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EAST ASIAN SEAS ACTION PLAN

Coral Reef Monitoring and Data Acquisition
Workshop

Phuket, Thailand, 9-11 May 2000

**REPORT OF THE WORKSHOP ON
CORAL REEF MONITORING AND DATA ACQUISITION
IN THE EAST ASIAN SEAS REGION**

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UNEP Coral Reef Monitoring and Data Acquisition Workshop in the East Asian Seas Region, Phuket, Thailand, 9-11 May 2000

Background

Coral reefs are widely regarded as fragile coastal ecosystems in the East Asian Seas region because of their high biodiversity and the apparent susceptibility of reefs to anthropogenic impacts in particular. The sustainable use of this important coastal resource requires sufficient knowledge about the biology, geology and physics of coral reefs, impacts of human activities, global warming and economic, legal and political advice.

Monitoring is an essential part of any programme of coral reef management. Monitoring is important to enable early detection of change in coral reefs over time due to natural impacts such as storm disturbance and starfish infestations, human impacts such as water pollution and anchor damage and the global scale processes such as climate change. Monitoring programmes are also necessary to determine the response of coral reefs to management action undertaken to reduce threats, such as the installation of mooring buoys, or reduction of fishing pressure on particular reefs.

Recognising the importance of monitoring, many initiatives have been developed world-wide to collect new data and bring existing information together to assess the status of reefs across particular regions and the world. Programmes include the Global Coral Reef Monitoring Network (GCRMN) sponsored by the Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Programme and the World Conservation Union, Reef Check and Reef Base.

However, current monitoring programmes are limited by the lack of trained personnel, widespread involvement of local communities (local people and private industry); and financial and other resources (boats and dive gear). Problems also exist in the communication of information needs between reef managers and researchers and in the accessibility of monitoring data by managers and providers once they have entered existing reef databases.

In the East Asian Seas region, many dive shops operate frequent dive programmes on a daily basis in tourist-attractive coral areas. With public education on the importance of coral reefs as marine resources, it is widely understood by the dive shops operators that monitoring will greatly help the understanding of the status of coral reefs, and help make correct decisions on the protection of this important resource.

The workshop was intended to bring together the people and agencies, which are actively monitoring coral reefs in the East Asian Seas Region, to review existing knowledge and information acquisition, assess and archiving procedures for coral reef monitoring in the region, and to identify the necessary action to be taken to develop a regional database network.

Agenda Item 1: Opening of the meeting

The Workshop was opened by Dr. Hugh Kirkman, Coordinator, East Asian Seas Regional Coordinating Unit (EAS/RCU), UNEP at the Felix Karon Hotel, Phuket, Thailand on 9 May 2000. In his welcoming speech, Dr. Kirkman introduced the objectives of the workshop and background on the regional coral reef monitoring and database networks. With emphasis on the importance of defining specific targets for a monitoring programme and designing monitoring activities, he brought the attention of the workshop to the user requirements of monitoring. The aims of the EAS/RCU are to identify where coral reef monitoring should be done, who should train trainers and prepare national and regional status of coral reefs reports. He said that monitoring should be continued indefinitely and that the data must be archived and analysed. He stressed the need for feed back to the people doing the monitoring. He gave a summary of the theoretical objectives of monitoring and the criteria on which to base monitoring programmes. The good features of monitoring were listed and the dangers of changing protocol or losing enthusiasm by the people

monitoring were emphasised. He completed his talk explaining why a regional database network was necessary.

On behalf of the Global Coral Reef Monitoring Network (GCRMN) and Reef Check Global Survey programme, Dr. Greg Hodgson gave the opening address. He reviewed the development of GCRMN and Reef Check in the region with emphasis on monitoring and data management aspects.

Dr. Hodgson reviewed the development of the International Coral Reef Initiative (ICRI) and its management umbrella, which included the Global Coral Reef Monitoring Network (GCRMN). He further informed the meeting of the development of the Reef Check programme.

The global-scale goals of Reef Check are to carry out a synoptic assessment of human impacts on coral reefs and long-term monitoring of selected sites. For conservation and management purposes, Reef Check aims at raising public awareness about the value of coral reefs, threats to their health, solutions to these threats and building a network of monitoring and management teams.

Dr. Hodgson further briefed the workshop on the findings of Reef Check from 1997-1999 and on its management and operation. He emphasised that community-based management is important for sustainable implementation of the project. He finally summarised the Simple Reef Solutions:

- Properly managed tourism;
- Well designed aquaculture;
- More, larger, well-managed marine parks;
- Energy conservation, reduced logging;
- Community-based monitoring and management -- Reef Check.

All participants provided a brief self-introduction, and a list of participants of the workshop appears as Annex 1.

Agenda item 2: Organisation of the meeting

(a) Designation of officers

The workshop elected Dr. Chou Loke Ming from Singapore as Chairman of the workshop.

(b) Organisation of work

Dr. Kirkman informed the participants of the structure and order of business for the workshop. It will work in plenary as far as possible and will form working groups if necessary, reporting back to the plenary. The workshop will take the form of an informal meeting to achieve the following objectives:

- (i) To discuss and decide on the necessary technical and management aspects of the network for monitoring and data/information exchange;
- (ii) To get some commitment from database operators for regular, sustained analysis and feedback of monitored data;
- (iii) Based on (i) above, to identify a regional target for the monitoring of coral reefs and relevant data/information exchange, and to select pilot site(s) for the initiation of the monitoring project;
- (iv) Commitment to train trainers in the agreed methods and develop a Plan of Action to achieve sustained monitoring at pilot site(s).

The working language of the workshop was English only.

Agenda item 3: Adoption of the agenda

The workshop adopted the Agenda proposed by the East Asian Seas Regional Coordinating Unit (EAS/RCU). The adopted agenda is attached as Annex 2.

Agenda item 4: Assessment of Existing Projects and Knowledge on Coral Reef Monitoring and Data/Information Exchange

The meeting invited participants to report on relevant activities at national and regional levels with regard to coral reef monitoring and data/information exchange. General discussion on monitoring and databases will contribute to achieve (i) of the objectives.

Dr. Annadel Cabanban spoke about coral reef monitoring in Sabah, Malaysia. Surveys to assess the status of the reef were conducted in Sabah by the Universiti Malaysia Sabah and the Universiti Malaysia Sarawak with volunteers from Sabah Parks and Aberdeen University. These surveys were conducted with the methods developed under the ASEAN-Australia Living Coastal Resources (LCR) Project and Reef Check. A total of 49 fringing reefs in the Sabah coastline and islands were surveyed from 1996 to date. A few more were conducted under the ASEAN-LCR Project along the coast and in Layang in the 1980s and by consulting firms in the last 3 years.

The coral reefs of Sabah are valuable for various reasons. The reefs are found in two Large Marine Ecosystems – the South China Sea on the west coast and the Sulu-Sulawesi Seas on the east coast. They are the habitat of diverse corals and fishes, some endemic to the localities, and many undocumented marine organisms. Three marine parks (Pulau Tiga, Tunku Abdul Rahman Park, and Turtle Islands Park) and two *de facto* protected areas (Layang Layang and Sipadan) attract numerous tourists every year. The catches of coral reef fishes are high but declined in 1987.

The condition of 49 surveyed reefs were mostly good (Pilcher and Cabanban, in prep.). The analysis was done using a 6-point grading scale of 7 indicators (coral cover, fish diversity and others) with 1, indicating poor condition with poor coral cover and low fish diversity and 6, indicating excellent condition with high coral cover and high fish diversity. The distribution of condition grading was a normal curve, with the majority of the reefs found between the 3.0-5.5. Thus, most of the reefs are in good condition but are under threat due to human activities on the reef and on land. Blast fishing is rampant while sedimentation is high due to logging, agriculture, clearing of mangrove forests and coastal reclamation.

More surveys are planned with Sabah Parks and the community of recreational divers in Sabah. The Semporna Expedition is planned for next month to estimate the coral cover and damage due to destructive fishing. A series of nature talks on the seas of Borneo and training for Reef Check are planned. A “Smart Partnership” with a local firm is under development with the UMS.

Monitoring, a repeated observation of variables, e.g., coral cover, fish diversity, and other attributes of coral reefs, is being conducted by Sabah Parks and Oxford University in the three gazetted marine parks in Sabah. The UNIMAS also monitors the reefs in Layang Layang. In Peninsular Malaysia, the network of marine parks is monitored by the Department of Fisheries, Malaysia.

Dr. Chou Loke Ming from Singapore provided information on the ASEAN–Australia project. Under the ASEAN–Australia Living Coastal Resources (LCR) project (1986-1994) the five participating countries (Indonesia, Malaysia, Philippines, Singapore, Thailand) adopted a common reef survey method to enable regional comparison of data. The 100 m line intercept technique was refined during the project. Non-scientific volunteers could be trained in its use as demonstrated by a Singapore project. The LCR project included mechanisms for data collection and integration. The database has recently been transferred to Reef Base. With the conclusion of the project in 1994, countries continued with reef monitoring but data collected since have not been placed in a central depository.

Dr. Niphone from Thailand gave a presentation on long term monitoring of coral reefs in the Andaman Sea by Phuket Marine Biological Center (PMBC).

Phuket Marine Biological Center conducted a coral reef monitoring programme in the Andaman Sea in order to determine the long term change in coral and reef fish communities since 1981. In principle, the quadrat–photographic method was used for assessment. In the early period, the effect of off-shore tin mining to the reef was studied. At the same time, the outbreak of crown-of-thorns starfish was studied by the manta–tow technique. During 1988-1991, the ASEAN–Australia Co-operative Programme was carried out. Since then, the line intercept method was used to study coral communities. On the same fixed line, fish communities were assessed by the visual census method. Since the ASEAN–Australia Project ended, the Department of Fisheries' long-term monitoring of reefs under the Coral Reef Management Programme has been done. There are approximately 80 permanent study sites on the islands, along the Andaman coast. From the results of manta-tow surveys, the coral reef map book with detailed descriptions of the status of the reefs was published. Similar work was also done in the Gulf of Thailand, where the project was conducted by PMBC to monitor the reefs within national parks. Once, dive-tour divers were trained for reef watch purposes, but the programme was not followed up well enough. Some of the Thai divers who use internet are now trying to set up a group carrying out Reef Check with PMBC.

To introduce coral reef monitoring in Vietnam, Dr. Vo Si Tuan provided the workshop a map indicating areas of coastal reefs and monitoring sites in Vietnam with the following specifications:

- Coral reefs are located from the north to the south of Viet Nam, and twenty six coral reef areas have been recorded.
- Coral reef monitoring was conducted since 1998 at three sites including Nha Trang Bay, north Binh Thuan Province and Con Dao islands. An additional three sites, Ha Long bay, Van Phong Bay & Phu Quoc Islands, are planned for 2000. Methods used in monitoring are Line Intercept Transect (LIT) and Reef Check.
- The results obtained from the surveys in 1993-1995, at seven sites, were used as a comparison.

Detailed results obtained at Con Dao Islands were presented as an example. These data reflected variation of average coverage of corals and abundance of butterfly fish during 1994-1995, April 1998, Oct 1998 and July 1999. Impacts of typhoon Linda (Nov. 1997) and coral bleaching (1998) were recorded. Recovery of corals was influenced by a combination of impacts, and it was very slow. The density of butterfly fish clearly decreased, and its recovery, too, is slow.

A proposed system of coastal and marine protected areas was analysed in selected areas where coral reef monitoring will be implemented in the near future.

He further informed the workshop about the training activities carried out in Viet Nam, including:

- Two training courses on using the Line Intercept Transect method for the Institute of Oceanography at Nha Trang and Hai Phong (1997).
- One training course on using methods of LIT and Reef Check for participants from Viet Nam, Cambodia, China and Myanmar (1999).
- Reef Check training (1998) for trainees from the Con Dao National Park and Fishery Protection Station.

Mr. Vann Monyneath, from Cambodia, gave a presentation entitled “Cambodia Assessment of Existing Projects and Knowledge on Coral Reef Monitoring and Data/Information Exchange”.

In Cambodia, there are several on going projects in coastal areas:

- Environmental Management of the coastal zone (Phase II) funded by the Danish Government (DANIDA) for a period of 2 years (2000-2001). The project focuses on policy, legal and institutional frameworks, environmental management and planning and a pilot project on community resource based management.
- Participatory management of mangrove forest resources funded by IDRC, which mainly focuses on community level research, training, livelihood, institutional analysis and developing a management plan.
- Coastal and Marine Environmental Management in the South China Sea, which developed a strategic plan for coastal and marine environmental management in Cambodia, a marine protected area plan, and some coastal zone databases.

Since 1998, a DANIDA project funded a small case study on destruction by dynamite and coral collection on the coral reefs of Sihanoukville. This case study focused on the socio-economic framework for destructive fishing practices and coral collection, the ecological impacts of destructive fishing and coral collection and management strategies to stop or regulate the destruction of coral reefs.

To supplement the above information, Mr. Matt Wheeler, Wetlands International, informed the meeting on the current status of coral reefs in Cambodian waters by trying to answer the questions of (i) What are the threats? (ii) How are they being monitored?

He said that the recent detailed analysis of the status, health and threats to coral reefs in Cambodia was conducted by the DANIDA funded programme: “Environmental Management of the Coastal Zone of Cambodia, 1997-1999”.

As part of the study two reports were produced: Profile of the Coastal Zone (Volumes I and II) and Coral Reefs of Sihanoukville – Destruction by Dynamite and Coral Collection: A Case Study. The latter was produced with the collaboration of the Sihanoukville Coral Reef Working Group. Very little is known about coral reef systems in Cambodia and so general statements about integrity are not possible. It is known from land use maps based on 1994 aerial surveys that coral reefs exist around much of Koh Rong, Koh Rong Samlem, Koh Sdach, Kos Pos, Koh Ta Kiev, Koh Thmey and Koh Ses. At Koh Tang, a brief survey identified some 70 species in 33 genera and 11 families. Koh Tang is part of an offshore group that is characterised by clearer waters, favouring *Acropora* and *Montipora* species.

Threats to coral

1. Natural – Bleaching, Crown-of-thorns-starfish (COTS).
2. Anthropogenic – Bombing, cyanide and coral collection, trawling, sewage runoff.

Status

The condition of a particular reef is not indicative of the status of Cambodia reefs in general. A quantitative survey of Koh Rong Samlem found that cover was approximately 50% of the site. There was evidence of bleaching. Crown-of-thorns- starfish were recorded at one site with individuals numbering 20 within a 100 square metres area.

There is extensive damage of coral by dynamite in Koh Pou, Koh Tres, Koh Thas, Poi Kompenh, Poi Tamoung and Condor Reef. Coral collection is extensive in neighbouring countries but it is unclear as to how significant it is in Cambodia. Anecdotal evidence suggests that a senior police official took 5 car loads of coral to Phnom Penh. Coral is openly for sale in Sihanoukville despite being regulated.

Indicators of health

A survey of Koh Rong in September 1998 indicated that species abundance and diversity were main indicators of health. Over-fishing resulted in no commercial fish species (grouper, humphead wrasse, baramundi cod) being recorded. There was no sea cucumber and few giant clams. In contrast, there was an abundance (2-3 per sq. metre) of black spiny sea urchins (*Diadema* spp.).

Conclusions

- The coral reefs of Cambodia generally seem to be in poor health.
- Low species diversity, and over-fishing is prevalent.
- Offshore reefs seem to be in better health but are still at risk from coral collection and blast fishing.

Lauretta Burke, World Resources Institute introduced the project Reefs at Risk in Southeast Asia. This regional analysis of threats to coral reefs in Southeast Asia is a follow-on to the global *Reefs at Risk* analysis completed in 1998. Reefs at Risk in Southeast Asia (RRSEA) has four primary goals:

- Through collecting and integrating information, improve the base of information available for examining threats to, status of, value of, and protection of coral reefs within Southeast Asia;
- Evaluate and model the relationships between human activities and reef condition. This will allow for extrapolation about threats to (and likely condition of) the many reefs for which survey information is not available;
- Develop a geographic information system (GIS)-based tool for more local-level evaluation of development scenarios and related implications for coral reef health and associated economic implications;
- Raise awareness through wide dissemination of integrated data sets, model results, a published report, and the GIS planning tool.

Development and dissemination of an integrated, spatially-referenced base of information is the first step toward being able to better identify causes of reef degradation. Regional extent data sets which are assembled and improved under this project include data on coral reef locations, mangrove locations, observations related to coral condition (this includes percent live coral cover, coral bleaching, coral diseases, and observed impacts to coral reefs from pollution, sedimentation, tourism, and destructive fishing), marine protected areas, land cover, elevation and bathymetry, hydrology, population and administrative districts, populated places and infrastructure. The RRSEA project is implemented by WRI, in collaboration with over 20 international, national and more local partner institutions. Although the main product of RRSEA is a standardised indicator of human pressure on coral reefs, the integrated database is an important related product.

“A Brief Introduction to the Coral Reef Monitoring and Preserving in South China Sea” was related by Mr. Han Baoxin.

- From 1996 – 2000, a general investigating project for the Nansha Islands was carried out, including investigation and study of the reef corals and their environment, and the relationship between coral reefs and environmental factors. There were four cruises (Spring, Summer, Autumn, Winter) each year.
- From 1991 – 1995, a general investigative project for the Nansha Islands was organised. As above the survey included investigation and study of the reef corals and their environments. The project was carried out four times each year.
- The same survey was organised from 1986 – 1990.
- From 1973 – 1975, a general marine investigation of the Xisha Islands and Zhongsha Islands was organised.
- From 1980 – 1986, a general marine investigation along the coast of Hainan Island and Guangdong and Guangxi Province, included an ecological investigation of coral reefs.
- From 1990 – 1995, an investigation and study of the biological diversity in shallow water and tidal flats in Hainan, Guangdong and Guangxi Provinces were organised.
- Coral Reef Monitoring in Sanya Natural Protected Area was also carried out.

Dr. Anond Snidvongs informed the workshop how Southeast Asia START Regional Center can help in data exchange and management. SEA START RC is a non-government organisation and part of a global START network initiated by IGBP, IHDP and WCRP. It encourages multi-disciplinary research on the interactions between humans and the environment affecting and being affected by global changes. It is also interested in different aspects of global change and various physical settings including land, ocean, and atmosphere. Rather than generating data from scientific research, SEA START RC gears its program towards regional synthesis and integrated analysis using existing data collected elsewhere. Apart from facilitating analytical research, capacity building and training are its other areas of interests.

Focusing on the question of how SEA START RC can help in providing data for the coral reef monitoring project, it must be clearly noted that SEA START RC may not be able to acquire the *in situ* coral reef data as other programs, for example, Reef Check and Reef World do. However, the Center can provide second-hand data that are archived for water-related projects currently carried out by the Center. The International Co-operative Study on the Gulf of Thailand, initiated by the Intergovernmental Oceanographic Commission (IOC) and Southeast Ocean Programme on Ocean Law Policy and Management (SEAPOL), is an integrated co-operative study of multinational and transboundary issues in the Gulf of Thailand, a shared water body among four bordering countries, Cambodia, Malaysia, Thailand, and Vietnam. Apart from conducting research cruises to collect oceanographic data, the project also archives a considerable number of data sets acquired from various data sources. These data are analysed and outputs are made available to interested users. This is where the Centre can offer help to the coral reef monitoring groups by providing data of oceanographic parameters that are relevant to analysis of reef conditions, for example, currents, temperature, and salinity. However, there are some limitations in using GoT data in a coral monitoring project. The data are on a large geographic scale that can be too coarse for the analysis of small local reef areas.

Southeast Asia Integrated Regional Model of Drainage Basin Input to the Coastal Zone (SEA/BASINS) is a model of drainage basins in Southeast Asia from the Mekong to small coastal and island basins. As far as the relevance to the reef project is concerned, data on characteristics of the land-based activities and inputs are very important as the coastal environment is strongly influenced by such inputs. Data, such as river discharge, sediments, chemical loading, land use and land cover, and socio-economic drivers, may be useful in coral monitoring and data interpretation.

Directory Interchange Format (DIF) is a metadata system for Southeast Asia and is willing to add a coral reef component to its programme and provide such data to reef monitoring users.

Dr. Anond commented during discussion that data users must be clearly identified as well as the project's objectives. It would be a waste of effort if huge amounts of data have been gathered but no real users are identified. While some projects have already integrated data into information, such a large-scale approach and resolution may not be very useful to local users who may need different levels of data.

Ms. Sheila Vergara presented information about Reef Base, a global database of coral reefs and their resources. Some of its primary functions are to serve as a global repository of coral reef related data on ecology, stress, mariculture, harvest, tourism, and socio-economic factors. Information in the database, combined with expert advice, is intended for the informed management of coral reefs.

To support the repository of data for both historical and future monitoring activities, Reef Base has been designed on a reef-by-year structure to provide users with time-related information on coral reefs, and a view of changes or trends in the reefs of interest to them. To cater to diving groups requiring regular feedback on their monitoring efforts, and stakeholders with needs to manage coral reefs, the developers of Reef Base plan to incorporate data contribution and interrogation procedures, and repatriation strategies, by remote entry. Such arrangements for addition of data by certified contributors, and access to summary information by any user, would enhance the content and utility of Reef Base greatly.

To extend the utility of Reef Base to users who have no access to the Internet, but have indicated the need to establish their own coral reef databases, the Reef Base format will be provided to them upon request with encouragement to contribute the data on a regular basis. Future development of Reef Base will be balanced between continued input of data in Access 2000 to ultimately provide a comprehensive data set, and the development, in consultation with an advisory group, of an internet version that is easy to use. Reef Base will also continue to be provided on CD. The resources needed to continue to expand Reef Base, and to modify it so that it can be interrogated easily on the internet, are now being sought.

Mr. Ketut Sarjana Putra presented the framework and outcomes of the activities carried out by Reef Check Indonesia in 1999.

In order to magnify and establish a strong network in coral reef monitoring in Indonesia, the Reef Check programme was started with a Training for Trainers (TOT) programme for 31 participants from all over the country. After training, they were expected to return to their own base and then voluntarily organise Reef Check activities on their own coral reefs. The Reef Check was done in only 8 locations and 33 sites. As the commitment to sharing data and information was established during training, they have an obligation to send all data and information they gather to WWF Indonesia Office in Denpasar, which has to put the data and information into a national report. WWF then disseminates the report to the Reef Checkers (divers and organisers), media and the important decision makers (ministry level).

From this experience, he believed that successful measures for coral reef monitoring could be:

- Standard Methods applied;
- Monitoring network established;
- Data and information disseminated to stakeholders/public;

- Data and information used to support management of coral reefs (policy changes).

Mr. Matt Wheeler started his second presentation by stating the "Mission" of Wetlands International: "To sustain and restore wetlands, their resources and biodiversity for future generations through research, information exchange and conservation activities, world-wide."

Wetlands International, the world's leading non-profit wetland conservation organisation, was created by the integration of the Asian Wetland Bureau, the International Waterfowl and Wetlands Research Bureau, and Wetlands for the Americas. The achievements of the founding organisations date back 40 years, and include the launch of (and support to) the Ramsar Convention, major regional surveys and conservation programmes for wetlands and wetland species, and the development of international programmes for migratory waterbird conservation.

Wetlands International's global network provides rapid access to wetland conservation specialists throughout the world. Together with the staff of the organisation's 18 regional and project offices, it provides a unique force to support wetland conservation activities. Partnership is at the heart of Wetlands International, and strong links exist with other international conservation agencies such as IUCN, WWF and BirdLife International, and the secretariats of the Ramsar and Bonn Conventions. Global and regional programmes are supported by over 120 government agencies, NGOs, foundations, development agencies and private sector groups.

Wetlands International, as a global organisation, is divided into three broad geographical areas - Africa, Europe and the Middle East; The Americas; and Asia Pacific. The three divisions are coordinated by the International Coordinating Unit based in Wageningen, the Netherlands. The Asia Pacific Division has offices in Cambodia, India, Malaysia, Thailand, China and Indonesia with sublicensed offices in Australia and Japan.

Wetlands International has adopted the philosophy of the "wise use" of wetland resources. This is the sustainable use for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem.

Dr. Jamie Oliver from the Australian GBRMPA gave a presentation on maximising the utility and influence of monitoring programmes. He indicated that there are currently more than 20 major monitoring programmes operating within the Great Barrier Reef. These cover a wide variety of subjects, and are conducted by a variety of agencies and individuals. This diversity reflects the fact that no single monitoring program is adequate to address the issue of reef health, conservation and management. Monitoring programs can be divided into 3 categories:

- Site specific monitoring which addresses human impacts at a specific location;
- Issue specific monitoring which examines the implications of a particular type of disturbance (either natural or human induced); and
- Background status monitoring which seeks to monitor changes over time without any specific reference to particular human impacts. While this last type of monitoring is the focus for both GCRMN and Reef Check, it is not necessarily the most efficient for addressing the problems faced by individual countries.

One of the common problems which arises during the life of a monitoring program (or at its conclusion) is that insufficient resources have been allocated to database, analysis, and reporting requirements. This can lead to under-use of valuable data and occasionally to loss of data due to inadequate database archiving.

Reporting of monitoring results should not simply be restricted to the production of a technical report containing summary data. Interpretation of the ecological and management significance of monitoring data is essential in order to capture the true value of a monitoring program. Web access, meta-databases, and knowledge bases should all be considered as

important methods to ensure that monitoring data and conclusions are made available to stakeholders in a variety of easily accessible and understandable formats. In this context we need to borrow concepts from other fields such as education, psychology and e-commerce in order to provide interpretations of monitoring data in a form most likely to influence target users and decision makers.

Dr. Suraphol Sudara from Thailand emphasised the importance of user requirement. Who is the user of database? What kind of information do those users want? These are questions to be answered in designing the type of database service. In general, examples from other areas can be useful as an example to argue with decision makers and some successful results can be used as a pattern to follow. Databases can also be used as general information to show the existing conditions. Most important of all, the database will be very useful for researchers giving wider information and more in-depth data.

The ASEAN–Australia LCR project was a very good example on how to get data essential to the project management process, but the priority is to allow for human development. The expertise was not all the same in each country, ranging from very good to those who had almost no experience at all. Through the project, many young researchers emerged, all involved in the activities. Much co-operation among various groups within and between countries had been going on and that helped in getting more data available to the whole group. Much of the information gathered has now been developed into action plans in almost all participating countries. The difference in expertise between those countries participating and those not participating is very obvious. Mechanisms to help those who need expertise is essential in order to have good regional databases. One very serious problem is that, once the project stops, even though the activities are still going on within each country, the accumulation of the total data also stops due to lack of funds and no specific objective to continue. Therefore, necessary funds should be allocated to keep the monitoring going and to service the regional database.

On behalf of Dr. Laurie J. Raymundo, Dr. Kirkman read her presentation entitled “Reef Check Monitoring in the Central Philippines”. Silliman University Marine Laboratory (SUML) became involved in the global Reef Check monitoring project in 1998, one year after Reef Check began. For the first two years, 1998 and 1999, surveying was limited to the Apo Island Marine Reserve, in Dauin, Negros Oriental, due to time and budget constraints. Permanent transects were set up within the reserve in 1998, and are surveyed annually for target fish and invertebrate species, substrate cover, and signs of stress (such as garbage, bleaching, anchor damage, Crown-of-thorns starfish). Monitoring Apo through Reef Check allowed a formal and detailed survey of the reef during the 1997-98 El Niño bleaching event, and mortality/recovery the following year. These data become part of the global database for reef health, and have been used locally. The fishing community of Apo, responsible for enforcing fishing regulations around the island, make use of the data to monitor the reef community within the reserve. Apo Island is a prime tourist destination, and mounting concern over tourist diving pressure and its impacts on the reef has led to further regulations regarding the number of divers allowed on the reef per day. Reef Check data are the primary source of information regarding the presence and abundance of target species and coral condition, and provide the community with a scheme by which to monitor changes in these important aspects of the health of their reef.

Because of the success of the Apo monitoring, SUML would like to expand Reef Check to several other sites in the immediate area. Negros Oriental is particularly active in coastal resources management, and a total of 26 marine protected areas (MPAs) have now been established along its coast. Although Reef Check relies on volunteer divers who provide their own gear, there are regular costs involved. Documentation of surveys involves video and still photography; film, tapes, postage, computer disks, etc. are needed annually. Many of the technicians and scientific experts at the SUML do not own complete sets of SCUBA gear, but their expertise is necessary in both training and surveying, so specific pieces of gear must be rented or repaired. Boats, or other forms of transportation, must be paid for, and if expansion is to proceed, SCUBA tank rental will probably be necessary.

Summary of the presentations

(i) Monitoring of coral reefs in the East Asian Seas is at very different levels

From the presentations, it is apparent that coral reef monitoring activities are widely carried out in the East Asia Seas region, but in an unbalanced way. Some countries, e.g. Thailand, collect enough data to provide information on current status of coral reefs. While other countries have not started coral reef monitoring. It is also clear that the countries participating in the ASEAN–Australia Living Coastal Resources obtained better expertise and basic facilities to carry out monitoring work and used the same methods and identical data formats.

(ii) Data collection and management need more co-ordination and co-operation

Data collection from the monitoring activities in the region has been actively carried out, but it is mostly at the institutional level, or even personal level. There were only a few cases where national efforts were made to co-ordinate coral reef monitoring and data collection. A similar situation exists in data management.

(iii) Data and information feedback to the data collectors is generally lacking

It was clear from many presentations that the feedback of monitoring data in the form of data products and information is essential to keep the incentive of data collectors, particularly volunteers, to continue monitoring activities. Systematic analysis of data obtained and feedback need tremendous efforts. The first step would be the assessment of user requirements for the monitoring network in the region.

(iv) Geographic coverage of monitoring activities is limited

It was encouraging from the presentations that coral reef monitoring was implemented in most countries of the region, and some monitoring activities continued for several years. However, the monitoring sites and geographic areas covered are limited, led either by scientific interests or by concentration of tourists in the case of volunteer participation.

(v) Training and capacity building for some countries are urgent needs to implement monitoring activities

The needs for training and capacity building in carrying out coral reef monitoring appeared in many presentations, covering different training requirements. Training for trainers, training on relevant monitoring methods and support for necessary equipment are the basic requirements for a regional network.

(vi) Sustainable monitoring activities require support from different levels

It was widely recognised that a coral reef monitoring network needs long-term action to understand the status and changes in coral reefs in the region. To achieve this goal, support from different levels is required, including governments, donors, dive shop operators and volunteers. Self-sustainability must be introduced, by which community-based monitoring is one example.

(vii) Standard data and information products are needed by all levels

Several data products and information generated from original data were shown to the workshop. It will be easy for non-scientific users to understand if appropriate data products, in the form of graphs for instance, are generated and provided, perhaps in a GIS-type format.

(viii) Many coral reef monitoring methods are currently in use, thus making comparisons difficult

The Reef Check method is applied in some countries for observations carried out by volunteers, but there are several other methods used by countries in coral reef monitoring to meet national requirements. There is still no indication on how these methods can be compared. This should be one of the first activities planned for a regional network on coral reef monitoring and data exchange.

Agenda item 5: Enhancement of a Co-ordinated Regional Network on Coral Reef Monitoring

General discussion on Agenda Items 5.1 through 5.5 was conducted in plenary sessions focused on the objectives (Agenda Item 2.b) and listed in the Annotated Agenda prepared by EAS/RCU. Following general discussion and summaries made by rapporteurs of each group, the workshop continued relevant discussion in five working groups. The results of the discussion were reported back to the plenary session and summarised as *needs*, *solutions* and *actions*.

5.1 What is required for successful, long-term coral reef monitoring?

The workshop discussed this topic and listed the following requirements for a monitoring network. The group also provided relevant solutions and actions to meet the requirements.

Requirement 1: National coral reef monitoring and management plan

Solutions

- *Long-term solution*

It was recognised that a national monitoring plan in every country is a long-term goal that is not immediately achievable, therefore, in the meantime, there is a need to start with a pilot monitoring programme and related activities as quickly as possible.

- *Short-term*

To develop a pilot monitoring programme in the region with available resources.

Actions

It was recommended that

- UNEP increases its commitment to the renewed Call for Action by ICRI for all countries in the region. GCRMN and ICRI to work to support the goal of establishing a national monitoring and management plan;
- UNEP to seek multi-million dollar funding from GEF and other funding agencies to support the development of national coral reef monitoring and management programmes;
- UNEP to provide available financial support to immediately implement the existing monitoring programs using the Reef Check method.

Requirement 2: Standard Methods

Solutions

Adopt Reef Check as the starting method for use at the regional level. In the meantime, the methods used in the existing national monitoring programmes should continue taking into account the different national requirements.

Actions

- Given the limited resources available, and the large task of national monitoring, the workshop recommended Reef Check to be the primary collaborative and community-based monitoring method for the region.
- Review Reef Check and other standard methods and adapt as needed for each country.
- Produce training material in the appropriate languages and format for each country (published manuals, video training and others).

Requirement 3: Monitoring design to meet the needs of management

Solutions

Design guidelines for coral reef monitoring plans for each country as resources become available.

Actions

Hold workshops to design guidelines for monitoring programmes at a national level.

Requirement 4: Funding

Long-term self-financing, external financing schemes and a suite of mechanisms to ensure a stable supply of sufficient funding to meet the changing needs of the monitoring programme are necessary. This is analogous to a business- plan for the programme.

Solutions

Design self-financing and external and internal schemes.

Actions

- UNEP to seek external funding to catalyse local government financing.
- Find a co-ordinating mechanism to ensure that the external funding reaches the appropriate teams.
- Training on self-financing schemes such as Reef World, smart partnerships between business, adopt-a-reef, dive industry and resorts should be given to relevant fund-seeking agencies.

Requirement 5: Formal government approval, support, and co-ordinating mechanism for two-way flow of information.

Solutions

Seek approval and linkage between government, external donors, research institutions, business and NGOs. Establish a suitable co-ordinating mechanism that includes both government and NGOs.

Actions

- Governments to establish positions for community-based monitoring managers.
- Choose a counter-part NGO (university, environmental group, etc) staff person where appropriate.
- Seek formal documents that approve the monitoring plan.
- Incorporate monitoring plans into the existing Biodiversity Action Plan and other relevant coastal management plans.
- Make it clear to governments why they should support monitoring and management.

Requirement 6: Community support

Solutions

Raise public awareness.

Actions

- Prepare pilot PR programmes.
- Develop necessary training material in the form of video, radio, TV, posters etc.
- Show the community what the benefits will be of community involvement in monitoring and management.

Requirement 7: Trained people

Solutions

Provide adequate equipment for training purposes and data collection.

Actions

- Help participating countries to obtain diving equipment;
- Prepare survey material;
- Help in obtaining laptop computers;
- Link monitoring activities with Global Position System (GPS).

The workshop discussed why regional co-ordination is needed and reached the following conclusions:

- Linkages among sites-biological and physical
- Trans-boundary impacts/threats
- Learning from others
- Stronger political force/voice
- Global impacts
- Donors more interested
- More effective management response for pollution and genetic problems
- Regional network can help build capacity
- Comparison of Marine Protected Areas
- Regional help from PR - more powerful statements

5.2 Co-ordination mechanism for a regional coral reef monitoring

Requirement 1: Identification of

- all groups capable of contributing to coral reef monitoring;
- how to obtain contributions at the local and national levels;
- the resources needed by the various groups to make contributions;
- international conventions which require contribution of data on coral reefs.

Solution

Commission consultant to identify all potential contributors and conventions.

Actions

Hold meetings/workshops of all interested parties to:

- outline the benefits of contributing to the monitoring network;
- explain how to interact with Reef Base;
- identify the needs of the various contributing groups;
- decide how best to support local groups and countries to contribute.

Requirement 2: Maintain a relevant, adaptable database for contributions that provide information at the local, national and regional levels. Maintain the motivation of contributors

Solution

Modify Reef Base to:

- make it more interactive;
- have a consultative committee to ensure that the database provides popular and useful forms of feedback.

Actions

- Establish a consultative committee to meet and advise Reef Base on new design;
- Allocate funding to appoint a programme for Reef Base to make it more interactive.

Requirement 3: Maintain the motivation of contributors

Solution

In addition to making Reef Base interactive, provide incentives for contributors, including evaluation and perception of existing incentive schemes.

Actions

Choose and implement an appropriate incentive scheme, including an annual award ceremony.

Requirement 4: Sustainable co-ordination mechanism

Solution

Ways to obtain sustainability include:

- Establish a formal monitoring network with dedicated staff to ensure continuity of operations.
- Identify groups with vested interests in coral reefs that are capable of supporting the operation of the network in the long term, e.g. airlines, hotel chains, diving industry manufacturers, etc.

Actions

- Evaluate whether the GCRMN node for East Asian Seas is an appropriate network or whether another network is needed.
- Appoint a person dedicated to operate the network and ask an appropriate organisation to house the staff in the long-term.
- Promote the network.
- Seek sponsorship for functions of the network.

5.3 Technical considerations of the monitoring network

The discussion on the technical considerations were focused on six elements, i.e. Reef Base, Reef Check, national databases, meta-database, knowledge base and GCRMN.

For Reef Base

Requirement

There is a need for an easily accessible regional repository for summary information and monitoring results for reefs in the East Asian Seas region.

Solution

- Support Reef Base as the primary information base summarising reef information at the global and regional level;
- In particular Reef Base should be the primary information base for GCRMN and Reef Check (but should not be limited to these);
- Seek user input and feedback in developing next versions of Reef Base.

Actions

- A consultative committee of Reef Base contributors and users should be formed;
- A questionnaire for Reef Base users should be designed to determine what information and facilities users want from Reef Base;
- A discussion paper and questionnaire should be circulated to key users prior to the Bali Conference (October 2000);
- First meeting of consultative group should be held in Bali and should consider results of questionnaire and make recommendations for future Reef Base versions; and
- Reef Base should be the primary repository for all Reef Check data.

For Reef Check

Requirement

There is a need for immediate feedback on the results and significance of Reef Check data collected by volunteers.

Solutions

- Create a data input, analysis and reporting module for Reef Check using input from a Reef Check users' needs analysis to be conducted using a range of Reef Check users (4-6 months full time programmer);and
- Where available, encourage expert-based feedback to Reef Check contributors.

Actions

- Decide whether Reef Check data input and analysis should be included as a component of Reef Base;
- Module should interface with a temporary database with final user data input into Reef Base only after quality checking;
- Format of user feedback report could be in the form of graphs showing trends over time, and comparison of users site with other sites, regional mean and standard for a "healthy" reef;
- Report could be generated by web interface, stand alone PC program with copies sent by email to all participants;
- Report could include an "experts report" using conditionally merged standard sentences based on results for key variables; and
- Future reports could be generated from a "reef assessment and diagnosis" expert (rule based) system.

For National Databases

Requirement

There is a need for each country in the region to establish a database which suits its own needs, but which can be used to make effective and meaningful comparisons at a regional and global level.

Solutions

Encourage and assist countries to adopt standard data structures or to be able to convert their existing structure into a standard format as needed.

Actions

- Establish a co-ordinating body to set voluntary standards;
- Encourage countries to validate and adopt these standards by demonstrating their advantages;
- Reef Check should be used as a training stage for the development of national monitoring programs and databases; and
- Reef Base can assist by providing a training and generic data template.

For Meta-database

Requirement

There is a need for access to information on what data exists on coral reefs and where it can be accessed.

Solution

A regional meta-database (in co-operation with START – RC).

Actions

- Ask START – RC to include coral reef information in its meta-database;
- Link into Reef Base and other databases.

For Knowledge base

Requirement

High level data summaries and interpretations of reef monitoring and assessment data which are easily accessible and key-word searchable.

Solution

Create an indexed “knowledge base” containing text and graphical summaries, initially based on existing summaries in the grey literature.

Action

- Use existing consultative groups to develop this concept further and create a prioritised list of information sources;
- Create as an additional feature for Reef Base (will require additional funding); and
- Create the knowledge base to include keyword search of all abstracts of relevant grey literature (including ICRS abstracts) and agency reports/recommendations.

For GCRMN – detailed national monitoring programs

Requirement

Current results of GCRMN detailed monitoring programs and status assessment efforts to be available and searchable within Reef Base.

Solutions

Need to incorporate summary information into Reef Base and to capture the data and information coalesced through the biannual assessment efforts.

Actions

- Include key parts of biennial status reports co-ordinated by Clive Wilkinson (1st stage – quite easy);
- Capture information that is assembled by authors of country status reports (2nd stage – not so difficult, but would require some data entry. Authors of country status reports often assemble supporting data tables. These could be easily captured within a database as part of this process);
- Establish a series of standard indicators, graphs and tables which all participating countries submit to Reef Base (3rd stage).

5.4 Pilot site for coral reef monitoring

Ms. Anne Miller, Reef-World, presented her work on reef monitoring and awareness building focussing on dive operators, students and community involvement. Her important message was to provide ways to catch and maintain the interest of participants. She produced handy Reef-World Kits for those involved in her project. These could be sold to raise funds at a local level. Certain funding support had also been given for Reef Check activities that involved more time and effort. Her system proved to work very well, particularly on the design for a market-orientated approach to data collection by volunteers.

Ms. Pakdee Khruthanang, owner and operator of West Coast Dive, was invited to answer questions on her experience in participation of coral reef monitoring and protection. She strongly supported the activities discussed by the workshop, and indicated that a sustainable approach needed more incentive and motivation, though she was willing to continue her efforts indefinitely.

It was discussed and agreed by the workshop that a pilot programme of monitoring should be process-specific and not location-specific.

Requirement 1

Criteria for measurement of success:

- Time period 3 years;
- Outputs: (annual update from national meeting).

Solution

Creation of checklist for participating countries to use and feedback.

Action

- Participating countries to implement nationally relevant steps and report back regularly; and
- UNEP to provide funding for focal co-ordination groups to co-ordinate a pilot programme.

Requirement 2

Motivation of volunteer monitoring groups.

Solutions and actions

- Focal co-ordination;

- Long-term context of participation;
- Recognition award to participants, e.g. status linking with particular research institute, overall program.
- Feedback, e.g. particular reef, graph, use of kit to disseminate info.

Requirement 3

- Structure and system of monitoring operation (dependent on group);
- Dive Operator, Academic, MPA, Community-based management, NGO.

Solutions (Dive Operator Group) and actions

There are two types of activity, for instance:

- In-house with individual dive operators: basic data collection level, e.g. reporting on such things as bleaching, large impacts, CoT numbers, Reef Check methods applied over 20M, use of Secchi disc for vertical visibility, temperature (surface and at depth), report on trash (need training to collect.), maps.
- Public calendar of monitoring events: schedule of scientifically-led monitoring events, perhaps one annual meeting where school groups, universities and other country members are invited. Develop links between university groups and school-children outings.

It was recognised that useful demonstrations have been develop in the region, i.e.

- Singapore Project: as an early warning, continued over 18 months, and participated in by 150 volunteers collecting information on a weekly basis.
- Indonesia “Friends of the Reef” programme.
- Dive operator adopting a reef.
- managing co-ordination through national dive association groups. If something like kits are to be distributed to dive operators, use of dive associations to co-ordinate that activity.

Solutions (Snorkelling Group)

Ways to involve tour boats, etc.

Solutions (Other Community Groups)

In the case of a few dive operators, require a system to work with other collaborating stakeholder groups, such as MPA officers, fishing community, e.g.

- Viet Nam: Fishing community reporting to NGOs on fish catches;
- Philippines: community-based management. Monitoring fish catch within MPA and outside. Showing increased fish catch in MPA.

Requirement 4

Link monitoring programme activities with government offices.

Solutions

There is a need to link monitoring programmes with government offices, e.g. in Thailand to work together with Department of Fisheries, Royal Department of Forestry (Marine National Parks), Tourism Authority of Thailand.

Requirement 5

Link monitoring programme activities with UNEP EAS/RCU and focal co-ordinating groups in other countries.

Solutions

Close co-ordination between UNEP EAS/RCU and other existing projects, e.g. Reef Check to ensure effective operation of the network.

Requirement 6

Training needs of various volunteer groups.

Solutions

To link training activities with other programmes, e.g.

- Thailand: TAT linked training for marine tourism guides, MPA park rangers;
- Viet Nam: scuba training, marine conservation awareness, monitoring methods.

Requirement 7

Information about individuals and groups that are able to participate in monitoring.

Solution

Creation of lists of network participants, including dive operators, universities, individuals, etc.

5.5 Needs for training and capacity building in the region for coral reef monitoring

The workshop discussed the training needs for the regional network on coral reef monitoring and concluded the following points.

Who needs the training?

Trainers, provincial staff, middle management i.e. people in other sectors not necessarily those directly involved with marine parks/protected areas.

Why?

Integrated coastal management requires that all stakeholders understand the implications of impacting coral reefs.

Degree of capacity in the region

- Capacity in Thailand is much higher than in, for example, Cambodia or Viet Nam – thus level is not uniform and so capacity needs to be raised in these areas.
- Need for training materials to be translated into the local language making them more accessible.
- Need for intensive coral reef training in taxonomy, ecology, biology, for example.

Training and awareness

- Need to produce materials to get the message across that surveying is going on.
- Materials produced in as many local languages as possible. For example, in Cambodia need to provide this to local fishers, park rangers, military etc.
- Produce radio/TV shows to raise attention.
- Involve tourism departments in decision making and in the promotion of Reef Check.

Organic Enrichment

- Take advantage of the fact that there may be staff available from other development programmes operating in your area.
- Use these people, train them or empower with knowledge of Reef Check and then send them back to their programmes, e.g. Danida and IDRC in Cambodia.

Sustainability of Training

- Need to secure, in a financial sense, training activities;
- Need to train in how to go about securing long term funding;
- Perhaps Reef Check should consider taking on a business attitude to its fundraising activities;
- At a certain stage, there may be a need to establish a trust fund for the network.

Training and Extension

If possible, UNEP could buy the Reef World training kits and distribute these to country focal points. Each pack would be translated into the local language.

Incentives

The following action will increase the incentives for the monitoring network

- Training – Certification, even in an informal sense;
- Publicity, raising profile;
- Training at the actual location.

On the job training

It was realised that learning by doing rather than in the classroom is much more beneficial. The trainer, working with volunteers, could do on-the-job training.

Regulation of activities

Reef Check is at present an unregulated (Self Regulated) organisation. There is a need for an external body to validate trainers in diving safety, surveying and ecology.

Focal Points

For future training courses, there is a need to strengthen required qualifications of trainees by focal points before they are selected. There should be an ability and willingness to reject inappropriate nominees.

Summary of Agenda 5

There were extensive and constructive discussions during the workshop on how to enhance the regional network on coral reef monitoring. There was also much overlap in the reports of the working groups on the various items for Agenda 5. The needs, solutions and necessary actions are clearly identified in the five sub-items.

(i) Regional network is needed

It was agreed that a regional network is needed for coral reef monitoring activities for more effective management responses to pollution and genetic problems, better assistance in building capacity in the region, stronger political voice in protection of coral reefs, clear analysis of trans-boundary impacts/threats, and a larger contribution to the study of global impacts.

(ii) Training is of high priority

Due to unbalanced expertise in the different countries and new requirements for monitoring activities, training and capacity building are the priorities of the network to ensure wider participation of countries and wider coverage of monitoring sites. The formats of training should be carefully reviewed, and include preferably on-the-job training, training for trainers, and in-country training.

Public awareness is essential and important for a sustainable network.

(iii) Sustainable operation of monitoring is essential with the support and participation of communities and effective co-operation with government agencies.

In some countries community based monitoring is effective and sustainable but in others it is not. Close linkages with efforts carried out by government institutions will provide more useful results and create stronger motivation.

(iv) Technical considerations should be put in place to ensure effective management of the network

Technical considerations were given to the meeting based on the existing programmes and projects. Detailed recommendations provide for future development and co-ordination among the network of monitoring agencies, e.g. Reef Base, Reef Check, GCRMN, etc. A standard method is preferable, and the Reef Check method should be used as a starting method for the network.

(v) Data exchange, in particular the data feedback in appropriate and easy-understandable forms will secure motivation and incentive

It was repeatedly stated by the participants of the workshop that data exchange and feedback will secure motivation and incentive of volunteers. The suggested formats include analysed data in graph format, GIS-type products and a knowledge base. The message from the users was quite clear, the timeframe for feedback was the sooner the better.

(vi) Financial support

Appropriate level of financial support is needed even if the network is based, to some extent, on volunteers. UNEP is requested to approach the funding agencies to allocate more funds to the network, including attempts on a multi-million dollar proposal with GEF.

Agenda item 6: Summary of the meeting

The workshop agreed that the draft report of the workshop should be produced by EAS/RCU and circulated by email to all participants for comments and modifications within the week following the workshop.

Agenda item 7: Closing of the meeting

Dr. Kirkman thanked Prof. Chou, the chairman, for his excellent work in guiding the discussion of the workshop. He also thanked the rapporteurs of each working group for their full support and contribution to the success of the workshop. Dr. Kirkman expressed appreciation to the excellent organisation of the workshop by Ms. Chanruvan Kalyangkura who attended and her team in Bangkok.

The workshop closed at 16:20, on 11 May 2000.

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AGENDA

1. Opening of the meeting
2. Organisation of the meeting
 - (a) Designation of officers
 - (b) Organisation of work
3. Adoption of the agenda
4. Assessment of Existing Projects and Knowledge on Coral Reef Monitoring and Data/information Exchange
5. Enhancement of a Co-ordinated Regional Network on Coral Reef Monitoring
 - 5.1 What is required for successful, long-term coral reef monitoring?
 - 5.2 Co-ordination mechanism for a regional coral reef monitoring
 - 5.3 Technical consideration of the monitoring network
 - 5.4 Pilot site for coral reef monitoring
 - 5.5 Needs for training and capacity building in the region for coral reef monitoring
6. Summary of the meeting
7. Closing of the meeting