data.

9.2 Software packages available for water quality monitoring

a) *AQUASEA*: a tool to evaluate tidal flow and coastal waters, transport of suspended sediments.

b) *EnviroData*: a tool to managing and displaying site environmental data. r.

c) *EnviroScape*: a tool to assess non point source pollution

d) *Watershed Hydrologic and Water Quality Modeling*: a tool to simulate water quality for both conventional and toxic organic pollutants. Flow rate, sediment load, and nutrient and pesticide concentrations are predicted.

e) *SMS - Surface Water Modeling System*: a tool for one-, two, and three-dimensional hydrodynamic modeling. Capable wave analysis, contaminant migration, salinity intrusion, sediment transport, wave energy dispersion, wave properties.

10.0 In-house training facility for stock assessment and water quality monitoring

- Formulation of survey proposals
- Identifying the survey methodologies
- On the job-training to conduct surveys and assessments of sedentary species, coral reef, mangroves and sea grass
- Biological studies (age/size composition), oceanographic studies.
- Use of remote sensing and GIS applications;

11.0 Identification of suitable agencies for provision of training where needed

Training requirements – NARA and Universities

- Identification of bio-indicators
- Bio-accumulation
- Toxi-ecology
- Taxonomy of sponges, seaweeds and sea grass
- Acoustic surveys

Training requirements – Department of Fisheries and Aquatic Resources Development

- Formulation of fisheries policy

- Formulation of participatory fisheries management plans
- Formulation of regulation
- Implementation of Environmental Monitoring System

12.0 Scope and evaluation of existing facilities for utilizing remote sensing and GIS technologies in monitoring GoM

Information Technology Division of the NARA is in the possession of hardware, professional work station and software for processing MODIS, Landsat, IKONOS, ORBVIEW, NOAA satellite images. The IT division engaged in zonation of coastal zone for aquaculture, while the Oceanography Division used the satellite images for forecasting potential fishing zones.

13.0 Guidelines/requirements for optimal utilization of remote sensing and GIS technology for GoM.

Remote Sensing and GIS technology is a useful tool for following and managing natural resource. The technology facilitates to quickly detect changes of environment. The derivative maps and statistics that take from period images not only help us assess a part of changing trends of nature and environment, but also propose reasonable ways in using resource and protecting environment.

Remote sensing techniques can be used to monitor water quality parameters;

- Suspended sediments (turbidity)
- Algae
- Dissolved organic matter
- Oils
- Chlorophyll
- Temperature

Integration of remotely sensed data, GPS, and GIS technologies provides a valuable tool for monitoring and assessing marine waters. Remotely sensed data can be used to create a permanent geographically located database to provide a baseline for future comparisons.

However, the development of reference color code for the respective water quality parameters is vital for quantification of a water quality parameter. This requires development of algorithms for the followings, which are generally site specific

- Empirical relationships between spectral properties and water quality parameters.
- Statistical relationships between measured spectral/thermal properties and measured water quality parameters.

Possible areas of collaboration and mechanisms for education and awareness building including networking for sustainable utilization of Gulf of Mannar*

1.0 Background

The Gulf of Mannar (GoM) is located at the southeastern tip of Tamil Nadu extending from Rameswaram in the North to Kanyakumari in the south, covering 365 km long coastline within four coastal districts Ramanathapuram, Tuticorin, Tirunelveli and Kanyakumari. The 140 km GoM stretch extending from Rameswaram to Tuticorin consists of 21



Figure 5: Gulf of Mannar coastal area

uninhabited islands, which are surrounded by coral reefs and seagrass beds. The Government of Tamil Nadu in September 1986 declared the Gulf of Mannar Marine National Park covering the 21 islands and the surrounding shallow coastal waters comprising 560 sq.km areas. The GoM was declared as "Marine Biosphere Reserve" in 1989 and the extent of the Biosphere Reserve area is 10,500 sq.km from Rameswaram to Kanyakumari (Figure 1).

The 21 islands are located between Lat. 8° 47' N and 9° 15' N and Long. 78° 12' E 79° 14' E and are grouped into four namely, Mandapam group (7 Islands - Shingle, Krusadai, Pullivasal, Poomarichan, Manoliputti, Manoli and Hare), Keezhakkarai group (7 Islands - Mulli, Valai, Thalaiyari, Appa, Poovarasampatti, Valimunai, and Anaipar), Vembar group (3 Islands - Nallathanni, Puluvinichalli and Upputhanni), and Tuticorin group (4 Islands - Kariyachalli, Vilanguchalli, Koswari and Vaan).

The islands lie at an average distance of 8-10 km from the main land. Narrow fringing reefs are mostly located at a distance of 100 to 350 m from the islands and patch reefs rise from depths of 2.5 m to 8 m and extend up to 1 - 4 km in length with width as much as 50 m. The large areas of reefs off the GoM are generally in poor condition due to anthropogenic activities of people living along the coast, who depend on fishery resources of reef areas for their livelihood. Pillai (1986) provided a comprehensive account of the coral fauna of GoM, 94 species of 37 genera, with most common being *Acropora* sp., *Montipora* sp and *Porites* sp. Patterson *et al.*, (2004) updated the list of corals of GoM from 94 to 104. The survey of the entire GoM during the study between 2003 and 2005 further updated the list of corals from 104 to 117 (Patterson *et al.* 2007). The present average live coral cover in Gulf of Mannar is 37.30% (Patterson *et al.*, 2012).

The estimated flora and fauna species in Gulf of Mannar is about 4100 (GOMBRT Report, 2012). The Gulf of Mannar is rich in various bio-resources such as 147

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species of seaweeds (Kaliyaperumal 1998), 13 species of seagrass (Rajeswari and Anand 1998), 17 species of sea cucumbers (James 2001), 510 species of finfishes (Durairaj 1998) 106 species of shellfishes such as crabs (Jeyabaskaran and Ajmal Khan, 1998), 4 species of shrimps (Ramaiyan *et al.*, 1996) and 4 species of lobsters (Susheelan 1993). During a recent survey on mollusks, 5 species of polyplacophorans, 174 species of bivalves, 271 species of gastropods, 5 species of scaphopods and 16 species of cephalopods (Scaphopods added for the first time) were recorded (Deepak and Patterson, 2004).

2.0 Management issues

Gulf of Mannar is easily accessible to the people who depend highly on its resources. Therefore, the degradation of this ecosystem is very fast because of various anthropogenic impacts. Majority of the reefs were destroyed because of mining and destructive fishing practices during 1970-1990 and natural recovery would take longer duration and also in most cases conducive situation would not occur as fishing pressure is increasing every day. The conservation and protection of this ecosystem becomes very important and essential in order to get sustainable fishery harvest for the dependent coastal folk and to conserve the precious natural wealth.

Traditional fishers who form the majority population along GoM have increased in numbers during the last decades. As per the 2005-2006 Census by Department of Fisheries, Government of Tamil Nadu, the total marine fisher's population in the GoM area is approximately 200,000. Crowded fishing grounds, increasing demand for fisheries products, and declining catch deprive artisanal fisher families of livelihoods and food security (Deepak Samuel *et al.* 2002, Bavinck, 2003). During 1970-1990, the fisher communities of GoM were characterized by low literacy rate, lack of awareness of environmental issues, low income and a resulting reluctance among fisher folk to take up livelihood options other than fishing. This lead them to involve in more effective but illegal, destructive and unsustainable fishing practices, such as shore seine, purse seine and push net fishing, dynamite fishing and cyanide fishing. Also, a number of fishermen have taken up the illegal and very destructive coral mining practice as a supplement to fishing. Two islands (Poovarasanpatti and Vilanguchalli) are already submerged due to excessive mining and erosion noticed in several other islands (Vaan, Koswari and Kariyachalli). The bottom trawling by big mechanized boats using banned gears (roller madi, and pair trawler madi), which completely sweep the seafloor, depleting fishery resources and causing damage to critical habitats, such as corals reefs and seagrass beds (Bavinck, 2003). Several other factors such as seaweed collection; trap fishing; sewage disposal and coastal development activities such as salt pans, shrimp culture and industries add considerable stress to the coastal ecosystem.

In earlier days for several decades, the coral mining was practiced as the use of corals in construction, lime industry and ornamental purposes as the resources were plenty and cheap. It was estimated that the exploitation of corals was about 60,000 cubic meters (about 25,000 metric tons) per annum from Palk Bay and GOM together (Mahadevan and Nayar, 1972). The federal government in 2001 included all Scleractinian, Antipatharian, *Millipora* sp., gorgonians and *Tubipora musicace* under schedule I of the Wildlife (Protection) Act, 1972. Though the rate of coral mining was considerably reduced due to the stringent action by the enforcement authorities, the poor fishermen practiced this illegal mining activity for their daily livelihood until the 2004 Indian Ocean Tsunami. The number of boats involved in mining varied with fishing season with highest number during the lean fishing season. Besides enforcement and surveillance, the tsunami has made a change in the minds of fishermen and they believed that their villages were protected because of the presence of corals reefs and islands. Therefore, they voluntarily stopped the coral mining activity, particularly in Tuticorin coast, however still sporadic incidents

are reported.

The Tuticorin coast in the Gulf of Mannar is comparatively highly stressed due to increased rate of industrialization and the discharge of untreated or partially treated effluents from various industries and also domestic sewage disposal along the entire coast. There are several sewage disposal points in the reef area which is one of major causes for coral diseases.

During 1998, a significant rise on the surface water temperature in the Indian Ocean and elsewhere was observed and the fact that many reefs previously regarded as near pristine was seriously affected. The bleaching and subsequent mortality resulted in serious socio-economic impacts, particularly for those nations whose economics are heavily dependent on the revenues generated by reef-based tourism and reef-based fisheries. Hard hit were large areas of coral reef from Sri Lanka and the Maldives in South Asia to the East African coastal line. Though bleaching impact was experienced in Gulf of Mannar (Venkataraman, 2000), studies in Southern part of Gulf of Mannar, Tuticorin coast showed densely populated corals and no sign of impact of ENSO event of 1998 (Patterson *et al.*, 2003).

3.0 Impact of Indian Ocean Tsunami 2004

The post tsunami reef assessment in Gulf of Mannar by SDMRI during 4-10 January 2005 revealed that, though the tsunami impact was observed in Gulf of Mannar, there was no significant impact on corals, associated habitat and resources except minor transitional damages. Most of the fisher folk (small scale fishing) living along this coast depend mainly on the fishery resources in and around the reef areas for their livelihood. Tsunami has also no significant impact on the livelihood and socio-economic conditions of the fisher folk, living along the Gulf of Mannar coast.

Fishery

As per the 2005-2006 Census, the marine fisher folk population in the 4 districts in the GoM region is 421 630 (Ramanathapuram: 138 618; Tuticorin: 83 171; Tirunelveli: 23 763; and Kanyakumari: 176 078). It is to note that part of the Ramanathapuram (141 km coastline out of 237 km) and Kanyakumari (11.5 km coastline out of 71.5km) districts are coming within GoM region.

The year-wise marine fish production in Gulf of Mannar region is as follows:

Year	Production (Kg)
1997-1998	86,905
1998-1999	103,749
1999-2000	100,162
2000-2001	101,225
2001-2002	107,672
2002-2003	105,628
2003-2004	105,345
2004-2005	86,971
2005-2006	109,120

4.0 Evaluation of existing education and awareness building programmes

Education and awareness building programmes play lead role in the conservation and management of marine biodiversity for sustainable utilization. The destruction in Gulf of Mannar during the period 1970-2000 is mainly due to low literacy and lack of awareness. In recent years several programmes are initiated through Gulf of Mannar Biosphere Reserve and Marine National Park authorities, mainly the awareness building programmes. The Gulf of Mannar Biosphere Reserve Trust (GOMBRT) is implementing the UNDP-GEF project on "Marine Biodiversity Conservation" actively from 2006 introduced several vocational training programmes and awareness building schemes. The following are some of the vocational training programmes:

- Diploma in female Nursing Assistant
- Operation Theatre Technology
- Diploma in Hospital Asst.
- Refrigeration & Air conditioning
- Catering Technology
- A/c Mechanic
- Nursing
- Auto Mobile Engineering
- Computer Application
- Electrician & Plumbing
- Lab Technician
- Diploma in Early Child Hood Care and Education
- Basic Electrical Engg & Plumbing
- Four Wheeler Driving
- Tailoring
- Basic Electronics and Computer Hardware Training
- JCB., CRANE and FORKLIFT Operator Training
- Automobile Mechanic
- Printing Technology,
- Fashion Designing,
- Beautician course
- Primary school Teacher Training
- Fitter
- Fire Safety Management
- Diploma in Medical Laboratory Course.

The awareness building programmes are mainly distribution of pamphlets, booklets, posters, sign boards in tourist places, local village level workshops, advertisement through radio, television and newspaper media, nature camps and tours to school children, folk cultural programmes etc.

5.0 Identifying needs of different level of stakeholders

In Gulf of Mannar all stakeholders require education and awareness creation in terms of biodiversity conservation for sustainability. The level of requirement to various sectors may vary, but the ultimate theme has to reach the entire population like local community, school children, college students, conservation staff, NGOs, administrators, judiciary, political leaders etc.

6.0 Identification of priorities areas for education and awareness building

The key to success is the identification of priority areas for education and awareness building. As GOMBRT has done lot of work in this area, it is essential to study the success of the programmes implemented by GOMBRT and to identify the priority areas.

The GOMBRT has done several programmes among school children, local community and few among line department staff. These initiatives have to be continued and new areas (location) have to be identified.

It is also to note that, until now, all programmes are implemented in the area between Rameswaram and Tuticorin covering 140 km coastline, where the Marine National Park is located. However, the area between Tuticorin and Kanyakumari

covering 225 km coast line has been neglected fully and so, priority has to be given in these area for education and awareness building programmes.

7.0 Comparison of needs and existing resources

The foundation has been laid through GOMBRT and the new initiative has to be built up from the existing knowledge / facility. The education and awareness building are key components which are to be implemented in a continuous process, but the implementation method may vary time to time.

8.0 Identification of national, regional and international agencies for education and awareness building

For education and awareness building, in the Gulf of Mannar, GOMBRT has to act as key nodal agency. In addition, the following organizations can also be involved for success:

- Tamil Nadu Forest Department
- Centre for Environment Education
- CPR Foundation
- Prominent Local NGOs
- Local schools and colleges
- BOBP-IGO, IUCN, UNDP

9.0 Strategic plan for awareness building

- Confidence building among politicians, administrators and general public.
- Coordination with 4 districts administration.
- Coordination with education department.
- Preparation of booklets in local language .
- Local village level workshops.
- Preparation of short film using the services of celebrities to telecast in TV and cine malls.
- Awareness rallies in association with schools, colleges, SHG members.
- Nature camps in association with schools, colleges, SHG members.
- Posters and pamphlets for distribution to all stakeholders.

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Possible Areas of Collaboration and Mechanism for Education and Awareness Building Including Networking for Sustainable Utilization of Gulf of Mannar in Sri Lanka^{*}

1.0 Location of Gulf of Mannar

Gulf of Mannar is defined as the segment of the coast which extends from the Northwestern coastal area of Thalai Mannar to Puttalam. It also includes Thalai Mannar and other smaller Islands that are located in the North western seas. The North western coastal zone, extends between latitudes 20' N and 9°.05'N and longitudes 79°20' E and 79.55' E, and forms the longest stretch of coastline covered. The total length of the mainland segment of this zone was found to be 113 km while South of Thalai Mannar Island had 30 km of coast. (Except northern coast Thalai Mannar Island 33km) the coastline generally faces a northwesterly direction.

2.0 The Physical and Environmental Setting

The average extent of continental shelf around Sri Lanka is 20 kilometers and it is narrowest in the south of the island and widest in the northwest of the island, especially in the north of the Kalpitiya Peninsula, which lies in the southern Gulf of Mannar, and ranges from 30 to 60 km.

The shelf edge around the island is covered with a thin layer of organic compounds consisting mainly of calcareous material, shell and coral fragments, worm tubes, echinoderm spines and foraminifera. The inorganic component consists of quartzes, sand and other coarse materials. The Gulf of Mannar, Palk Strait and Palk Bay areas act as repositories for materials that are swept northwards along the west coast and southwards along the south east coast of India. Strong currents occur in the Palk Strait between India and Sri Lanka with velocities between 2.5-3m/sec and are common at Pamban Pass at the Indian end of Adam's Bridge. High velocities of this nature may contribute to increased sediment transport within this area. The ocean current is driven from the Bay of Bengal to the Arabian Sea during the north-east monsoon and from the Arabian Sea to the Bay of Bengal during the south-west monsoon.

The only area with an elevation above 30 m is found in the southern part of the coastal zone where Kudiramalai rises over 75 m above sea level. Some of the shallowest seas around the island are found near the Northwest coast. Here the 10 fathom isobaths extends to more than 50 km into the sea at certain places. The submarine contours also indicate submerged river courses, particularly those of the Malvatu Oya and the Kala Oya located between Kalpitiya and the Thalai Mannar island (Deraniyagala 1958).

Most parts of the North-western Coastal Zone are sheltered by barrier islands, off-shore bars and spits. Although the North west coast is in general a protruding one characterized by rapid depositional regression, there are problems of coastal erosion in certain localities.

Climatically, the Northwestern Coastal Zone forms one of the driest areas of Sri Lanka. In early demarcations of climatic regions in the Island this area was indicated

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as an 'Arid Zone'. The mean annual rainfall as reported from Pomparippu, Mannar and Thalai Mannar rain gauging stations is less than 1000 mm. Long periods of drought exceeding 200 days per year are common in the area. The only months in which there is some water surplus are those of the Northeast monsoonal period. The mean maximum temperatures exceed 90°F in April at both Puttalam and Mannar. Thus a combination of conditions of low rainfall, high temperatures and high evaporation rates tend to create an 'arid' climate in the coastal landscape. A large part of this coastal zone still remains sparsely populated and therefore, some natural vegetation cover still remains in the area. In contrast to the extensive coconut plantation areas on the West coast, Palmyra palms begin to appear in greater numbers as one moves northwards. Jungles of Palmyra cover many parts of the Thalai Mannar Island. A few Baobab trees which were introduced several centuries ago from East Africa can still be seen in places like Errukkulampiddy.

3.0 Major Ecosystems/habitats

The north-western maritime region of the island consists of numerous coastal and marine ecosystems and habitats, in the northern Indian Ocean. These include coral reefs, sea grass beds, mangrove, salt marsh, tidal flats, lagoons, estuaries, sand bar and sea vegetation.

Reef habitats in the area constitute of true coral reefs and sandstone reef habitats. True coral reefs can be further categorized into two geologically distinct reef formations as fringing reefs and patch reefs. Fringing reefs are found in shallow water close to the shore, while patch reefs are found further offshore. Fringing reefs are found in the Gulf of Mannar, between the Kalpitiya Peninsula and Mannar Island. Patch reefs are generally found further offshore, and consist of corals growing on raised humps or ridges on the seabed. Extensive patch reefs exist in the Gulf of Mannar, particularly within the Bar Reef Marine Sanctuary and further northwards towards Mannar.

Extensive sea grass beds have been reported from the Dutch Bay (in Kalpitiya) and from Mannar to the northwest across the Palk Bay to Rameshwaram Island on the Indian coast. The sea grass beds in the Palk Bay-Gulf of Mannar area are the main habitats of the globally endangered Dugong. Extensive salt marshes occur in the Mannar area in the coastal belt from Mantai to Vankalai. The mangrove vegetation in the islands off Kalpitiya peninsula is dominated by *Rhizophora mucronata* where as in the Mannar region *Avicennia marina*, *Aegiceras corniculatum* and *Excoecaria agallocha*, which are characteristic species in high-saline mangrove forests.

The population of the globally endangered Dugong has been documented within the extensive sea grass beds north of the Kalpitiya peninsula. Three species of marine turtles have been recorded in the Gulf of Mannar region. The predominant species is the Olive Ridley (*Lepidochelys olivacea*), followed by the Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Erytmochelis imbricata*). Twelve species of marine mammals have been documented within the north western maritime zone of Sri Lanka and all above species are considered to be globally threatened. Other marine reptiles documented from the north-western marine waters include sea snakes, such as the hook-nosed sea snake (*Enhydrina schistosa*). In addition, more than 40 species of marine and brackish water fish species have been recorded from the Kalpitiya North marine area. A recent survey of the Bar Reef Sanctuary indicated that it possesses year round abundance and species richness of marine mammals and suggests that the northern and central area may be considered a cetacean 'hotspot.'

The Gulf of Mannar region forms part of the Central-South Asian migratory bird flyway and a total of 166,300 water birds were recorded from this region in 2003. As such the island habitats of this area are of high ecological significance for annual migrants. In 2008, an area of 5000 ha was declared as the Vankalai bird's sanctuary (covering Vankalai, Puliyantivu Island, and Tiruketiswaram) between the Mannar Island and near coast mainland.

4.0 The fishery Resources and Socio-economic Significance

Sri Lanka is a tropical country with a high diversity of species. The present production level is around 300,000 Mt, while the potential is estimated to be around 500,000 Mt. annually (FAO 2003). Most of the species were identified in the Gulf of Mannar. However, the narrowness of the continental shelf and the non-existence of upwelling, set limitations to the abundance of marine fisheries. In addition to a thriving fisheries industry that supplies the local market, export-oriented fisheries targeting high-value invertebrates such as shrimp, lobster, chunk, sea cucumber, etc., take place in the north western marine region.

Reef and reef-associated fisheries are the main economic use of reefs in Mannar. Major activities in the coastal fisheries sector within the Gulf of Mannar and Palk Bay are spiny lobster fish and the marine ornamental fish, almost all of which are dependent on reef habitats. Sea cucumber and sacred chunks are harvested in soft bottom areas between patch reefs. Ornamental fish, sea cucumber and chunks are harvested exclusively for export, while most of the spiny lobster catch is also exported. However, the fishery sector contributes about 2% to the GDP of Sri Lanka. In 1992, an area of 306.7 sq. km encompassing coral reefs, sandstone reefs, soft bottoms and sea grass beds was declared as the Bar Reef Marine Sanctuary in order to protect threatened sub-tidal ecosystems and associated biodiversity. However, there is no management of this sanctuary at present and destructive practices continue unabated.

The major marine fisheries can be categorized as pelagic, demersal and "other fisheries". Among the pelagic fisheries are: sardine, herring, and anchovy; Medium sized pelagic such as Indian mackerel, flying fish, halfbeak, gar fish, and ribbon fish; and large pelagic, mainly tuna, billfish, sharks and seer fish. The demersal fisheries include finfish, such as pony fish, bream, snapper, grouper; shellfish, i.e. shrimp, lobster and crab, mollusks as chunk, mussel, clam squid and cuttlefish; and sea cucumber. "Other fisheries" include ornamental fish, collected for live fish trade brine shrimp and seaweeds. Within the coastal waters, the fisheries vary according to their distance from the shoreline. In the inshore areas (3-5 km) there are concentrations of all-size pelagic species, small demersal species and non-fish marine resources such as shrimp, lobster, crab, and sea cucumber. The medium sized pelagic species and large demersal species are caught beyond the inshore areas as well. The large pelagic species (*e.g.* tuna) have a wider distribution migrating between inshore and offshore waters. Small pelagic species dominate the coastal pelagic fisheries in Sri Lanka.

At present, among catches, the highest densities of stocks are in the northwest and northeast waters. Though there are a large number of fisheries, catches are dominated by sardines and anchovies in the area. The main fishing gear is small mesh gill nets (80 per cent) and beach-seine (20 per cent). The large pelagic fisheries are characterized by a large number of species, but in very varying quantities. Estimates made by NARA (1995) indicated that landings of large pelagic consisted of 50 per cent, 35 per cent sharks and 10 percent billfish (Ministry of Fisheries and Ocean Resources 2002). The tuna fisheries are dominated by the

highly migratory skipjack tuna and yellow fin tuna. Shark fishing also contributes substantially, due to the export-prices of shark-fins.

The demersal finfish are economically important, though they are not a major target group of any fishery (Ministry of Fisheries and Ocean Resources 2002). The fisheries are characterized by a high diversity of species (215 species belonging to 55 families). Eight groups are commercially dominant; emperor fish, snappers, jacks and trevallies, groupers, sweetlips, pony-fishes, surgeon-fishes, and sharks and rays. The short-lived, small-sized and low-value species predominate in the north and northwest. They are often caught in large quantities by Indian trawlers as by-catch.

There are 132 species of shrimp in Sri Lanka. However, only 4 are of economic importance. The Indian white shrimp contributes 6-7000 tons (50-70 percent) of the catches from coastal waters. There is an annual catch of 800-1000 tons of lobster, predominantly spiny lobster. Lobster is over-exploited and in certain areas the stocks are depleted. Crab is mainly caught in lagoons for fattening and export. Squid and Cuttlefish are mainly caught as incidental catch. Sea cucumber is an important export commodity harvested from large lagoons in the north, northwest and northeast.

5.0 Evaluation of existing education and awareness building programs

5.1 Existing education system

As Sri Lanka is an island, it is rich in marine resources. As such, in order to get maximum utilization, sound education in the form of knowledge, skill and attitude is a necessary requirement. There are formal educational institutions and government departments mandated for protecting and enhancing marine environment through awareness programs and conservation measures. These institutions concerned with marine resources management can be classified as;

1. Primary level - based on school
2. Secondary level - based on fisheries training college.
3. Tertiary level – based on universities and other institutes.
4. State and NGO's level (MOFAR) (EDA) (CCD)

Provision for marine education has been incorporated in the curriculum of primary and secondary education at school level. The subjects, marine fisheries and inland fisheries have been introduced in the GCE (O/L) since 1970 as technical subjects which are optional. The name of above subjects has been changed to **Fisheries and Food technology**. The objectives of this subject are as follows:

- Understand the extent and the diversity of the aquatic resources of Sri Lanka.
- Assure the Sustainability of the aquatic resources and the aquatic eco-systems.
- Reduce the wastage of fishery resources using suitable preservation and handling methods.
- Upgrade the nutritional and Social Status of the people.
- Contribute to the national economic development through fishery.
- Contribute to the Community development of Fishermen

But it has not been implemented properly due to lack of human resources. In case of Mannar region (where fishing is a main occupation) the above subjects are taught only in three schools and only a few students opt to take these two subjects. This is not an encouraging sign. Awareness programme at School level too is not significant in the region. This is due to lack of resource persons and students do not desire to pursue these subjects.

Secondary Level

The Regional Training Colleges under the National Institute of Fisheries and Nautical Engineering (NIFNE)

There are six regional training colleges under the auspices of NIFNE: Negombo, Tangalle, Batticalao, Jaffna, Trincomalee, Colombo, Kalutara and Galle. These lay an important role in the training of local fishing communities. They issue certificates and diplomas for courses that last from 1-7 days up to one year. The courses cover a wide range of topics - e.g. fire fighting marine fisheries technology, repairs of fiber-glass fishing crafts and fisheries management. The courses target local fishing communities and are not academic in content. They are partly held by mobile training units that go to the coastal communities to conduct the training courses.

Tertiary Level

Tertiary levels of educational programs are implemented via National Universities and National level institutions. Institutions concerned with marine environment are National Aquaculture Resources Research and Development Agency (NARA), National Institute of Fisheries and Nautical Engineering (NIFNE) and National Aquaculture Development Authority of Sri Lanka (NAQDA).

The National Institute of Fisheries and Nautical Engineering (NIFNE), which was established in 1999, offers training programmed both for those actually engaged in fisheries and for those who wish to enter the sector. It is also responsible for conducting seminars, symposia, research, surveys and other investigations, and also for developing and maintaining links with other educational and training institutions in the field of nautical engineering.

The aim of NIFNE is to become Sri-Lanka's "Oceans University". NIFNE is located in Colombo and has a staff of approx. 35. Among these 7 are technical staff/coordinators. NIFNE has no-permanently employed teaching staff (2001). Lecturers are hired from NARA and Universities who also provide most of the available facilities. All facilities have to be upgraded to provide a reasonable infrastructure for the planned development of NIFNE into a university. The following B.Sc programmes, which are indicative of the issues of priority, have been planned or are implemented: Aquaculture, Post Harvest and Fish processing, Marine Fisheries, Extension and Management, Boat Building and Naval Architecture, Marine Engineering Harbour Construction, Coast Conservation and Management Aquaculture Engineering, Air Conditioning and naval Electrical Engineering.

National Aquatic Resources Research and Development Agency (NARA) is the principle national institute charged with the responsibility for carrying out and coordinating research, development and management activities on aquatic resources. It is effectively the research-arm of MFOR. It was established in 1981 as a response to the implementation of Sri Lanka's EEZ. It provides scientific and technological expertise and advice for the development and management of the fishing sector.

NARA consists of some divisions such as, the Marine Biological Resource Division, Inland Aquatic Resources and Aquaculture Division; Post Harvest Technology Division; National Hydrographic and Oceanography Division; Fishing Technology Division and Socio-economic and Market Research Division. To conduct surveys and research, NARA disposes of 4 operative vessels as per 2000 ranging from 20 to 6 meters in length and with varying technical equipment.

Universities

There are two national universities in the country provides educational programs relevant to marine environment. The two universities are;

- Faculty of Fisheries and Marine Sciences and Technology- University of Ruhuna
- Department of Fisheries, Faculty of Science University of Jaffna (Including- Centre for Development of Fisheries (CDF))

At the national level, there are two tertiary institutions which provide degrees. However no research or awareness campaign have been undertaken by these institution due to war. Their objectives are:

- To train professional man power, initially by providing a degree course.
- To conduct basic and applied research to promote new technologies relevant to the needs of the fishing industry.
- To disseminate new knowledge and engage in extension work for the benefit of the fishing community in the region.
- To develop the coastal and fresh water aquaculture and provide advisory and consultancy services to facilitate transfer of new technology appropriate to local situation to the industry.

Since, Higher Educational institutions such as University and Fisheries Training Colleges are located in the extreme north of Sri Lanka and in the southern part of Sri Lanka; they do not pay much attentions towards Gulf of Mannar.

5.2 State and NGO Level Activities

Government Departments

Government Departments such as Central of Environmental Authority, Marine Pollution Prevention Authority (MPPA), Coastal Conservation Department, Natural Hazards Management Unit, Ceylon Fisheries Cooperation, Ceylon Harbour Cooperation, Meteorological Department, Naval Defense Force, etc. are mandated with working to improve the marine ecosystem.

Coastal Conservation Department has initiated a Mangrove planting program in the coastal areas in Mannar district through deploying children and Pallimunai fishermen society. Coastal Conservation Department undertook an awareness program related to the coastal conservation, among the fishermen societies in the district level. Hazard Management Unit has undertaken an awareness program on tsunami early warning system among the villagers of Mannar district. Department of Fisheries and Aquatic Resources has conducted a capacity building program related to environmental conservation, sustainable fishing (eliminating harm full fishing methods) and economic development to the fishermen societies in Mannar district.

In addition, there are institutions such as NORAD, SIDA, JICA, FAO, BOBP-IGO having indirect involvement with marine resources management. The social institutions that have indirect responsibility of conserving the marine environment are Schools, Universities, Community organizations, Religious Institutions.

These government departments did not function in the past to conserve the marine resources. On the one hand, due to the abnormal situation prevailed in the country particularly in the north and east prevented the government authorities to perform their responsibilities. The presence of defense forces in the public domain hampers the normal utilization of the marine environment.

Only Coastal Conservation Department and Natural Hazards Management Unit have played little role to manage and conserve marine resources but other departments are not operating towards these objectives. Other institutes do not contribute to enhance the marine environment because they are not existing in the region.

6.0 Identifying needs of different level of stakeholders

Since, marine resource is a common property for all members of the society, it is very important to integrate all users concerned to sustain the marine environment. These marine resources have to be conserved and utilized because Fishery sector is second largest economic activity in the region. The impact on Gulf of Mannar region may affect majority of the community in region. So far there is no consensus among the users of the marine resources and no cooperation between the institutions and organization involved with the conservation and management of the Gulf region. Therefore, there is an urgent need for cooperation among different level of stakeholders. The identified stakeholders are as follows:

- Fishermen Societies
 - Local fishermen
 - Migrant fishermen
- Coastal villages
- Fishing traders
- Catholic churches
- Coastal Conservation Department
- Central Environmental authority
- Natural Hazard Management Unit
- Department of Fisheries and Aquatic Resources
- National Aquatic Research and Development Agency
- National Institute of Marine Nautical Engineering
- Universities
- Financial Institutions
- Defense Forces
- Local Governments
- District Secretariat
- Divisional Secretariat

7.0 Identification of priorities areas for education and awareness building

The following areas have been identified to undertake for education and awareness building Programs in the Mannar district:

Criterion for prioritization

Severity of environmental degradation will be considered as the criterion for priority of actions. The areas where the sea erosion and destruction of marine ecosystem such as destruction coral reef and coastal vegetation take place will be highlighted for conservation measures.

Priority Areas

Coastal Conservation

Coastal conservation measures are necessary since there are deforestation and sea erosion in the coastal areas. The area of southern part of Mannar, from Southbar to Silavaturai coastal area vegetation are being destroyed by the small scale fishers and dynamiters, to cut trees and tree branches to take away from the coastal areas, it's used for illegal fishing operation and firewood purpose which in turn caused sea erosion in the areas from Southbar to Silavathurai extensively. Sand mining for construction purpose is another cause. Such areas are damaged extensively due to the above mentioned illegal activities.

Conservation of Marine Ecosystem (Coral reef and sea grass)

Illegal fishing nets used on oceans is one of the most serious threats to the health of the world's fisheries and, to the secure employment of fishers. Illegal modes of fishing adversely affect the fishing industry according the Fisheries and Aquatic Resource of Sri Lanka, the regulatory body of the fisheries industry. Use of illegal nets has increased during recent years though, the Fisheries Act.1996, have prohibited some fishing methods in Sri Lankan waters. Fisheries Department of Mannar has announced that the following fishing methods have been strictly prohibited in the district from 23.10.2010

Use of *push net* for fishing operations, *harpooning* for marine mammals such as whales, dugong and dolphins, *mox nets* operation, using *gill net* or trammel net on coral reefs or rocks and the use of *monofilament net* and Bottom trawling nets for fishing are prohibited in the country. The fisheries Act, further prohibits any poisonous explosive like dynamite or stupefying substance or other noxious or harmful materials or substance in Sri Lankan waters for the purpose of poisoning, killing, stunning, disabling any fish or other aquatic resources.

Operation of the above nets in waters damages inhabitants, such as juveniles of bottom living fin fishes and shell fishes and that cause damage to the sea bed habitat and coral reefs once they used for fishing in lagoons and coral reefs. Bottom trawling nets can break these corals and destroy the sea grasses that are attractive marine habitats. "Once destroyed, corals may take years to recover, so it will directly affect our marine biodiversity," Dr. Terney warned.

Trawl net, Dynamite fishing, Purse seine, use of any harmful substance, such as tree logs, stone car body, monofilament nets use of tree branches for cuttlefish etc. Such destructive fishing demolishes the 3D structure of the reef, no longer providing shelter and food to reef organisms. The corals break into pieces making them vulnerable to wave action, leaving the shoreline open to erosion. It replaces the live reef with dead rubble mounds. The high shock waves kill most coral organisms and also smother all living coral further down the reef slope. Using nets is common practice throughout the coastal areas of Sri Lanka. However, northern Sri Lanka had been affected by the above fishing methods, especially dynamite fishing, and bottom trawl.

Dynamite fishing



Poaching in Sri Lankan waters



Over exploitation



Dugongs have been killed for their meat and at now threatened with extinction



Slow moving species such as sea cucumber and conch



8.0 Conservation of Marine resources

Dugongs, also known as sea cows are damaged or killed outright by the dynamite explosion. Sea Cucumbers and Pearl Oysters are also the targets of Bottom Trawling. Dr. Terney pointed out that the seas around Mannar and Palk Bay are famous for Pearl Oysters and Sri Lanka could lose the economic benefits of this harvest because of the encroaching Indian fishermen. There is high demand for Sea Cucumbers in East Asia where it is a delicacy. The unsustainable collection has already depleted the Sea Cucumber populations in southern Sri Lanka and if bottom-trawling continues they will fast disappear in the northern seas too. The problem with most of these invertebrates unlike fish that mature fast to lay thousands of eggs, is that they are slow breeders. The problem would be further compounded if this method of fishing continues in shallow waters Dr. Terney said adding that the

Indian fishermen are now bold enough to poach as close as 500m away from our shores.

Senaratna (2011) said he has received many reports confirming that blast fishing or dynamite fishing is taking place in Mannar despite it being illegal. He further added that "We have also received information that some fishermen in Mannar are in the practice of killing these mammals," he said. Dugongs, also known as sea cows are rare species protected under local and international law. "We will not allow this to happen," he said. Referring to the dead dugongs, he said looking at the size of their bodies and their weight, one can say they were 20 to 30 years old "It takes a long time for them to reach this size and the weight," he said. "The two killed were fully grown dugongs, a female and a male. The weight of the female is about 545 kilos and the male 480 kilos," the Minister said.

The empty shells of giant clams can be seen buried or overturned and sea cucumbers or lobsters are missing or drastically reduced in number after blast fishing. The marine ornamental fishery industry is affected. When blast-fishing is carried out in resort areas, it could pose a danger to tourist and divers while also causing negative publicity.

9.0 Comparison of Needs and Existing Resources

9.1 Existing Knowledge and Information

The knowledge and information on Gulf of Mannar are inadequate to utilize in a sustainable manner by different stakeholders. The different stakeholders in the region have traditional knowledge and experience on the resources in the Gulf of Mannar which is inadequate to address the present issues and challenges. Current issues and challenges require scientific knowledge and information to utilize its resources sustainably which is lacking in the region. Scientific knowledge and information infers that the users of the Gulf of Mannar do not understand the consequences of destructive economic activities and do not know the existing environmental conditions resulted by different activities in the region such as trawling, dynamiting destruction of coastal vegetation and coastal erosion.

9.2 Human and Financial Resources

Human resources concerned with the conservation of marine environment in the region are lacking. Human resources working in the Departments of Coastal Conservation, Department of Fisheries and Aquatic Resources, Natural Hazard Management Unit etc. are not professionally qualified personnel to handle the task of conservation in the region and they are involved with administrative works only. Human resources with scientific knowledge are lacking in the region who can contribute to conserve and enhance the resources sustainably. Financial resources are needed for different activities concerned with conservation of the marine environment. Conservation of marine environment requires updated data and information on Gulf of Mannar which needs substantial financial resources to produce. So far there are no data and information available. This has not been produced so far due to lack of financial resources and institutional capacity. Research and development on Gulf of Mannar which are very essential for the conservation of marine environment require financial resources but has not been feasible in the past. Conservation measures require financial resources to implement different programs and projects concerned are lacking.

10.0 Identification of national, regional and international agencies for education and awareness building\

10.1 Criterion for Identification of Agencies

- Protection of marine environment
- Environmental stock assessment
- Mapping of marine environment
- Awareness building

Duties and responsibilities concerned with conservation of marine environment will be identified. The duties and responsibilities may include protection of marine environment, awareness building on the conservation measures. Institutions concerned with research and development will be considered for the above purpose.

10.2 Identification of national and regional and international agencies for education and awareness building

Institutions			
Local Level	Regional Level	National Level	International Level
<ul style="list-style-type: none"> • Schools • Community Centers • Churches • Fishermen Cooperative Societies 	<ul style="list-style-type: none"> • Coastal Conservation Department • Central Environmental authority • Department of Fisheries and Aquatic Resources • Meteorological Department • National Institute of Fisheries and Nautical Engineering 	<ul style="list-style-type: none"> • NARA • Ministry of Fisheries and Aquatic Resources Development • Universities • CFC • CFHC 	<ul style="list-style-type: none"> • SIDA • NORAD • JICA • FAO • UNDP • UNEP

10.3 Networking of Different Agencies

It is necessary to build up network among the agencies which involved in the conservation and management of marine ecosystem. The coordination should be in the areas of research, awareness building and conservation and management measures. Particularly, there should be coordination between the research organization, academic institutions and departments and institutions which carry out works related to marine environment. The research institutions should identify the areas to be conserved and managed and it should be communicated with other institutions which undertake different activities in the ground. National Institutions should facilitate the regional and local level institutions utilize spatial information such as GIS, Remote Sensing and Global Positioning System for ocean resource identification and management.

11.0 Proposed Strategic Plans for Education and Awareness Buildings

#	Identified problem	Reasons	Mitigations Measures/Proposed Agencies
01	Lack of awareness about the boundaries of coral reef area among the fishermen	Coral Reef is not physically demarcated	<ul style="list-style-type: none"> - Creating awareness to fishing community – University, Schools - Propose demarcating coral area. – NARA, Regional Training College, CEA
02	Reduction in quality and quantity of the coral reef	<ul style="list-style-type: none"> - Damaging fishing methods - Over usage of sea resources. 	<ul style="list-style-type: none"> - Prevent improper fishing system – NARA, University, CEA, CCD, Police, Naval Defense Force - Creating awareness to fishing

		Removing corals for various purposes	community – MFOR, CEA, CCD, MPA, - Finding alternative livelihood activities for the community depending on corals. – DFAR, UNDP, NORAD,
03	No enforcement of rules and regulation and lack of management of coral reef area by responsible authorities.	- No relevant authority to work in the field in Mannar district - Shortage of resources to the relevant bodies.	- Creating awareness to fishing community & relevant officials - MFOR, DFAR, Training College, Schools, NIFNE - Giving proposal to appoint relevant staff - MFOR, DFAR
04	Lack of awareness of existing rules and regulation in coral reef area	- Low level of education - Lack of awareness - Low level interest to know about this - Lack of enforcement	- Creating awareness to the fishing community - MFOR, DFAR, Schools, CEA, CCD - Creating awareness to rules enforcing bodies such government officials and Police – CEA, CCD, Police, Naval Defense Force
05	Applying improper fishing methods	- Low level of education - Lack of awareness - No ideas about conserving the nature specially about coral reef - Low socio-economic condition	- Taking action to prevent improper fishing method such LILA, SURUKKU Net etc. through government officials – NARA, NAQDA, NIFNE, - Introducing alternative livelihood activities - DFAR, UNDP, NORAD,
06	Increasing number of fishermen fishing on coral reef area.	- Fishing activities of migrant fishermen - Increasing population	- Introducing alternative livelihood activities - DFAR, UNDP, NORAD, - Demarking coral area - University, NARA, Regional Training College, CEA
07	Lack of interest in health and education	- Poverty situation - Low level of interest - insufficient facilities	- Giving suitable and sustainable alternative economic activities to the poor people - DFAR, UNDP, NORAD, FAO, MFOR, - Motivate the people to conserve the corals - DFAR, UNDP, NORAD, FAO, MFOR,
08	Poverty situation among householders and poor family management	- Low level of education - Large family system - Low level income - Poor family planning and economic management - Insufficient income for a larger part of the population	- Increasing incoming earning sources - DFAR, UNDP, NORAD, FAO, MFOR, - Introducing enterprises - - Increase the resources of Medical; health officers and relevant body to provide better family planning services – Ministry of Health, ICRC, SLRC - Creating awareness to youth. - DFAR, UNDP, NORAD, FAO, MFOR,
09	Poor maintenance of health	- Lack of safety water obtaining sources - Lack of sanitation facilities especially toilets. - Maintaining proper distance between open duck-wells and toilet pits - Open space toilet system	- Building a safety water supply system - UNDP, NORAD, FAO - Providing knowledge about health through an awareness programme - NARA, NAQDA, NIFNE, - Provide toilet facilities to the families those do not have toilet facilities. ICRC, SLRC
10	Teenage marriage system	- Low level education - lack of awareness and family planning	- Providing opportunity to get high education to the children in fishing community - Providing family planning services Ministry of Health , ICRC, SLRC
11	Coastal erosion or depositing	- Anthropogenic activities such sand mining reef	- Creating awareness to the people who involve this activity – CFHC,

		damaging due destructive fishing - Sand mining in coastal area.	CFC, - Enforcing law and order. Police, naval Defense Force
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11.1 Strategic Plans for Awareness Building

- Awareness workshop on the impacts of destructive fishing methods should focus not only fishermen but also to general public, administrators, and politicians.
- Awareness on the ecosystem of the Gulf of Mannar to all stakeholders.
- Video documentation on the issues and problems of Gulf of Mannar.
- Poster and essay competitions on issues and challenges of Gulf of Mannar at school level.
- Preparation of booklet, atlas and pamphlets in local languages.

12.0 Conclusion

Marine environment is a vital component of earth to support all living being. The marine environment in the Gulf of Mannar has been degraded extensively due to various factors. Although there are agencies at different level mandated for the conservation and management of Marine ecosystem in this area, they are not functioning properly or able to carry out their duties and responsibilities effectively. The primary reasons why the marine environment is damaged severely are due to lack of awareness among different users of marine resources and lack of monitoring and conservation mechanism which can play a significant role. Here, several measures have been proposed to conserve the marine environment and if these proposed activities are implemented through BOBP-IGO, there are possibilities to restore the marine ecosystem to the previous level in the Gulf of Mannar.

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Report of the Field Visit

On the second day of the Consultation (19 June 2012), participants were taken on a full-day field visit to Mannar Island and the north-east coast of Sri Lanka that borders the Palk Bay and the Gulf of Mannar. The participants left Jaffna at 0600 hour and took the A 32 road that crosses the Jaffna lagoon with the Sangupitty Bridge that has been built recently to replace the ferry service that was in operation previously. The distance from Jaffna to Mannar by this road is 132 km, and over half that distance the road falls on the coast that borders the Palk Bay. Mannar Island is connected to the mainland with a 3 km bridge. Mannar Island is 32 km in length and at its end towards the mainland is the Mannar city. At its other end is Thalai Mannar, which was the last point on the railway line in Sri Lanka on the way to India through Dhanushkody prior to 1964 and subsequently through Rameshwaram. The ferry service from Thalai Mannar to Rameshwaram was suspended in 1982 due to security reasons.

Mannar Island and its associated area lie in the north-east arid zone of the country and receive less than 1000 mm rainfall annually. The entire area is comparatively sparsely populated. In Mannar Island there were large tracts of wild-grown Palmyra trees, and a population of wild ass.

The participants watched both the Palk Bay and the Gulf of Mannar, and fishing activities there. The fishermen undertake mostly gillnet fishing. There was evidence that the prohibited monofilament net is also used by some fishermen. From Thalai Mannar the participants visited Vankalai, a fishing village on the mainland bordering the GoM located 5 km south of the bridge referred above. The participants met with the fisher community at Vankalai and discussed the issues they (the fishers) are facing within their fishing activities. The fishermen discussed about instances of cross-border fishing activities by Indian fishing vessels which are usually better equipped and engaged in trawling. The fishermen suggested to hold bi-lateral discussion to settle the issue of cross-border fishing between fishers from both the countries. The fishermen also informed that they are facing competition from other Sri Lankan fishing vessels from the southern part of Sri Lanka covering from the Kalpitiya area and further south. They alleged that some of these southern fishing vessels have bottom-set nets using tall iron rods installed which hinder their fishing operations and damage their nets. The local parish priest acted as the spokesperson of fishers during the meeting.

After Vankalai the participants visited "Doric House" at Arippu, an archaeological site located 12 km further south on the coast. The house was constructed in 1805 in accordance with the Doric architecture to serve as the residence of the first British Governor of Sri Lanka, Fredrick North when he used to visit the area to monitor pearl fishing activities. This is also an area where severe coastal erosion is witnessed.

While returning the participants returned through Vavunia using A 30 and A 9 roads and reached hotel in Jaffna at 0300 hours in the morning of 20th June. The total distance covered by the field visit was 457 km. The field trip and interaction with the fishers were also documented audio-visually. During the trip, excellent food and hospitality were provided by the Sri Lankan navy in their naval bases.

Details of Group Discussions

Group 1	Group 2	Group 3
Developing projects and programmes: - 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.	Identify and define the scope of action of concerned agencies (BOBLME Project and its partners: BOBP-IGO and Mangroves for the Future- MFF) in respect of collaborative action in the GoM.	Guideline for institutional arrangements for collaborative action in GoM
The Groups may consider the following.		
<ul style="list-style-type: none"> • Projects may be of various durations (short; medium; long) • Project objective should be easily implementable (independent to the maximum extent possible of other events that may affect implementation of the project). • Implementation procedure and risk factors may be identified. • Replicable. • In case the group finds time is not sufficient, one or two priority initiatives may be identified and developed into complete projects ideas. 	<ul style="list-style-type: none"> • What are the possible uses of BOBLME Project and its partners in GoM. • What could be the best uses of BOBLME Project and its partners for different durations (short: < 1 year; medium: 1- 3 years and long > 3 year) in view of uses identified. • Whether the organizations should play a complimentary/ catalytic/ supplementary role? • In case of mixed roles, areas where roles can be clearly demarcated should be highlighted. 	<ul style="list-style-type: none"> • Develop institutional arrangements for bilateral cooperation between India and Sri Lanka.
Composition		
<ol style="list-style-type: none"> 1. A Anrose 2. G Gopakumar 3. TT Ajith Kumar 4. JPI Swanalatha 5. K Ravindran 6. HPK Hewapathirana 7. RAR Premakumara 8. Arjan Rajasooriya 9. Sisira Haputhanthri 10. Sevvandi Jayakody 11. Christine Dasanayake 12. ARM Haleem 13. Roppiyel Jude Ravel 14. NM Ishwar 15. R Mukherjee 	<ol style="list-style-type: none"> 1. G Syda Rao 2. V Selvam 3. Vencilas Vijayan 4. AP Mallikarachchi 5. Upul Wanniarachi 6. Ajith Rodrigo 7. K Arulananthan 8. PBT Pradeep Kumara 9. BS Miranda 10. Suppaiah Yogarajan 11. Abdul Aziz Rahim 12. Kumudini Ekaratne 13. Sumana Narayanan 14. A Hettiarachi 15. Rudolf Hermes 	<ol style="list-style-type: none"> 1. Damitha de Zoysa 2. A Mathew NP 3. H Nautiyal 4. JK Patterson Edward 5. J Vincent Jain 6. N Ganeshmurthi 7. AE Nilanthini 8. HD Gamage 9. BHJ Premathilake 10. Chamari Dissanayake 11. N Ponnambalam 12. AS Soosai 13. S Vidanage 14. Nishanthi Perera 15. Y S Yadava

Report of Group 1: Development of Projects and Programmes

Key research areas identified

1. Large marine mammals and other ecologically important species and key habitats
2. Water quality and coastal erosion
3. Fisheries management in GoM

Project duration

- Short term – up to 1 year
- Medium term – up to 3 years
- Long term 1- started now and continued up to 5 years
- Long term 2 – started later on once preliminary data and resources are available

Charismatic and other important species surveys

- Sirenians (dugong) - long term 1
- Cetaceans (hump-back whale, sperm-whale, dolphins, etc.) – long term 1
- Turtles – short term
- Whale sharks – short term
- Sea cucumbers, sea urchins – short term
- Sea horses, sponges, chanks – short term
- Distribution and abundance (spatial and temporal) – short term to long term 1
- Habitat mapping (species composition and distribution) - short term to medium term
- Genetic studies to determine connectivity - short term

Habitat assessment

- Coral reef ecosystems and sea grass tracts
 - Assessment of current status and distribution- medium term
 - Coral associated species assessment – short term
 - Oceanographic parameters (current patterns and sedimentation) – long term 1

Water quality and coastal erosion

- Determination of water quality (organic and inorganic pollution and un-degradable material influx) long term study in point selected - long term 1
 - Heavy metals and synthetic manmade materials and other organic and inorganic pollutants
 - Determination of indicator species
 - Developing protocols for long term monitoring
 - Development of BMP for water quality management
 - Ocean acidification
 - Harmful algal blooms and their effects
 - Look at information on the assessment of work that has been done on climate change. Dedicated website for this information.
- Sediment transportation and deposition and contribution of manmade activities for coastal erosion –medium to long term

Fisheries research

- Survey of current species exploited and the gear types used - short term
- Documenting current traditional and community based management in place - short term
- Economics of current mode of fisheries in Sri Lanka and India - short term
- Impacts of trawling on current species distribution - short term
- Participatory management and development of options of sustainable livelihood - medium term
- Deep sea sampling for unexploited species - short term

- Assessment of management capacities and opportunities for fisheries management - short term
- Ecosystem based approach to a selected group and development of models - long term 2

Capacity building and training - short-term and phased-out

- Ecosystem approach to fisheries
- Survey methodologies for demersal species
- water quality monitoring and use and calibration of instruments
- use of GIS and remote sensing
- PFZ training
- Taxonomy
- Survey methodologies for large marine mammals
- Diving
- Safety at sea
- Managers and communities
 - Alternative livelihoods
 - Legal policies in place
 - Community monitoring capability
 - Diving

Awareness building

- Politicians and policy makers
 - Current status and issues including trans-boundary issues
 - GOM and its importance
 - Importance for sustainable resource exploitation
 - Scientists
 - Current knowledge and gaps of research and ICM
 - Opportunities for collaboration
 - Data bases. Who is doing what in ICM?
- Managers
 - Current status and issues including trans-boundary issues
 - Management options
- Community
 - Charismatic species and their role
 - Impacts of resource use on ecosystems
 - Alternative live hood opportunities
- International community
 - Ongoing programmes, projects and status of species and ecosystem

Data sharing and monitoring

- Signing of MOU with interested parties for literature sharing
- Sharing and assessment of information of existing surveys and research, linkages their methodologies and areas covered
- Mechanisms should be in place to avoid plagiarism of information collected, data storage and use.
- Mechanisms should also be in place to allow data sharing between two countries with modes of access screened to ensure proper use.

Report of Group 2: Scoping for BOBLME Project and its Partners

Task:

Identify and define the scope of action of concerned agencies (BOBLME Project and its partners: BOBP-IGO and MFF) in respect of collaborative action in the GoM.

Main Questions:

- What are the possible uses of BOBLME Project and its partners in GoM?
- What could be the best uses of BOBLME Project and its partners for different durations (short: < 1 year; medium: 1- 3 years and long > 3 year) in view of uses identified?
- Whether the organizations should play a complimentary/ catalytic/ supplementary role?
- In case of mixed roles, areas where roles can be clearly demarcated should be highlighted.

Tier 1 Partners: Potential International and Regional Partners

- Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO)
- Mangroves For the Future (MFF)
- Food and Agriculture Organization (FAO)
- South Asian Co-operative Environment Programme (SACEP)
- International Union for Conservation of Nature (IUCN)

Role of others: UNDP, GEF

Possible Roles

- Facilitation of consultation and project formulation
- Coordinate between governments and departments and cooperation
- Technical and financial input
- Advisory services
- Policy advocacy
- Capacity building
- Awareness raising

What could be the best uses of BOBLME Project and its partners for different durations?

Short - term

- BOBP-IGO, BOBLME - Awareness raising on conservation and management at government levels and policy level
- BOBP-IGO, IUCN - Awareness raising on habitat / ecosystem based management at the partner, government and policy level

Medium - term

- IUCN, MFF- Documentation and communication
- IUCN - Implementation of common programmes on both countries (Living resources of GoM: Assessment of key species habitat for enchainning awareness and for conservation policy formulation)

Long - term

- BOBP-IGO, BOBLME - Facilitate consultative processes in the trans-boundary projects for conservation and management of GOM
- BOBP-IGO - Promote coordination between the Sri Lanka and India governments
- IUCN, MFF, BOBP - Policy advocacy
- BOBP-IGO – Technical inputs and project formulation relating to fisheries management
- FAO - Capacity development

- SACEP - Environmental monitoring and management
- WWF, IUCN -Technical inputs for formulating management plans/regulations/guidelines
- SACEP, BOBP-IGO - Technical inputs for formulating regional policies and strategies for environmental management

Tier 2 Partners: Potential National Organizations

Sri Lanka

- NARA, University of Ruhuna and University of Jaffna: Research and development on fisheries and aquatic resources, habitat mapping
- Ministry of Environment and Central Environmental Authority: Technical support, environmental standards
- Marine Environmental Protection Authority: Marine pollution monitoring and regulating
- Coast Conservation Department - Integrated coastal zone management policy and programmes
- Ministry Fisheries and Aquatic Resources Development and Department of Fisheries and Aquatic Resources – Implementation of management plans
- National Aquaculture Development Authority – Alternative livelihood programmes
- National Science Foundation – Coordination
- Department of Wildlife Conservation / Department of Forest Conservation – Coordination and implementation

India

- Ministry of Environment and Forests - Policy support, direction
- Department of Forests and Wildlife – coordination, policy support
- Central Marine Fisheries Research Institute – Technical support
- State Department of Environment and State Pollution Control Board - Marine pollution monitoring and regulation
- Annamalai University – Technical studies
- Coast Guard - ????
- National Institute of Ocean Technology –Data collection, monitoring
- International Collective in Support of Fisher-workers – Networking on livelihood aspects
- M S Swaminathan Research Foundation – Technical studies and project formulation, linking biodiversity and livelihood

Tier 3: Potential Local Partners

Sri Lanka

- Seva Lanka
- Sarvodaya
- Fisheries societies - Implementation of co-management
- Provincial Fisheries Ministry
- National Fisheries Solidarity Movement (NAFSO)
- Small Fishers Federation
- ZoA Foundation – Fisheries co-management
- Bar Reef Foundation

India

- Gulf of Mannar Marine Biosphere Trust - Coordination
- Fishery societies and community based organizations – mobilizing community and technical inputs for project formulation
- SDMRI – Technical studies and project formulation and implementation
- SIFFS – Liaison with community and project formulation and implementation
- Dhan Foundation – Micro financing and community development

Group 3: Guidelines for Institutional Arrangement for Collaborative Action

Existing Initiatives

Two countries are already signatories to various regional and international agreements and are also parties to several programmes, which bind them to the requirement of sustainable management of the resources

- IGOs – BOBP, SACEP/SASP, SAARC CRMC, BIMSTEC
- Joint working group on fisheries: meets every six months – MoU on Development and Cooperation in the Field of Fisheries is drafted and is being discussed
- International Maritime Boundary Line (IMBL) Meeting- every 6 month – Navy and Coast Guard
- MFF – already agreed joint project developed and about to be implemented
- NSF Collaborative research and exchange programmes
- UNEP/CMS- – MoUs on turtles and dugongs
- BOBLME Project
- National Fisheries solidarity and South Indian Federation of Fishermen Society– Alliance for Release of Innocent Fishermen
- FAO Code of Conduct of Responsible Fisheries
- UNESCO MAB initiatives - Indian part is already a BR, SL is in the process of declaring a BR in the area

Safe Entry Point

- Conservation of marine resources and protection of marine ecology

Facilitation of stakeholder interaction and working together

– Joint projects :

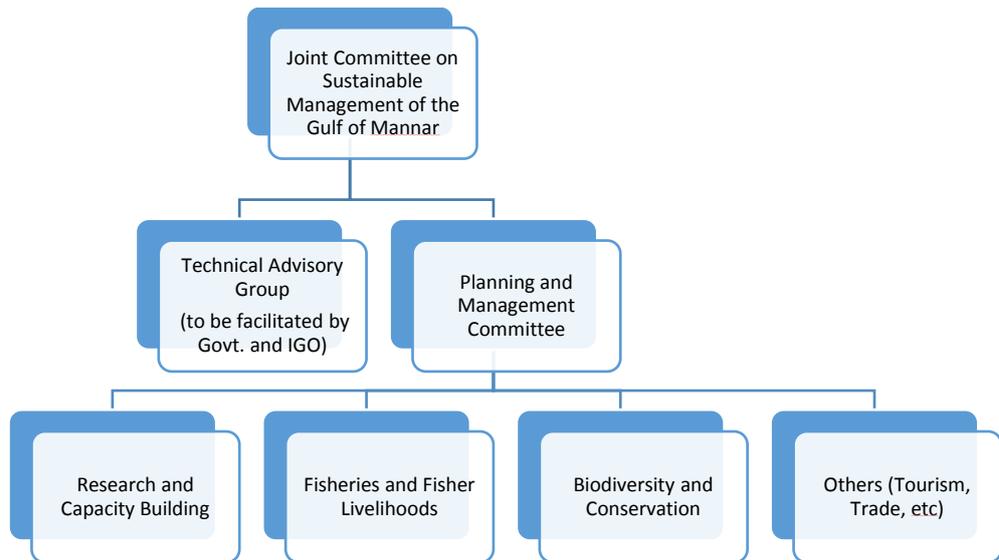
- Living Resources in GoM: Assessment of key species and habitats for conservation management and sustainable utilization – to be implemented by MFF NCs
- BOBLME Project - water quality monitoring, sea cucumber status assessment, and capacity building (GIS, Stock assessment, etc)
- BOBP-IGO - joint training programmes for fisher communities, alternative livelihoods and fishing technologies
- MOU on search and rescue operations
- MOU on training between Sri Lanka Coast Guard and Indian Coast Guard

Ways to ensure the success of such trust building?

- Giving opportunities for all stakeholders to understand and take part in activities – policy to grass root level
- Development and implementation of common research subjects and methodologies, e.g. sea grass extent assessments, dugong population studies, sea cucumber population studies, water quality monitoring, fish stock assessments
- Conduct symposium, side events at international/regional initiatives such as COPs or IGO meetings and share information
- Existing governmental initiatives for joint activities
- Regional Funding agencies should consider providing financial assistance for these activities.
- Annual review meetings – setting indicators for joint activities

If successful, how such initiatives can be utilized for building institutions in areas where there may be more conflicts?

- Policy makers to make use of the outcomes of the entry point projects to further strengthen confidence building in sensitive issues such as fisheries and cross border fishing.
- Long-term and short term problems to be prioritized.
- Stakeholders need to talk to each other to build consensus (Research and fisher organizations need to talk to each other to understand the real situation)



In case initial attempts may fail to produce desired results, how the lessons learned could be preserved for improving subsequent attempts?

- Preventive actions have already being considered
- Actions
 - Review the policy
 - Learn from mistakes and try again.



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



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