Regional Workshop on the Conservation and Sustainable Management of Coral Reefs

Workshop Proceedings

M.S. Swaminathan Research Foundation, Chennai, India
Bay of Bengal Programme (FAO), Chennai, India

December 15-17, 1997

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This volume contains the proceedings of the workshop on the Conservation and Sustainable Management of Coral Reefs held at MS. Swaminathan Research Foundation, Chennai, India. December 15-17. 1997.

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FOREWORD

Coral reefs have been described as the marine equivalents of rain forests with reference to richness in biodiversity. Yet, recent estimates reveal that nearly 95% of the world's coral reefs have been damaged by overfishing, dynamiting, pollution, poisoning or ship's anchors. Reef check carried out at 300 sites in the Carribean, the Red Sea and the Indo-Pacific Region during the summer of 1997 has indicated that fish and shell fish that were once common on reefs are gradually getting decimated.

1997 has therefore been declared as the Year of the Reef, in order to focus public and political attention on issues relating to the conservation and sustainable management of coral reefs.

It is sad that just at a time when awareness of the crucial importance of biodiversity conservation to the future of global food, health and livelihood security is growing, these fortresses of biological diversity are giving way to a combination of natural and human assaults. 1997 is marked by ***El Nino*** events. ***El Nino,*** associated with the warming of the water currents in the equatorial eastern Pacific, led to the killing of huge quantities of coral along the coasts of Costa Rica, Panama, Colombia and Ecuador during 1982-83. In normal circumstances, the reefs recover from natural destruction within a few decades. But now, natural stresses are compounded by human activity, and the coral treasures are being increasingly degraded with less chance for regeneration.

The Regional Workshop convened by M S Swaminathan Research Foundation in collaboration with the Bay of Bengal Programme of FAO is designed to address these issues and to develop an action plan for saving the remaining coral reefs in the SAARC region. Since its establishment in 1989, M S S R F has given priority attention to the conservation and sustainable use of Coastal Mangrove ecosystems. In many areas, Mangroves, sea grass meadows and coral reefs constitute an integrated ecosystem. The Gulf of Mannar Biosphere Reserve represents one such integrated ecosystem. Currently, a detailed action plan is being prepared with assistance from the Global Environment Facility (GEF) and the UN Development Programme (UNDP) for preserving for posterity the biological wealth of the Gulf of Mannar region.

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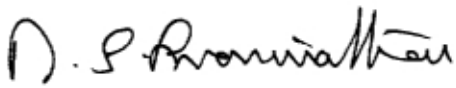
We are indebted to the following organisations for cosponsoring this Workshop and for providing financial support.

- The World Wide Fund for Nature - India
- United Nations Education Scientific & Cultural Organisation
- Department of Science Technology and Environment - Administration of the U T Of Lakshadweep.
- The Department of Ocean Development, Government of India
- The Ministry of Environment and Forests, Government of India
- Ministry of External Affairs, Government of India (SAARC Division)
- Ministry of Science and Technology, Government of India
- The Global Coral Reef Monitoring Network - South Asia
- The Bay of Bengal Programme of the FAO
- Australian Agency for International Development - Aus Aid

Our special thanks goes to the Bay of Bengal Programme, FAO for collaborating with us for the organisation of the dialogue and arranging for the country paper presentations. We are also grateful to the AUSAID for arranging to bring a monitoring expert from Australia and Dr Jason Rubens of the Global Coral Reef Monitoring Network for his valuable suggestions.

My sincere thanks go to my colleague Dr(Ms) Vineeta, Hoon for her tireless and dedicated efforts to make this Regional Workshop purposeful and memorable.



M S Swaminathan

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1. Recommendations of the Workshop Participants

Group A: Sustainable Use and Equitable Sharing

The Group discussed the dynamics of all end-user and dependent groups of reef resources, classifying them into different categories of stakeholders. The table that follows summarizes information about stakeholders, their unsustainable practices, corrective measures required to manage the resources on sustainable basis remedial action necessary to bring about long-term sustainable use and equitable sharing of coral reef resources.

The stakeholder groups were divided into the following categories as shown in Table 1.

1. The most sociologically important group is traditional fishermen and coastal dwellers. Fishermen were divided into two groups:

a) Traditional Fishermen: These Include Indigenous People who have been living in the vicinity of coral reefs for millennia. Their services can be availed of under the program almost as wardens.

b) Commercial fishermen: They use modern fishing methods and regard the reef resources as a short-term commercial proposition. They are not particularly concerned with the long-term conservation of the reef as their financial mobility allows them to shift operations from region to region once the catch is depleted. They use fine-mesh nets, such as gillnet and purse seine, fish poisons, cyanide and dynamite. They also carry out bottom netting for lobsters.

Corrective measures: Fisheries management, limiting fish catch and improved methods of fish catch, education and peoples participation and involvement in a long-term management plan.

Indicative values on a scale of 1-5 for the time, effort and money to be spent on these people because they are sociologically important for the coastal regions. A value of 4 is given to fishermen.

Divers: were further categorized as:

a) Sports divers: Diving as a sport can be sustainable if diving numbers (density) is regulated and maintained.

b) Commercial divers: Commercial divers who use scuba equipment without adequate training are destructive to the coral reef. This is because they do not fully appreciate either the ethics or function and use of scuba gear.

The diver code of ethics of PADI, NAUI, SSI, CMAS, and BSAC is Safety first and foremost; Insist on a buddy system (Two divers must always dive together); Protection of the environment and all its inhabitants. It specifically states that scuba gear should not be used for commercial purposes such as killing or catching fish, dynamiting, poisoning etc.

Corrective measures: There should be an organized program to train divers in safety regulations concerning scuba practices and bring them into the mainstream of International scuba activities with their rules and ethics involved.

Table 1: Sustainable use and equitable sharing of coral reef resources

Stakeholder Users	Unsustainable Practices	corrective Measures	indicative value 1(low) to 5 (high
Fishermen 1. Traditional Fishermen	NON-DESTRUCTIVE		
2. Exploitative Fishermen	Small Mesh Net Fishing Bilgewater, /Fish Offal Blast Fishing Cyanide Fishing (Poisons)	Education and Awareness Building Fisheries Management Measures	4
Ornamental Shell and Coral Collectors	Overexploitation	Culture shells & Corals. Revenue Generation Fisheries Management	2 5
Divers - Sports - Commercial - Scientific	Diver Overcrowding Lack of proper training in scuba Diving	Limit Number of Divers Scuba diving certification Education and training	4
Tourist Operators	Glass-bottom Boats Sewage/ Solid Waste disposal Excessive Draw and Use of Ground- water Resources. Indiscriminate Construction	Stringent Control Sustainability Awareness Implement Existing Regulations	4
Ports and Harbors	Dredging/Blasting	Harbor Management	3
Coral Miners	Complete Destruction	Ban/Alternate Sources of Building Materials	1
Naval Activities	Demolition Damage Anchor Damage Combat Diver Training	Environmental Education for Officers at School	1
Urban Developers	Waste Disposal Lack of Setbacks Reclamation	Implement Rules	2 5
Marine Archeology	Removal of Artifacts	Regulatory Agency	1
Aquaculture	Discharge of Effluents Antibiotics/Exotic Diseases Increased Sedimentation	Enforcement of Rules Better Management	3
Coastal Dwellers /settlers	Waste Disposal	Awareness building Bio Toilets	4
Shipping Industry	Oil Discharge Ballast Water Discharge	Enforcement Education	3
Ship Breaking Industry	Oil Seepage Scrap Matter	Designate Special Zones	
Coir Pith Producer	Increased Nutrients Pollution	Designate disposal areas Education Improve Technology	
Oil Industry	Oil-rigs	Laws Enforcement Awareness	3

4. Tourist operators: Tourism brings in revenue, creates employment and can be self regulating if a code of ethics is followed. Coral reef resorts live off the reefs and a lot of

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capital has gone into providing an infrastructure. They depend on the pristine-ness of the reef and it is in their self-interest to preserve the reef environment.

5. Ports and harbors: They are necessary for developmental infrastructure. But their construction should be regulated stringently. Environmental impact studies must be conducted on every major project, to check sustainability or environmental damage.

Corrective measures: Spear-head teams or groups of highly motivated environmental and social scientists to motivate and educate end user groups into forming associations that can regulate and manage their own reefs.

The following action steps were suggested to operationalise marine protected areas and fish sanctuaries:

1. De-mystify protection and management. Protection does not mean no fishing.
    - Responsible fishing (code of conduct for responsible fishing.
    - Professional ethics/PADI scuba certificate.
2. Stakeholder consultation and analysis to promote community bonding
3. Set up community learning and earning center's in fishing villages to serve as a focal point for co-management.
4. Training and awareness building.
    - Provide worthwhile occupational skills.
    - Construct signboards and posts in strategic public areas through key messages.
5. Mangrove re-plantation schemes - rehabilitation of coastal contiguous wet lands.
6. Seagrass replanting and rehabilitation
7. Construct and install artificial reefs as management tools and not as gear.
8. Encourage rotational fishing
9. Develop a core of community reef wardens (with/without incentives and a supporting policy environment)

Group B: Local Governance of Reef Resources and Habitats

The group's discussion was based on the consensus that given the complexity of coral reefs and the multiplicity of impacts upon them, any measures to sustainably manage and conserve them would be futile without the active participation of stakeholders. In order to facilitate and enable participatory, stakeholder governance the group through their discussions proposed recommended the following:

- Evolve supportive clauses into existing regulations to include coral reefs and to specifically delineate the area of jurisdiction;
- Evolve institutional frameworks to provide local decision - making platforms to manage and conserve coral reefs and to legitimize and empower such groups to undertake such efforts; and
- Propose miscellaneous tasks, which would enable and facilitate local governance options and build the capacity of agencies concerned to undertake similar efforts.

The recommendations of the group, broadly classified into three categories were:

1.0 Supportive Regulations and Legislation to include and delineate Coral Reefs:

1.1 All coral reefs should be declared 'protected areas" (ecologically sensitive areas with certain restrictions on destructive fishing practices, and activities) to enable conservation and sustainable management.

1.2 A special authority should be created in all coral reef areas to conserve and manage coral reefs or, an agency already existing should be empowered and authorized to undertake the mandate.

1.3 Legislation relating to Coastal Zone Regulation should be appropriately amended to enable integrated coastal zone management to cover the seaward side to depths of up to 200 meters.

1.4 Legislation to be appropriately amended to incorporate all coral species as marine fauna. In particular include the species 'corals' in the Schedules of the Wildlife (Protection) Act and include 'corals' in the definition of "wild animal".

1.5 As all South Asian countries are signatories of CITES, a complete ban on the export and trade of all coral species should be enforced.

2.0 Institutional Framework for Local Governance:

2.1 Under the aegis of the designated local coral reef authority, local governance of coral reefs should be encouraged and promoted. Appropriate local forums of stakeholders, including concerned government agencies, all user groups, interested parties and local government, where formed, should be empowered to assist and advise the CRA (Coral Reef Authority) in the development of conservation and management plans. These forums should participate actively in implementation of plans.

2.2 Coral reefs are vulnerable to human impact, some of which may be generated at points distant from the coast. In order to protect and conserve coral reefs, the Coral Reef Authority (or designated agency) should be empowered to co-ordinate with agencies whose area of jurisdiction impacts on coral reefs.

3.0 Miscellaneous proposals to enable and facilitate local governance:

3.1 Awareness building and education should be encouraged to promote the participation of stakeholders in conserving and managing coral reefs.

3.2 All users of coral reefs should be strictly licensed and regulated strictly, according to guidelines that specify extraction and use limits.

3.3 It is vital to document traditional management practices of coral reef communities to give direction to socially and politically feasible local governance modalities.

3.4 In evolving management plans for coral reef conservation and management, given the urgency of the task and the lack of hard scientific information, the CRA (Coral Reef Authority) should adopt the precautionary principle, depending on best available information.

3.5 To build the capacity of agencies concerned, to enable improved management and conservation of coral reefs, partnerships should be evolved in the region to make optimal use of available skills, talents, information, research facilities and tools.

Group C: Reef Research and Monitoring for Management

1. Issues

1.1 Networking and Information Sharing

Although there are a few significant gaps in the status of knowledge of South Asian coral **reefs, the general condition of** coral reefs, and related threats and resource-use issues are relatively well understood by regional specialists. However, it is widely recognised that information is restricted to specialist institutions and therefore tends to be fragmented and inaccessible.

1.2 Weaknesses in the Research Infrastructure

Certain weaknesses in the coral reef-related research community in South Asia were identified:

(i) although many institutions in India are conducting related marine work. India has no *dedicated* national centre for coral reef research; like Sri Lanka and Maldives.

(ii) South Asian regional institutions lack manpower for field activities, especially in-water data collection;

(iii) much of the present marine research activity is not related to management requirements and tends to be narrow-focused and qualitative. In particular there is a lack of quantitative survey work generating relevant management-related statistics;

(iv) there are problems in securing long-term commitment of funds for monitoring activities, which need to be continued year after year.

1.3 Community Participation in Research Activities

There is an acute awareness in the research community that extensive recommendations have been made over the years on coral reef management priorities, but very few have been put into practice by governments.

A fundamental reason, may be the lack of involvement of communities in the research process. This leads to recommendations that are neglect community interests. This in turn means that there is limited political will to implement such recommendations.

Greater active involvement by community groups would mean better integration of local or traditional knowledge of the coral reef envirorwnents and resource-use issues into the management recommendations.

1.4 Lack of Socio-economic Research on Coral Reefs

There are very few scientists from *socio-economic* disciplines who specifically address coral reef-related issues in the South Asia region.

This is one reason why community interests may have been insufficiently addressed in coral reef management recommendations in the past. Better participation by socio-economic scientists would also help to translate local understanding of coral reef environment into management planning processes.

2. Recommendations (not in order of priority)

2.1 Development of the South Asia regional component of the *Global Coral Reef Monitoring Network (GCRMN)* should be advanced as quickly as possible, especially to address the need to integrate available coral reef information and improve data accessibility.

2.2 Consideration needs to be given to establishing a nodal centre for coral reef research in India. Conferring the mandate for coral reef work on a single institution (either new or existing) may *not* be desirable, as there are strengths in the existing plurality and diversity of institutions. Nonetheless, some kind of national co-ordinating body is clearly required.

2.3 Research priorities at some marine research and related institutions and universities in India and Sri Lanka need to be fundamentally reviewed in the context of basic management needs; in particular, applied quantitative survey and monitoring work needs to be encouraged in favour of the current emphasis on qualitative studies such as taxonomic work, and detailed species-level studies.

2.4 National Government. funding sources in India should be requested to consider *routine* annual budgetary provision (i.e. *not* constrained to a fixed project duration) to fund ongoing coral reef monitoring activities.

2.5 There is a strong need for field scientists to encourage the active participation of community groups in field data collection, so that local knowledge can be accessed, and local awareness of the state of the environment increased.

2.6 Closer co-operation is needed between scientists, local communities and politicians and state and national government authorities in planning coral reef related research activities, so that such research is actively integrated into local management efforts and concerns.

2.7 Scientists from socio-economic disciplines would be encouraged specifically to address coral reef related issues and to develop resource-use and livelihood monitoring alongside biophysical monitoring.

2. Report of the Workshop

Session 1: Inauguration

Dr. M.S. Swaminathan, Chairman of the M.S. Swaminathan Research Foundation welcomed participants and guests. He mentioned that 1997 has been declared by UNESCO as the *Year of the Reef,* to focus attention on issues relating to the conservation and sustainable management of the remaining coral reefs on our planet. That this matter, needs urgent attention, will be clear from recent data, which indicate that nearly 95% of the world's coral reefs have been damaged by over-fishing, dynamiting, poisoning, pollution or ships anchoring. He urged participants to develop an integrated conservation and management strategy for coral reefs.

Dr. A. E. Muthunayagam, Secretary of the Department of Ocean Development, Government of India, inaugurated the Workshop. Stressing the importance of coral reef ecosystems, he said, that the Department of Ocean Development with support from the Ministry of Environment and Forests and the World Bank has embarked upon preparations for GIS based information systems for coral reef areas in the Gulf of Kutch, Malvan, (Kadmat) Lakshadweep, Gulf of Mannar and Wandoor (Andamans). This information system will be useful in the preparation of integrated management plans for the coral reef areas in India.

Dr. Graeme Kelleher, Vice Chairman (Marine) World Commission on Protected Areas delivered the keynote address[1] and stressed that it is essential to create public awareness on the delicateness and the fragility of the coral reef ecosystem. Education and extension programmes for the local people are useful tools in creating environmental awareness among local inhabitants. This is more likely to lead to lasting results than rigid conservation programmes.

Referring to his visit to the Gulf of Mannar area, he said that many areas of the Gulf of Mannar are already degraded and need strict enforcement of rules to protect them. A system of integrated coastal management (ICM) is needed to protect this fragile ecosystem. The goal of ICM is to improve the quality of life of human communities, who depend on coastal resources, while maintaining the biological diversity and productivity of coastal ecosystems.

The main problems caused by human activities to coral reefs and other marine ecosystems include pollution, overfishing, physical alteration of the seabed or coastline, introduction of exotic species and climate change

Dr. Vineeta Hoon proposed a vote of thanks.

[1]The keynote address is included in Section A of the Background papers.

Session 2: To review the current status of coral reefs in the SAARC coastal countries' experiences and to describe the problems

Chairpersons: Dr. A. E. Muthunayagam and Dr. Vineeta Hoon

Rapporteurs: Dr. Krishna Kumar and Ms. Devaki Pannani

Dr. Hussain Shihab, Director, South Asia Co-operative Environment Programme (SACEP) delivered a special address on the role of SACEP. SACEP has been in existence for 15 years. It was set up to evolve a common regional strategy for environmental management for South Asia. The nine member countries are:

1) Nepal, 2) Maldives, 3) Afghanistan, 4) Bangladesh, 5) Pakistan, 6) Bhutan, 7) Sri Lanka, 8) India and 9) Iran.

SACEP was ratified on the **15th** of March 1995. All the SAARC countries are members of SACEP. There are 15 priority areas identified by the SACEP secretariat with a focus on faunal biodiversity and environmental law. A number of workshops have been held, the latest being a workshop on faunal biodiversity in Calcutta, the outcome of which will be a Faunal Biodiversity Action Plan. The SACEP secretariat is the focal point for International Coral Reef Initiative (ICRI). It is collaborating with the Global Coral Reef Monitoring programme to develop a coral reef database for the South Asian countries. This database will be shared and developed by a network of Coral Reef Research agencies in South Asia.

The country papers[2] to review the current status of coral reefs in the SAARC Coastal countries were presented in the second session.

Mr. Maizan Hassan Maniku, Director General of Fisheries Research and Development, Ministry of Fisheries and Agriculture, Maldives (presently on leave of absence) presented the Maldives country paper, which had been prepared by Mr. Abdullah Naseer, of the Marine Research Section of the Ministry of Fisheries and Agriculture.

Mr. Arjan Rajasuriya, Senior Research Officer, National Aquatic Resources Agency (NARA), Ministry of Fisheries and Aquatic Resources Development of Sri Lanka presented the Sri Lanka country paper.

Dr. Vineeta Hoon, Social Scientist, MS. Swaminathan Research Foundation and Dr. Gopinatha Pillai coral reef Scientist (retired) from Central Marine Fisheries Research Institute (CMFRI) presented the India country paper.

Dr. A. R. Mollah from the Department of Zoology, Dhaka University, has prepared the country paper for Bangladesh.

Dr. Quddusi Kazmi and Dr. Afzal Kazmi from the Marine Reference Collection and the Department of Zoology have prepared the country paper for Pakistan.

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[2]The country papers for all five countries, specially prepared for this workshop, are included in Section B of the Background papers.

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Session 3: To discuss approaches and techniques of coral reef conservation and management experiences, particularly those involving stakeholders

Chairperson: Mr. Maizan Hassan Maniku **Rapporteur:** Dr. C. L. Rodrigues

1. BOBP's Approach in Fisheries Management:: By Dr. Kee-Chai Chong,[3] Programme Coordinator of the FAO/UN Bay of Bengal Programme

Dr. Chong provided a review of the Bay of Bengal Programme, highlighting the stakeholder approach to fisheries management in the region. He stressed the importance of involving all stakeholders in the marketing chain, from the primary producer to the final consumers. In between, there are the market intermediaries, fisheries manager and fisheries planners etc. Dr. Chong singled out fisheries planners as partly responsible for the pressure to expand production, which can then lead to overfishing. He pointed out that fisheries planners, in making their usual five year projections or even annual/biennial projections for planning purposes, invariably put down higher and higher projections without taking into consideration the existing per capita fish consumption and actual nutritional requirements. It is 65 kg/ capita/year in Japan, 45-50 kg/capita in Malaysia and Singapore. In short, fish consumption projections should not always be higher and higher but they should be realistic if we want to promote sustainable management.

Such projections place unnecessary pressures on existing fish stocks. There is a need to examine nutritional requirements and contribution of fish to the diet of the people in some countries; there is excess consumption of fish.

2. Management Experiences from Hikkaduwa National Park[4]: Dr. Ranjith De Silva

Dr. Ranjith de Silva spoke on his experiences from the Hikkaduwa Marine Park in Sri Lanka.

3. The Gulf of Mannar Project :Mr. Jaganatha Rao, Project Co-ordinator, M.S Swaminathan Research Foundation.

Mr. Rao spoke about the Management Plan being developed for the Gulf of Mannar Biosphere Reserve. This Plan is being prepared with funding from the Global Environment Facility (GEF)/ UNDP. The project was sanctioned in October1997. The project work has just begun and it is too early to provide a complete perspective of the plan. The plan will include a co-management strategy involving all the stakeholders in the Gulf of Mannar coast. Investigations are being undertaken to identify all the stakeholders. Discussions will be held with each stakeholder group to include their perspective in the Plan.

[3] Dr. Chong's complete paper is in section C of the Background papers.
[4] Ranith De Silva's complete paper is included in the Background papers

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4. **The Andaman and Nicobar Protect: Dr. A. K. Das, Sr. Scientist at the Zoological** Survey of India (ZSI), Calcutta

Dr. A. K. Das of the Zoological Survey of India spoke about the Management Plan being developed for the Andaman and Nicobar Islands with the help of GEF funding. He said that since the project was sanctioned in October, 1997, the ZSI had not yet started implementing the project. The project would ensure stakeholder participation in **developing the co-management plan for the Andaman and Nicobar Islands.**

Session 4: To discuss tools to promote coral reef conservation and management efforts to include community participation in the sustainable management and conservation of coral reefs

Chairperson: Dr. Kee-Chai Chong, Rapporteurs: Ms. Barbara Bierhuizen and Dr. Hemal Kanvinde.

Altogether 14 papers were presented. The topics ranged from mechanisms for monitoring coral reefs and coral reef health (4 papers) to two papers on carrying capacity and one paper on research and training on conservation and sustainable management. Other subjects covered legal and trade issues in coral reef products, **aspects of management of natural resources, definition and integration, role of media** and communication in management and eco-tourism designed on the principles of **ecology, economics and enjoyment.**

1. Mechanisms to Monitor of Coral Reefs: By Mr. Will Oxley, AIMS, Townsville, Australia

Mr. Oxley set out by describing a joint venture between India and Australia in capacity-building and training in monitoring of coral reefs, with experiences gained from their **programme in AIMS. In Australia the Great Barrier Reef monitoring programme started** in 1992, based on 15 years of previous research work. The objectives of this work are to assess the status of the reef, detect changes through time and provide an ecological basis for these changes and thereby assist in informed management. He said that basically there are three types of reefs: inshore, midshore and outshore. They monitor, coral cover, water-quality, nutrient status, COT (Crown of Thorns) and certain reef fish. The visual sensing technique is used for counting large and small fish. The video technique is used for monitoring coral cover and benthos. The manta Tow technique is used for assessing COT prevalence. The survey results are depicted in graphs and tables showing the change in hard coral cover or changes in COT count in different sectors of the reefs over time. Such information helps in predicting an outbreak of COT. The Park Authority, in one instance had launched a media campaign to inform people about the impending outbreak of COT. Outputs from this monitoring that can be used by others are status reports, standard operation procedures and technical studies. The monitoring programme also conducts training for in-house staff, Australian environmental agencies and Asian countries. Mr. Oxley further described the training

programmes conducted in Papua New Guinea where local guards and resort owners monitor the status of the reef. These local researchers helped the government of **Papua New Guinea to assess the extent of coral bleaching in their region. The** monitoring programme has developed a user-friendly database management system (ARMDES) to assist researchers in handling their data. He summarized the system by saying that such monitoring systems, if carried out in all the coral reef regions of the world will provide a global scale for local data. The data should be gathered through simple yet standardized techniques, and practical training should be imparted to the people of the coral reefs.

Discussion:

Q: What are the reasons for outbreak of COT?

A: It is suspected that COT larvae experience lower mortality under certain water nutrient conditions and thus survive much better than normal. These larvae stages are microbial and cannot be detected in the monitoring programme. Such sustained build up of population over 3-4 years may cause an outbreak of COT.

Q: Do you consider it a natural phenomenon? Do you advise removal of this organism?

A: It is a natural phenomenon. In Australia we undertake localised measures, mainly in tourist centres.

Q: How do you take observer error into account during the survey?

A: Two types of error may occur: observer specific and site specific. We consider that these two errors may account for up to 4 % change in coral reef cover.

Q: Is COT an indicator of environmental quality?

A: COT is not an indicator of environmental quality.

0: Are there any anthropogenic pressures on the reefs?

A: Anthropogenic pressures are caused by a) natural population growth, b) **increase in tourist arrivals and c) increase in commercial fishing. d) increased** silt runoff from land-based activities e) use of fertilizers by the sugar cane industry.

Q: Does the monitoring programme focus on conservation or on sustainable use of the reefs?

A: The monitoring programme's focus is on the sustainable use of reefs. It doesn't mean to isolate the reefs, It promote the concept of multiple use of the coral reefs.

Q: What is the impact of ballast water from ships on the reefs. Are there **instances of exotic species introduction due to this?**

A: The impact of ballast water is not seen in tropical waters. However, it **happens** in **temperate regions. For example, an introduction of a star fish caused reef degradation** in **Tasmania.**

2. Mechanisms In monitoring of coral reefs: by Jason Rubens, Regional Coordinator of the South Asia regional component of the Global Coral Reef Monitoring Network (GCRMN South Asia)

Mr. Rubens discussed the need for regular and repeated monitoring of the coral reef ecosystem. There are several reasons why reefs should be monitored. One is to find out who is responsible for causing the change, i.e. look at the reef as the scene of a crime, where criminal activities such as blast fishing, cyanide fishing and dumping of sewage take place. This leads to declining fish populations and corals. By monitoring reefs, we can find out the culprit responsible for the unsustainable use of reefs. Other reasons why reefs should be monitored are to improve understanding of the ecological changes taking place, to quantify known processes, to evaluate management effectiveness and to estimate carrying capacity and sustainable yields.

GCRMN is an inter-agency initiative of UNESCO, UNEP and IUCN. The GCRMN, South Aisia office is based in Colombo and funded by the UK Department for International Development (DFID). It seeks to develop a network to establish national databases on coral reefs, which is to be implemented at national levels within the present research framework. Each coral reef country has a national coordinator.

Discussion:

Q: How far do we understand the science of coral reefs? Do we not need to preserve all coral reefs as a world heritage?

A: Our present knowledge of coral reefs is fairly poor. We cannot preserve the reefs as a world heritage yet because the reefs are used by people. Some areas may be earmarked as preservation areas.

Q: What role does the international community play in conserving coral reefs?

A: The international community provides the funds that are essential for any conservation programme, including one for corals.

Q: Since the National Co-ordinator in each country is based far away from the reefs, how does the GCRMN provide for a trickle down mechanism of information dissemination for the benefit of the local community?

A: The monitoring and the database will be carried out by institutions already active in coral reefs research. The database will be housed in such institutions. The national coordinator will coordinate the activities of many such

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institutions. It is true inaccessibility of information from the central government may be a problem.

3. Remote Sensing and GIS for Coral Reef Mapping: By Dr. R. Krishnamoorthy, Scientist, M.S. Swaminathan Research Foundation.

Dr. K. Krishnamoorthy spoke about the feasibility of employing Remote Sensing and GIS techniques for monitoring the physical condition of the reefs over time. He presented a case study of the mapping exercises carried out in the Andaman and Gulf of Mannar region, and explained that satellite imagery data was used to categorize reefs as fringing, patch or platform. He further explained that GIS can be used as a tool to highlight changes in the coastal configuration because of erosion and accretion and their impact on the coral reef ecosystem.

Discussion: The participants wanted to know the percentage of accuracy of information gathered by the use of remote sensing data compared to the information gathered by conventional method? And whether fieldwork was carried out for ground truthing the satellite images in the Andaman Islands?

Dr. Krishnamurthy explained that the percentage of accuracy is up to 90 % and that a team visited the area to carry out ground truthing.

4. Coral Mortality in Reefs: The Cause and Effect: A central concern for Reef Monitoring[5]

By Dr. Chandra Lata Raghu Kumar, National Institute of Oceanography, Goa.

Dr. Chandra Lata discussed her project on Coral and Sea grass Mortality in Reefs: Microbial Pathogens and Environmental Disturbances' funded by the Department of Ocean Development. She explained that the indicators of ill health in coral reefs are partial mortality, bleaching, black-band disease, white band disease and excessive growth of algae. Causes for these are several: sedimentation, stress factors, eutrophication/pollution and pathogenic organisms. Ms. Chandra Lata pointed out that she does not speak about 'diseases' of coral reefs, she uses the more objective word mortality; Reason: corals might not die solely from biotic factors solely, abiotic factors could also be involved. She says it is not any individual factor but a complex that causes disease.

Discussion: The participants wanted to know whether she had observed a brown sponge as a secondary invader since it was found in the reefs of Sri Lanka. Had she observed any diseases in the Gulf of Mannar? Does the Crown of Thorns leaves any bacteria or pathogens.

Dr Chandralata replied that she had not observed a brown sponge as a secondary invader in the areas where she had carried out her study. She had not observed any

[5] This paper is included in Section C of the Background papers.

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diseases in the Gulf of Mannar. We do not know yet whether COT leaves bacteria after infestation of a reef area.

5. Research and Training for Conservation and Sustainable Management of Coral Reef Ecosystems, Present Status and Future Directions: [6] By Dr. S. U. K. Ekaratne, Department of Zoology, University of Colombo.

Dr. S.U.K Ekaratne described the status of coral reef research and training in Sri Lanka. He explained that reef habitats in Sri Lanka are degraded and impacted by a multiplicity of causes. Survey work constitutes the bulk of recent research activities. Quantitative data on reefs in Sri Lanka is lacking, so is data on reef processes and the diversity of the reef biota.

There is very little reef expertise in the country. A handful of people are engaged in established reef research programmes. The lack of trained personnel is the main impediment to collection of research data that can enable effective conservation and sustainable management of Sri Lankan reefs.

His talk invited the following comments:

C: The term "conservation" should be defined. Infact every speaker should define the terms used in his or her presentation.

C: It is important to keep administrators, members of Parliament and Ministers about the status of coral reefs.

Participants wanted to know how Dr Ekaratne studied the growth mechanisms of corals and why he used 15 Mts. as the length of the transects?

Dr. Ekaratne replied that growth experiments were conducted through simple area extension measurements in the field to calculate a coral growth index. He further explained that a length of 15 meters was chosen for convenience.

Carrying Capacity of Coral Reefs: By Dr. M. V. Wafer, NIO, Goa[7]

Dr. Wafer defined the carrying capacity of a reef as "its ability to support a range of extractive and invasive uses without perceptible changes and/or degradation of its biological productivity and species diversity over a reasonable period of time."

He emphasized that this definition is not restricted to tourism-related activities but is intended to cover all those activities (e.g. waste assimilation capacity) which have a potential for expansion and exceed the reefs ability to cope with these. He discussed six indices that are useful in measuring carrying capacity. These are indices of 1) productivity, 2) pollution 3) biodiversity, 4) harvest practices 5) interactions with adjacent ecosystems and 6) tourism.

[6] This paper is included in Section C of the Background Papers

[7] Paper included in Section C of the Background papers

Discussion: Participants wanted to know whether DR. Wafer was referring to carrying capacity or standing crop in his paper and he clarified that he was referring to carrying **capacity.**

6. An Analysis of the Carrying Capacity of Lakshadweep coral reefs[8]: By Mr. C. L. Rodrigues, Department of Biotechnology, University of Goa.

Dr Rodrigues analyses key parameters such as population size, number of houses, passenger traffic, cargo traffic and fish catch relating to major islands of the Lakshadweep archipelago to study the impact of human activities on the reefs. He explained that Lakshadweep has the third largest population density in the country. Rapidly escalating developmental activities are largely responsible for the degradation of the reefs. Fishery resources are under-exploited, and the fish catch can be augmented by adopting modern methods and diverting the impact of fishing boats to mainland ports. There is an urgent need to halt the degradation of reefs and reverse the trend.

Discussion: Participants wanted to know if Dr Rodrigues's results would have been different if he had based his analysis on island per kilometer^2 instead of per island. They also enquired why he used tuna catch as a measure of fish productivity. Since tuna is found outside the reef.

Dr. Rodrigues said that he felt a carrying capacity study per island was useful. The results would not be too different had he done it in any other way. As regards tuna catch as a measure of fish productivity . Dr Rodrigues said that tuna catch in Lakshadweep is dependent on live bait fisheries from coral reef areas. Therefore the amount of tuna caught reflects directly on pressure of the live bait species that are found on the reef.

7. Role of Communication: By Mr. Rathin Roy *Communications Adviser of the Bay of Bengal Programme*

Mr. Roy emphasized that communication should be a two-way process. In his experience, most valuable information at a meeting is acquired during thought **exchanges in the tea and lunch breaks of a meeting. He said that** it takes 10 years to become an expert, another 20 years to gain knowledge, but meanwhile nobody learns how to get it across. When talking about management of coral reefs, we mean management of the resource as well as of the people who use the resource. We must encourage and enable them to understand better the resources they are exploiting. Identifying stakeholders and making them participate in an activity is an important part of the stakeholder approach. It is not merely on 'getting together' to do something by highlighting areas of co-operation but rather to agree on removing areas of discord. Problem-solving involves mediation and communication skills and the capacity to listen.

[8]Paper included in Section C of the Background papers

8. Role of Electronic Media and Communication: By Mr. Prahalad Kakkar, Director LACADIVES

Mr. Kakkar explained that he got involved in coral reefs after his first scuba diving experience, which he called a religious experience. He wanted to share this experience with as many people as possible. By nature, Indians are afraid of the oceans, so many do not appreciate corals. He started by getting people together on the Kadmat Island in Lakshadweep. He stressed the value of introducing school children to coral reefs, because, once children are exposed to them, they are enthralled by the beauty of the reefs and want to learn everything about them. One consequence of his effort was that children stopped throwing garbage into the reefs and started collecting garbage. His training programme teaches people to take greater care of the reefs. His talk was followed by a short underwater video of the coral reefs around Kadmat Island.

9. Eco-tourism Designed on the Principles of Ecology, Economics, Education and Enjoyment: By Mr. Jose Dominic, Director of the Casino Group of Hotels.

Mr. Dominic started his talk by pointing out that corals need to be protected not only because they are our heritage but because pristine reefs have a great potential for attracting tourism. He explained that tourism is a double-edged sword. Tourism brings in revenue and in some areas is the only development tool. However, unregulated and unplanned tourism can lead to a number of ecologically sensitive problems and eventually destroy the very resource that people come to visit.

The Casino group started a tourist resort at Bangaram in Lakshadweep in 1988. Cottages already existed on the island. Mr. Dominic's task was to make it a profit-making venture. Setting up the resort was hamstrung by, many regulations for example no building materials could be used from the island. Everything needed for running a resort including food, had to be brought in from Cochin. Running the resort is very expensive and logistics of getting to and from Bangaram is always uncertain. However, they managed to turn the limitations into opportunities through successful marketing and the resort became a success. Holiday makers at the resort enjoy it so much, they come back to it. The same clients have returned to Bangaram for a holiday up to four times in the last decade. The lesson learnt is that conservation pays.

According to Mr. Dominic the tourism industry is definitely interested in conserving the environment but it needs advice on how to go about the task.

Mr. Dominic's talk was followed by a presentation made by. Mr. P. K. Kasali, Director of The Society for Promotion of Recreation Tourism (SPORTS) in the Islands

Mr. Kasali pointed out that the Lakshadweep Administration has restricted the entry of people from the mainland to the Islands. Entry is through special permits only and foreigners can only visit Bangaram for limited periods. They are allowed to transit through Agatti island, which has an Airport and take a boat to Bangaram. They now

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also allow foreigners to visit Kadmat. Low profile, tourism is being promoted. All tourists are given a list of do's and don'ts upon arrival. The use of plastic is banned in the islands. Building materials used in the islands are brought from the Indian mainland and garbage is taken back to the mainland for proper disposal. Local people use bicycles and two-wheelers for transportation.

10. The coral reef ecosystem of the Andaman and Nicobar Islands; Problems and Prospects [9] and the World Wide fund for Nature - India Initiatives for its Conservation: By Mr. Krishna Kumar, Project Officer for the Biodiversity Hotspots Programme of the WWF-India.

Mr. Krishna Kumar provided a summary of WWF-India's contribution to coral reef conservation and research in the Andaman and Nicobar Islands. He explained that WWF-India's interest in the Andaman and Nicobar Islands dates back to the mid-80's. Since then, WWF has continued to support several initiatives through local NGO's and various campaigns that have thwarted threats to the insular ecosystem.

11. Law and Policy for Conservation and Management of Coral Reef Areas in India[10]

By Ms. Devaki Panini, Environmental Law Department at WWF-India

Ms Panani explained that the law and policy for coral reefs in India are virtually non-existent. The only law that explicitly outlaws coral mining is the CRZ notification of 1991. Her recommendation for law reform and policy making for coral reef conservation and management in the country, concern amending the Wildlife (Protection) Act 1972 to include species of coral, in the Schedules and specifically state that the extraction of coral is prohibited under the provisions of Chapter V-A of the WPA..

12. Trade Issues of Coral Reef Products: By Ms. Fahmeeda Hanfee is Sr. Project[11] officer - Traffic India at the WWF -India.

Ms. Fahmeeda has undertaken a pilot study on the status of trade of coral reef products in India. She points out that a large amount of coral is used within the country, and does not figure in trade statistics. This domestic exploitation is mainly for building, curio collection and chemical extraction. Ms Fahmeeda said it is difficult to estimate the magnitude of trade in coral reef products. For example the United States report, import of coral reef products from India amounting for US$ 28,000/- in 1986 but no export of reef products were reported from India in that year. Ms Fahmeeda also highlighted the constraints to coral trade regulation.

The main recommendations of her study are:

Research on the coral trade is needed,

- The department of Fisheries has to be more involved in trade issues,

[9] This paper is included in section C of the Back ground papers.
[10] This paper is included in section C of the Back ground papers
[11] This paper is included in section C of the Background papers

- Management should be strengthened and an awareness campaign concerning coral reef products started.
- Customs officers need to be able to identify corals.

Discussion: Participants posed several questions to the three speakers from WWF-India. They asked whether trade was carried out in processed products from corals Fahmeeda replied that as far as she knew, only raw material was exported.

The talk invited the following comments:

"The Wildlife Act specifies that all wild animals are protected. Since corals are not domestic animals, they should be deemed "wild" and eligible for protection."

"India is a signatory to the CITES convention. This fact should be emphasized in all literature or discussion on the subject to protect corals."

"Most of the coral reef products are exported under an illegal name. Example: sea cucumbers are exported as dry fish."

"Similar to the Coastal Zone Management Act another Act is in the pipeline called a Ocean Zone Regulation Act.

While Ms Fahmeeda says sharks are overexploited. The CMFRI research concludes that sharks are not overexploited.

Session 5: Regional Co-operation and Initiatives to work towards sustainable management and conservation of the Coral reef heritage in the SAARC Region

Workshop Participants divided themselves into three groups to discuss the following topical issues with respect to coral reef management:

Group A: Sustainable use and equitable sharing: Inventory of reef resources and Stakeholder users dependent on reef products and services in order to assess existing exploitation practices that are unsustainable and suggestions to for remedies.

Group B: Local Governance of Reef Resources and Habitats: Steps that centre and State governments can initiate to share management and conservation authority and responsibility for coral reefs with reef users and other reef stakeholders

- Mechanisms to build partnerships and alliances between government and people to manage reef resources and habitats
- Mapping confkcts and evolving mechanisms for conflict resolution

Group C: Reef Research and Monitoring for Management: Steps that the scientific community can initiate to prioritise research focus, networking and sharing of information.

- Weaknesses and strengths with regard to reef research in adding knowledge to our reef heritage
- Mechanisms to build partnerships and alliances between research institutions towards developing a regional database such as the one initiated by GCRMN
- Scientific characterisation of reef resources and its ecology

Session 6: Recommendations of the three groups

Chairperson: Ms. Amarjit K. Ahuja, Jt Secy., Ministry of Environment and Forests.

The facilitators of the three groups presented the recommendations To Ms. Amarjit Ahuja. She concluded by saying that a lot of hard work had gone into this workshop. The recommendations would be very useful for developing a policy statement to be submitted to the Ministry of Environment and Forests.

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