



**East Asian Seas
Regional Coordinating Unit**



United Nations Environment Programme

Monitoring Coral Reefs for Better Management Schemes

**UNEP EAS/RCU
Small Grants Fund Programme
2002-2003**





First published in Thailand in 2004 by the United Nations Environment Programme.

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Cover Photo: Nguyen Van Long

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For citation purposes, this document may be cited as:

UNEP. 2004. Monitoring Coral Reefs for Better Management Schemes: UNEP EAS/RCU Small Grants Fund Programme 2002-2003 (268 pages).



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BACKGROUND

Coral reefs contain naturally high productivity and aesthetic values, and are frequently the highlight of marine protected areas. Coral reefs are comparable to tropical rain forests under the sea. Although they are less accessible to monitor and evaluate, as compared to mangroves or sea grasses, they are just as important to protect.

In order to wisely manage coral reefs, one must have information to know the location, distribution, and health of corals. It is important to keep track of these changes in order to determine whether present use and management plans are sustainable, and where or how these plans can be improved. Monitoring coral reefs on a regular basis will result in updated databases. However, the information should not be collected for simply data collection purposes, but should be used to influence management policies. Thus, monitoring for management is an essential activity to ensure sustainable use and protection of coral reefs.

To address the regional need of protecting and managing coral reefs, the Co-ordinating Body of the Seas of East Asia, through the United Nations Environment Programme, East Asian Seas Regional Coordinating Unit implemented two coral reef projects from 2002 to 2003. One project addressed data acquisition and monitoring, while the other project (International Coral Reef Action Network) focused on improving management of coral reefs. A collaborative activity between the two projects was to establish a Small Grants Fund to invite proposals addressing monitoring, management, and protection of coral reefs.

Proposals had to address any issue concerning strategy, monitoring, training, and tools for improved management of coral resources. The short-term projects began in June 2002, and ended in May 2003. The Call for Proposals (Annex 1) was advertised throughout the East Asian Seas region. A small group of three external reviewers that are experts in coral reefs evaluated the proposals, and recommended seven proposals for funding. Five of the seven projects were implemented, as the remaining two were not carried out due to changes in personnel to oversee the projects.

The projects have resulted in increased public awareness, improved capacity to monitor coral reefs, and formulation of management strategies and recommendations for new policies to protect coral reefs.

The reports of the five projects are published in this volume, with one report including a Bhasa Indonesia version:

1. "Danjungan Island Marine Reserve and Sanctuaries (DIMRS) Reef Monitoring Program" by Philippine Reef and Rainforest Conservation Foundation, Inc.
2. "Coral Reef Monitoring for Sustainable Uses of Resources Around the Islands Groups in the Coastal Waters of Southwest Viet Nam" by Institute of Oceanography, Nha Trang, Viet Nam
3. "Coral Reef Monitoring and Coral Campaign by REEFCHECK Program In Karimunjawa Marine National Park" by ReefCheck Indonesia and Diponegoro University
4. "Coral Reef Survey & Monitoring for Management in Central Sulawesi, Indonesia" by Yayasan Adi Citra Lestari (English and Indonesian version)
5. "Status Monitoring and Management Strategy Research of Luhuitou Fringing Reef of the Sanya Reserve" by South China Sea Institute of Oceanology

**Danjungan Island Marine Reserve and Sanctuaries (DIMRS)
Reef Monitoring Program**

Implementing Institution: Philippine Reef and Rainforest Conservation
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Negros Occidental 6100
Philippines
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1. BACKGROUND

Marine Protected Areas (MPA's) are a well-established tool to conserve biodiversity and manage fisheries and coastal resources (AAAS, 2001). In the Philippines, MPA's are often established as part of the community based coastal resource management initiatives, which the Philippines is in a leading position in South East Asia (Gomez et al., 1994; Uychiaoco et al., 2000).

The Danjungan Island Marine Reserve and Sanctuaries (DIMRS) were created through the Municipal Ordinance 99-52 and were formally established in April 2000. The DIMRS is part of Philippine Reef and Rainforest Conservation Foundation's (PRRCFI) Poverty Alleviation and Conservation Education (PACE) project, a community-based coral reef management initiative facilitated in three Coastal Barangays (villages) in the southern Municipality of Cauayan, in coordination with the provincial Southern Negros Coastal Development Program. The project aims to empower the communities to manage their coastal resources through community organization and education. Conservation education facilitates an awareness and stewardship towards the resources, capacity building provides communities with necessary skills and alternative livelihood schemes both remove fishing pressure and create economical incentives for resource conservation, e.g. nature tourism (Rivera and Newkirk, 1997; Alcala 1998). In 2002, the DIMRS was voted as "Best Managed Reef" in the Philippines by the PhilReefs, Department of Agriculture and the Philippine Council for Aquatic and Marine Research and Development of the Department of Science and Technology.

The foundation employs staff for community organizing, education, and for research and scientific projects. The principal investigator devotes 30% of his time to scientific work. Monitoring projects have been ongoing ever since the reserve and sanctuaries were established in 2000. This was aided by funding from the PACE project and a Small Rufford Grant won by the collaborating scientist on this proposal; this funding has now been spent. The monitoring included fish and benthic surveys, training of local fishermen in those techniques, a bleaching recovery study, sedimentation traps, crown-of-thorns sea star population and a test fishing study.

Table 1. Danjungan Island background information

Marine Protected Area Name:	Danjungan Island Marine Reserve and Sanctuaries
Barangay, Municipality, Province:	Brgy. Bulata, Cauayan, Negros Occidental
Area:	102.4 ha (3 sanctuaries no take zones) and approximately 100 ha (reserve around the island)
Local Fishfolk Organizations:	Handum MPC, PiPa MPC, Payaopayao MPC, Bulata MPC
Established:	Mun. Ord. 99-52 Passed by Municipal Council, Dec. 1999 Mun. Ord. 99-52 Approved by Provincial board, Feb. 2000
Boundaries Marked/Signs Posted:	April 2000
Enforcement:	April 2000
Management by:	Danjungan Island Marine Reserve and Sanctuaries Management Board and field personnel
Enforcement by:	DIMRS Wardens, Bantay Dagat Volunteers and PRRCFI Island Warden
Award/Recognition:	Best Managed Reef for 2002 by PhilPeefs, DA and DENR

2. PROJECT OBJECTIVES

The DIMRS Reef Monitoring Program was conducted in order to provide the following:

- Information on the fish stocks and benthic life (corals and invertebrates) in the reserve to improve existing management options.
- Data from fish catch and landing monitoring will be used to assess indirectly the impacts of the marine reserve upon the local fishing community.
- Increased local manpower and knowledge by training the local fisher folk to conduct surveys for both underwater surveys and fish catch and landing monitoring.
- Additional training of the Local Government Unit personnel and fisheries students in baseline survey and reef monitoring.
- Packaged information on reef resources and fisheries for the community to use in planning their reserve and sanctuaries.

3. OUTPUT SUMMARY

- A total of 17 persons were trained for reef monitoring and underwater survey techniques. Eight were from the Local Government Units (LGU's) of Sipalay City (4), Hinoba-an (2), Cauayan (1) and Sagay City (1). While 9 participants were from the local coastal communities of Bulata (5), and Elihan (1), Cauayan, Negros Occidental.
- Quarterly reef monitoring surveys were conducted within the Danjugan Island Marine Reserve and Sanctuaries and neighbouring reefs at 6 m and 12 m depths last August and November 2002 and February and May 2003. A total of 44 survey dives with 220 transects were carried out during the duration of the project.
- Eighteen (18) participants from the LGU, students and community and youth volunteers were also trained for data entry, management and analysis for the reef monitoring (12 persons) and fish catch monitoring surveys (6 persons).
- There were a total of 93 Fish Catch Monitoring respondents coming from 3 coastal barangays, Elihan (28), Inayauan (18), and Bulata (47), Cauayan, Negros Occidental. These coastal barangays are located adjacent to the DIMRS.
- A DIMRS Reef Monitoring manual was developed and used by the participants during their training and surveys.
- Seven (7) Fish Catch Monitoring billboards were constructed and installed in strategic locations within the 3 coastal barangays of Bulata, Elihan and Inayauan, Cauayan, Negros Occidental.

4. REEF MONITORING SURVEY TRAINING

Two separate Reef Monitoring Training Seminars for fish and benthic survey methods were conducted on August 16, 2002 and February 12, 2003 on Danjugan Island, Cauayan. A total of 17 participants were trained, 8 participants were government personnel from the Local Government Units (LGU's) of Sipalay City (4), Hinoba-an (2) and Sagay City (1) and a police officer from Cauayan, while 9 participants were from the local coastal communities of Bulata (5) and Elihan (1), student from Iloilo State College of Fisheries, PRRCFI staff and dive instructor volunteer.

During the training seminar, topics discussed included the following: fish visual census (fish identification, size estimation, survey methodology), benthic survey methods (corals identification and life forms, characterization of substrates), and macro invertebrates (identification of key species). A total of ten dives were done during the training, the initial two dives were done to practice basic skills and check competency levels of the trainees. On the following days the various skills learned in the classroom were practiced in the water both with snorkelling for benthic identification and SCUBA for practice with the transect line. At the completion of the training, each student was given a written

test on the various aspects covered during the training. It should be noted that the divers trained from Hinoba-an, Sipalay, and Sagay were used by their respective LGU in association with PRRCFI to survey current and proposed reserve and sanctuaries in Hinoba-an, Sipalay, and Sagay.

Table 2. Participants of training workshop

PRRCFI Staff	
Terence Paul Dacles	Science Coordinator, facilitator
Kevin Pacifico	Research Assistant, facilitator
Vincent Lumbab	Research Assistant, facilitator
Eric Wilkins	U.S. Peace Corps, facilitator
Participants	Affiliation
Ricardo U. Aguitayon	Sipalay City (LGU)
Severo L. Hablado	Sipalay City (LGU)
Ligan T. Jofre	Sipalay City (LGU)
Reynaldo Bendanillo	Sipalay City (LGU)
Bobbie Togle	Sagay Marine Reserve (LGU)
Jefre Encoy	Hinoba
Ley John Gestoso	Hinoba
Roberto Alfajora	Brgy. Bulata Community Volunteer/Bantay Dagat/DIMRS Warden
Noel Castillo	Brgy. Bulata Community Volunteer/Bantay Dagat/DIMRS Warden
Rudy Flores	PRRCFI Local Staff
Leah May Lontes	Student Iloilo State College of Fisheries
Celso Cañete	Brgy. Bulata Community Volunteer
Cywell Antonio	Brgy. Bulata Community Volunteer
Duane Lontes	Brgy. Bulata Community Volunteer
Andy Opong	Brgy. Elihan/Bantay Dagat Volunteer
PO2 Peter Joseph Palma	Community Police Bulata 4 th PMG
Charlie Unchuan	PADI Dive Instructor

5. DATA MANAGEMENT/ANALYSIS TRAINING

As part of the process for understanding the necessity of a monitoring project, two trainings were conducted with employees of LGUs, students and members of the local survey team. The two dates of the training were May 5 and May 10, 2003. This enabled the participants to work with data in which most had assisted in collecting. Participants were instructed in the basic use of Microsoft Excel for the use of data entry. Following was instruction in the generation of relevant graphs and charts, and practice interpreting what the graphs and charts represent. In addition six volunteers were trained in data collation, entry, and management for fish catch monitoring in the three barangays of Bulata, Elihan, and Inayauan.

Table 3. Participants of data management for monitoring survey

Participant	Association
Bobbie Togle	Sagay Marine Reserve (LGU)
Adrian O. Andale	Hinoba-an Community Volunteer
Noel Castillo	Brgy. Bulata Community Volunteer/Bantay Dagat/DIMRS Warden
Roberto Alfajora	Brgy. Bulata Community Volunteer/Bantay Dagat/DIMRS Warden
Rudy Flores	PRRCFI Local Staff
Leah May Lontes	Student Iloilo State College of Fisheries
Duane Lontes	Brgy. Bulata Community Volunteer
Celso Cañete	Brgy. Bulata Community Volunteer
Andy Opong	Brgy. Elihan Kagawad
Elpie Galgo	Brgy. Elihan Community Volunteer
Ronald Tanjusay	Brgy. Inayauan Community Volunteer
PO2 Peter Joseph Palma	Community Police Unit Bulata 4 th PMG

Table 4. Participants of data management for fish catch monitoring

Participant	Association
Pinky Gumban	Brgy. Bulata Volunteer
Rodgina Blando	Brgy. Bulata Volunteer
Elizabeth Amante	Brgy. Bulata Volunteer
Elaine Gacho	Brgy. Inayauan Volunteer
Andy Opong	Brgy. Elihan Kagawad
Michael B. Gamilong	Brgy. Elihan Volunteer

6. CORAL REEF MONITORING MANUAL

As the ultimate goal for the Danjugan Island Marine Reserve and Sanctuaries is for its function without or with minimal assistance from PRRCFI, it is important that the necessary materials are present for the DIMRS to continue monitoring the reserve in the future. For this reason, the “Danjugan Island Marine Reserve & Sanctuaries Coral Reef Monitoring Manual” was put together. This manual was used for all of the projects last year. Originally, it was used in individual parts per component, but has since been put together in entirety. The topics dealt within the manual include:

- Basic biology of a coral reef,
- Benthic monitoring (including an introduction into what monitoring includes and a review of survey methods), and
- Fish monitoring (including fish visual census and fish catch monitoring).

7. DIMRS FISH VISUAL CENSUS AND BENTHIC SURVEY

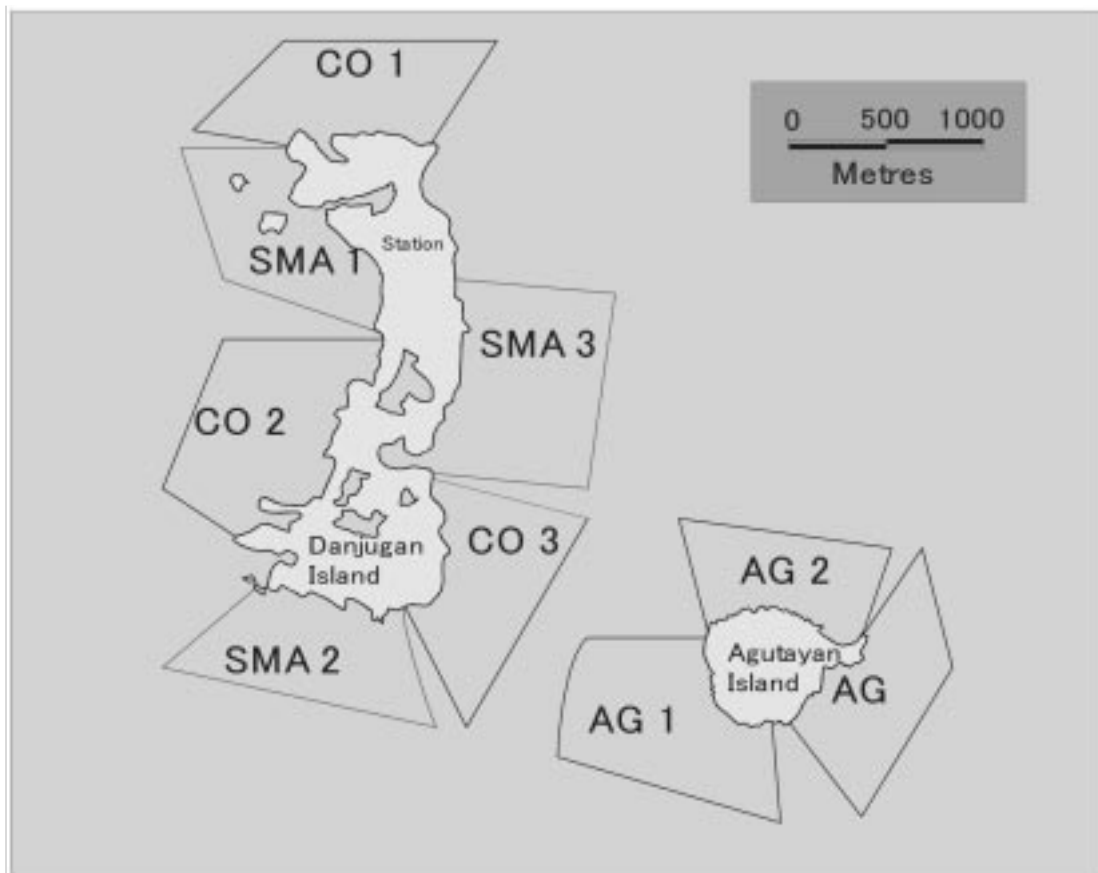
7.1 Methodology

The survey team was divided into two teams of four, and each team was assigned with a science staff/facilitator of PRRCFI. Each team was composed of two divers, the Fish Observer (F) and Fish Trainee (FT) who did the listing and estimation of the fish size. The two other divers, the Benthic Observer (B) and the Benthic Trainee (BT) did the listing on benthic cover. The last diver of the team did the listing on the macro-invertebrates (inverts) found along the transect line in the 5 metre belt.

Five transects lines were laid at each site at the depth of 6m, during August 2002 and February 2003, and 12 m during November 2002 and May 2003. This was done to collect information from differing communities at the two depths during both the wet and dry monsoon seasons.

The sites included were the 3 Special Management Areas (SMA) or the Sanctuaries, and 3 Control Areas (CO) in the Reserve. In addition, three sites at Agutayan Island (AG) were also monitored. Agutayan Island is considered as a control site separate from Danjugan. Two additional sites were surveyed off the mainland of Barangay Elihan. These were inside and outside the proposed Marine Protected Area. A total of 220 transects were observed and monitored in all 11 sites during the course of the survey.

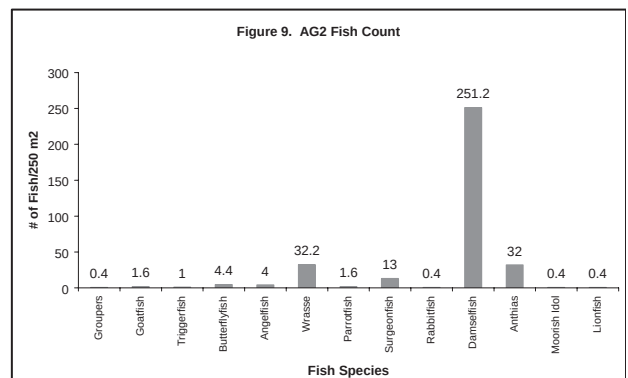
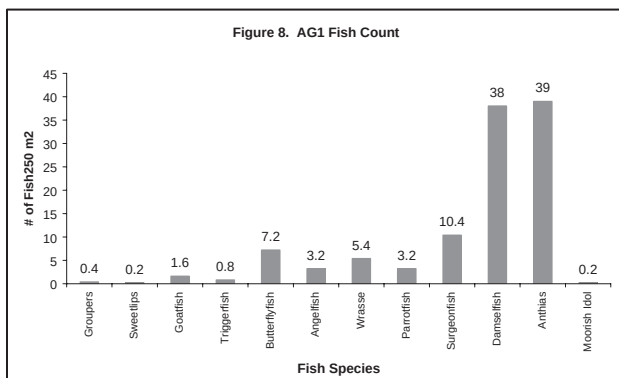
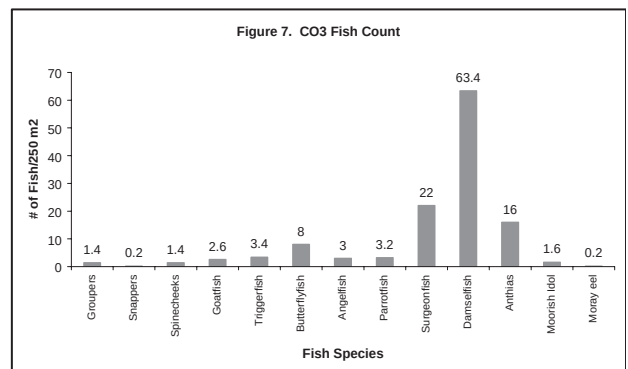
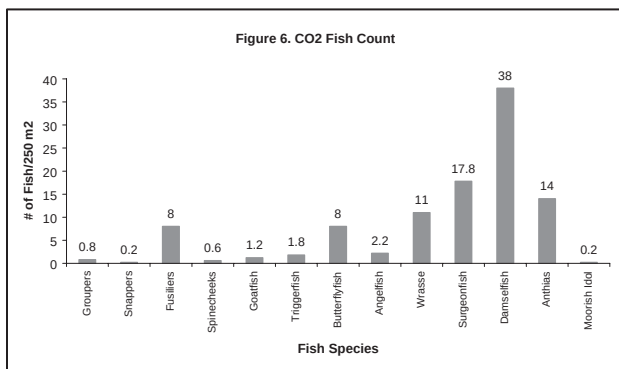
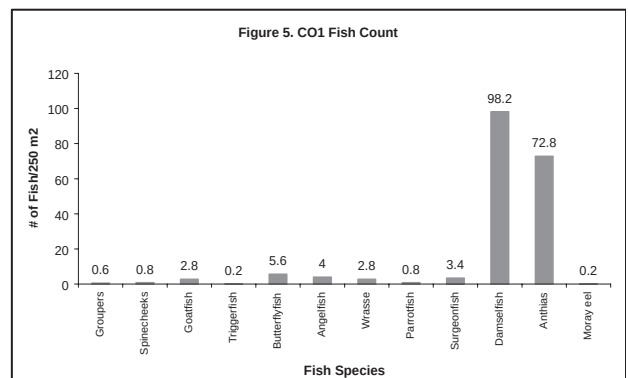
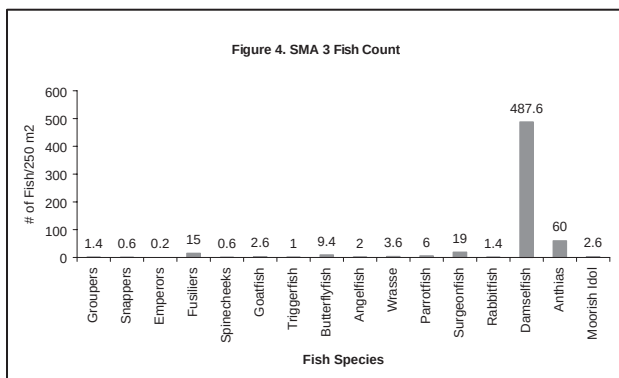
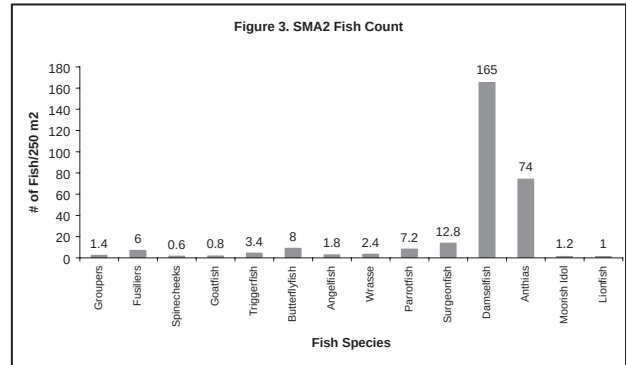
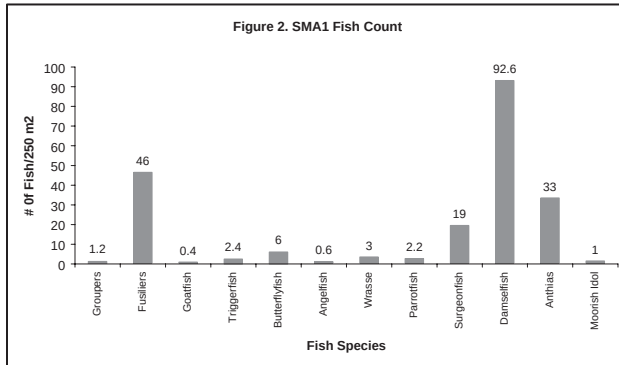
Figure 1. Sites in sanctuaries, reserve and control. SMA – special management area, CO – control inside the reserve, AG – control outside the reserve, Agutayan Island. Fishing and collecting is regulated by permits inside the reserve area and prohibited in the SMAs. Anchoring, destructive activities and extraction of minerals is prohibited throughout the reserve



7.2 Results for the Reef Monitoring Surveys

August 2002

Figures 2-12. The following show the average number of fish per species observed during the August Survey.



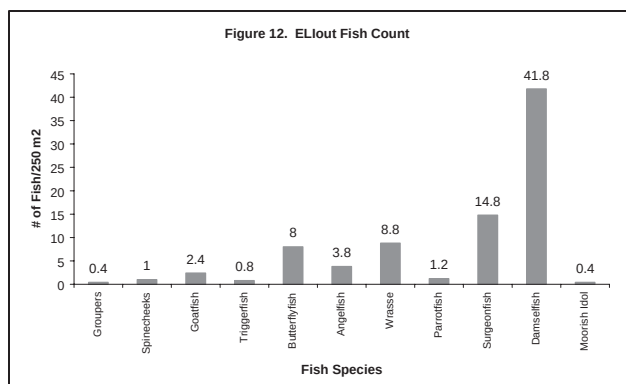
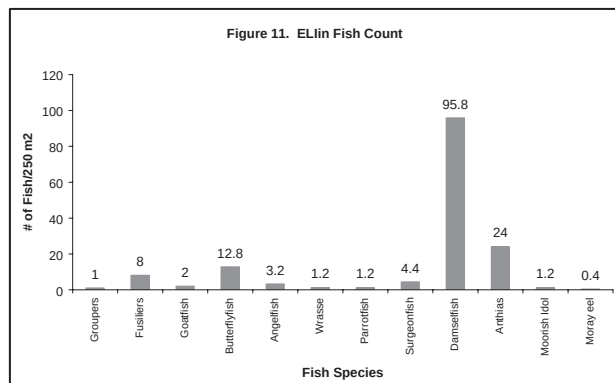
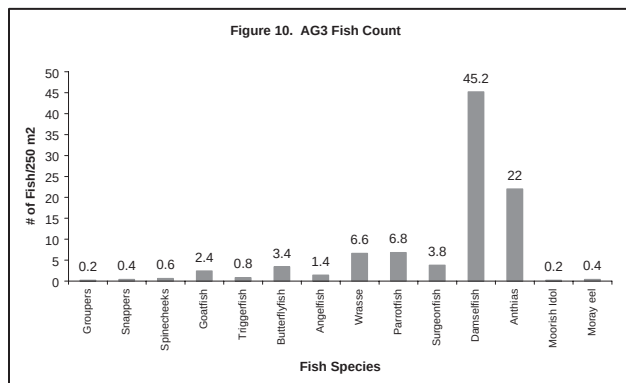
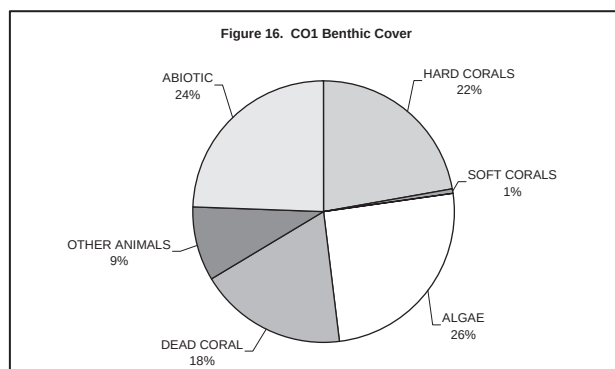
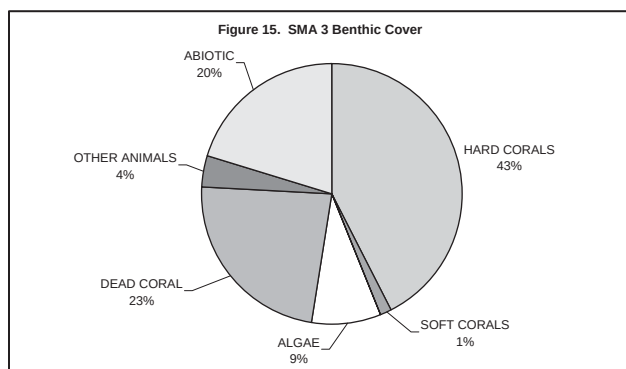
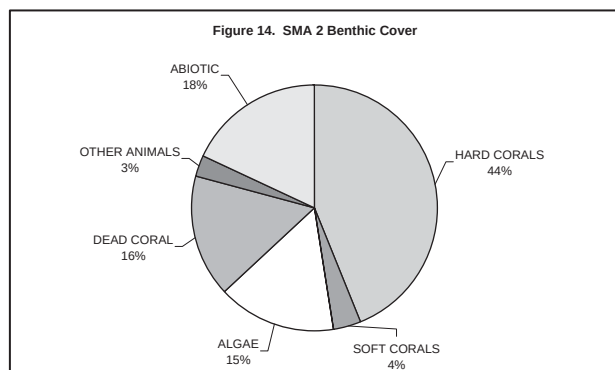
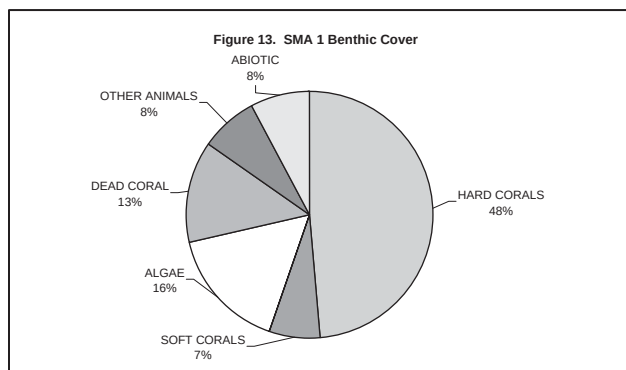
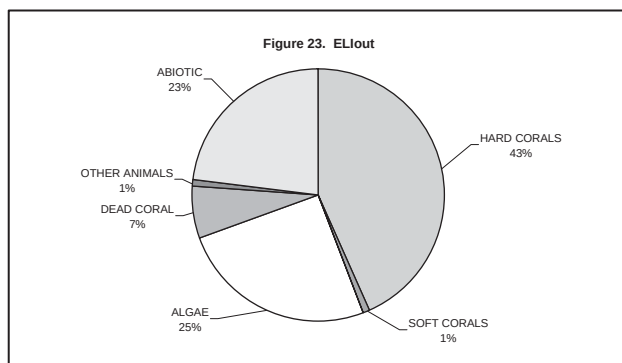
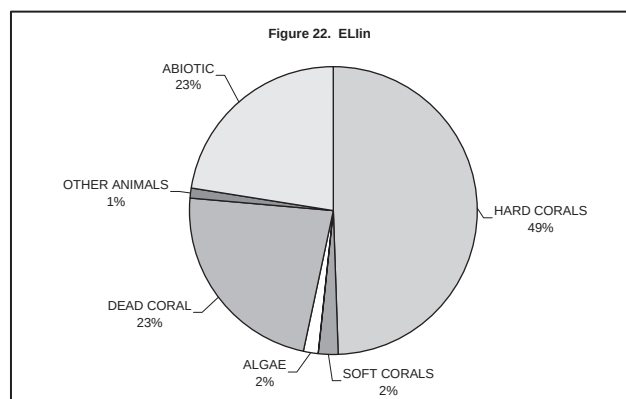
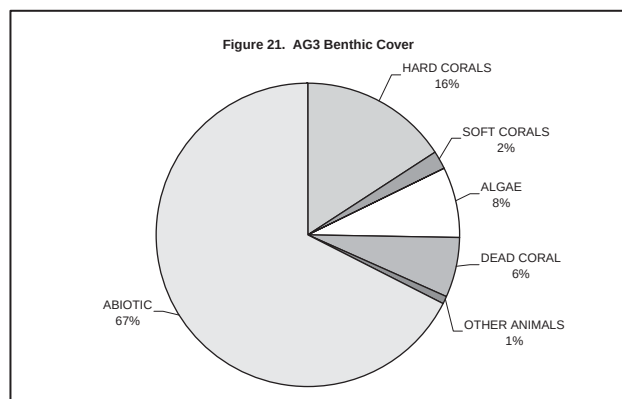
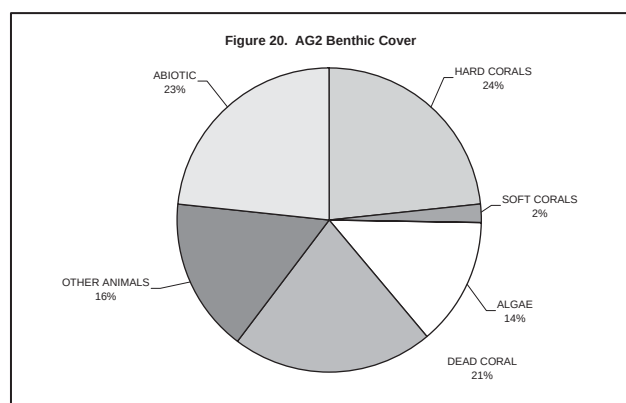
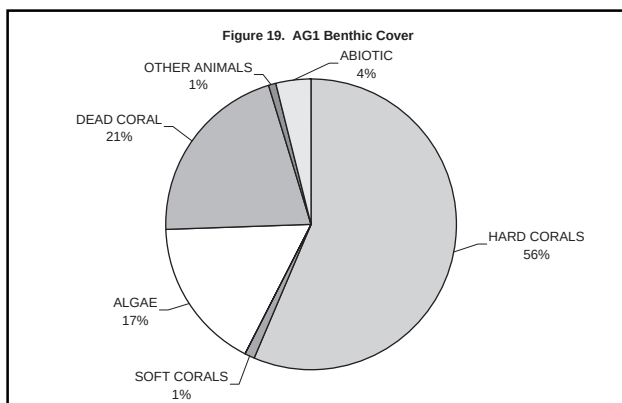
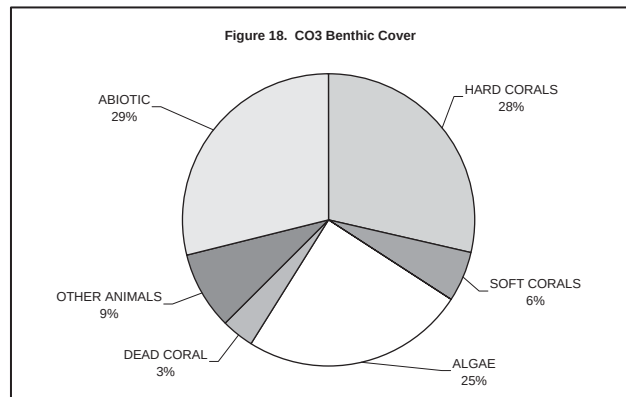
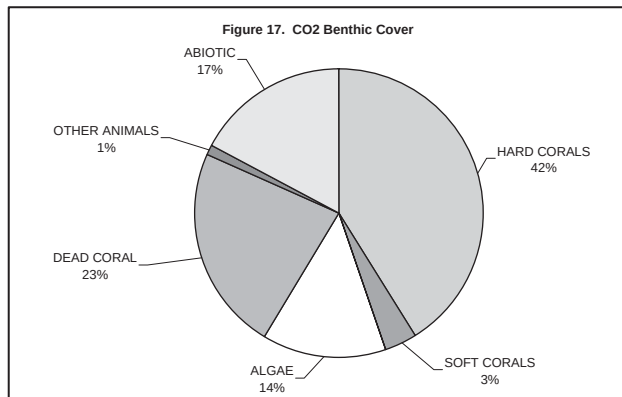


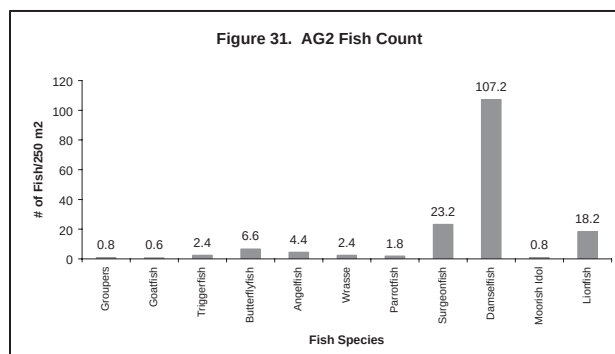
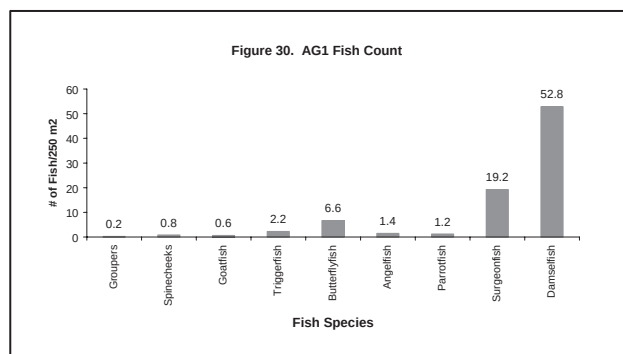
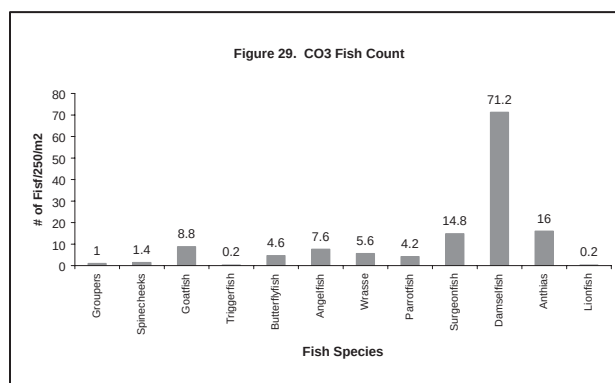
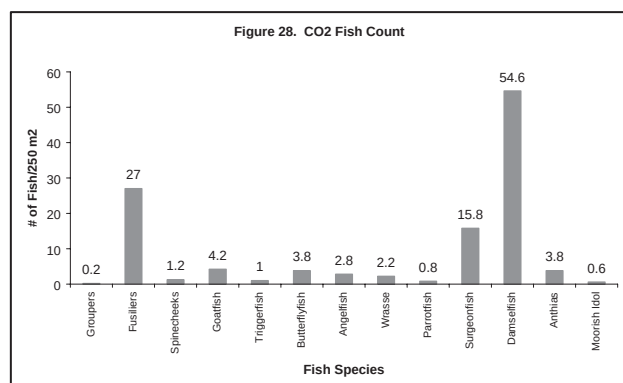
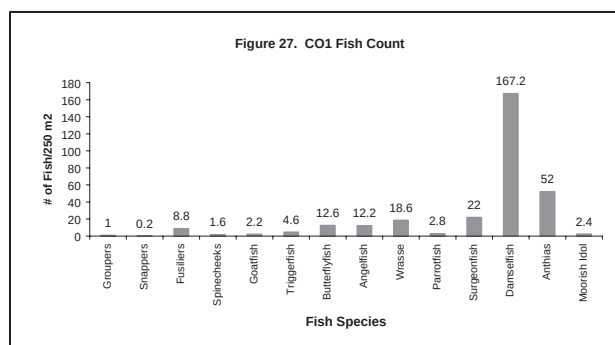
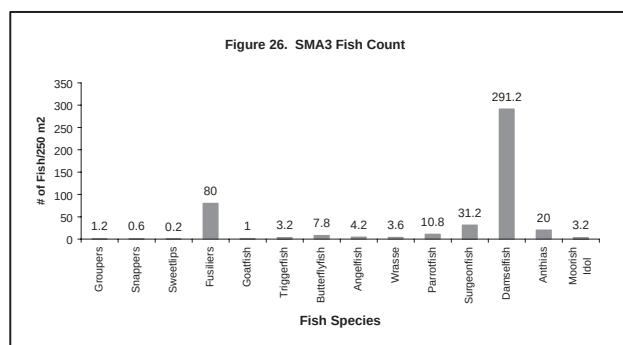
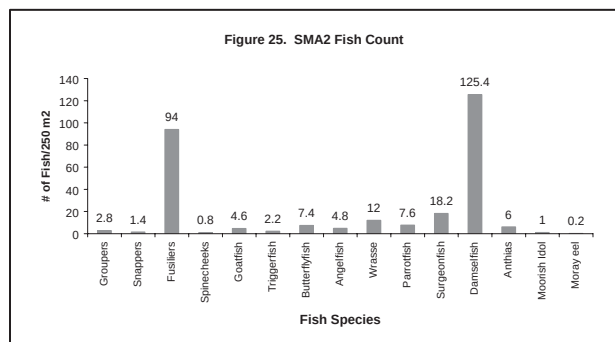
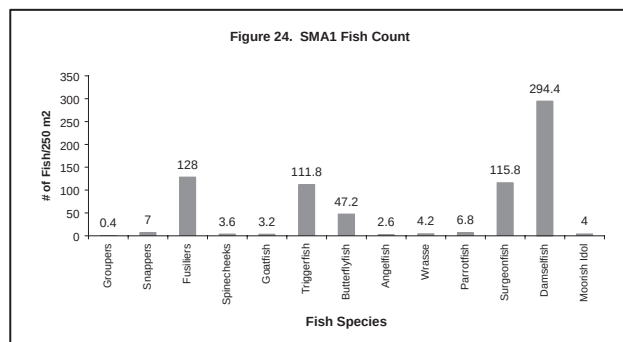
Figure 13-23. The following charts represent the average percentage of target benthic cover in each area for the month of August 2002.





November 2002

Figures 24-34. The following show the average number of fish per species observed during the November Survey.



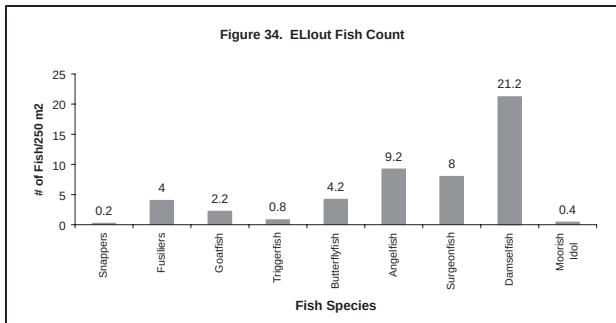
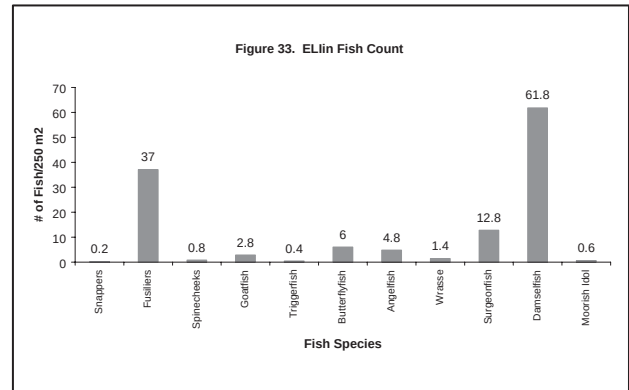
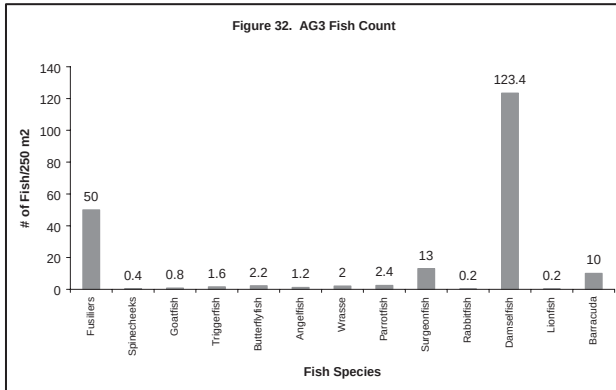


Figure 35-45. The following charts represent the average percentage of target benthic cover in each area for the month of November 2002.

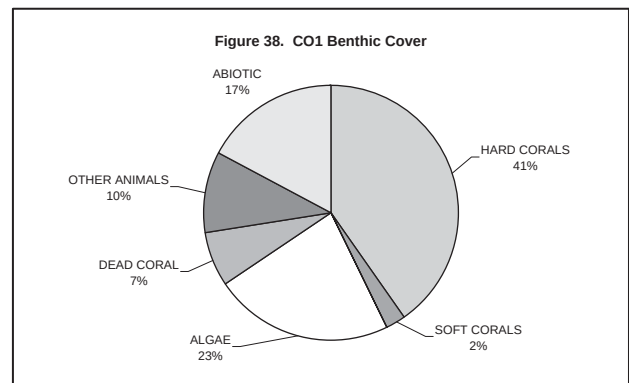
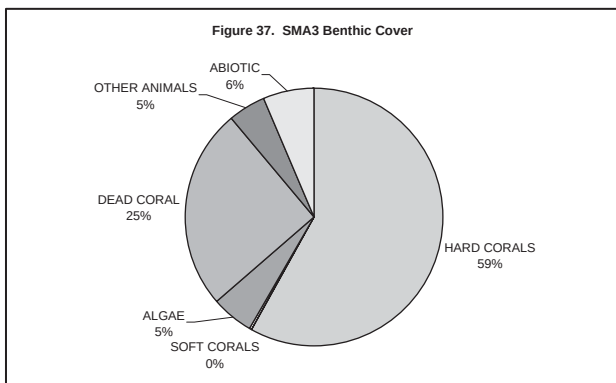
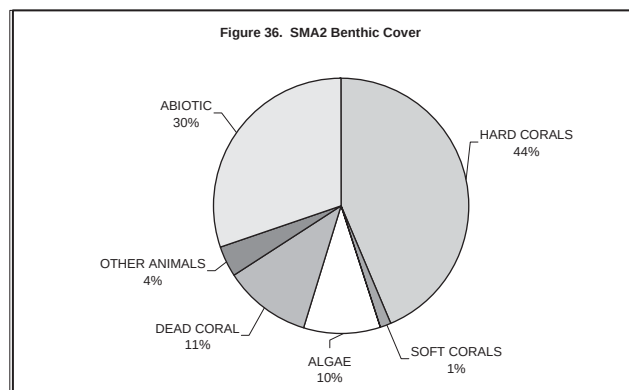
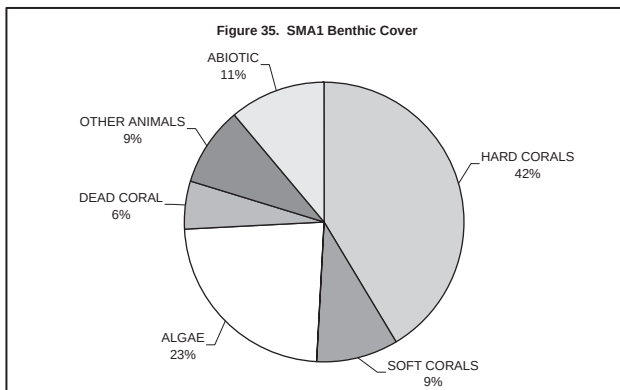


Figure 39. CO2 Benthic Cover

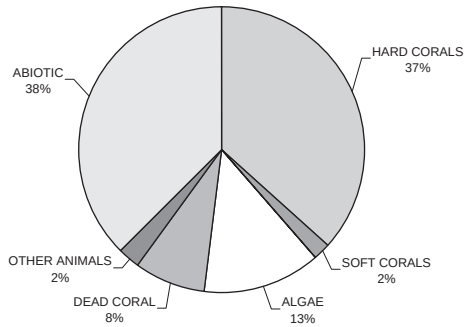


Figure 40. CO3 Benthic Cover

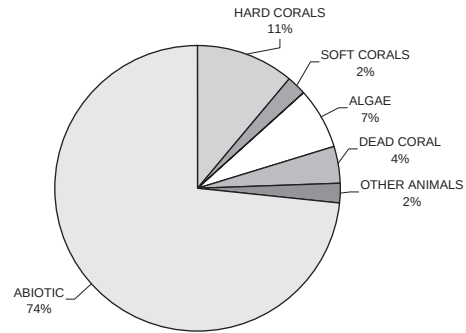


Figure 41. AG1 Benthic Cover

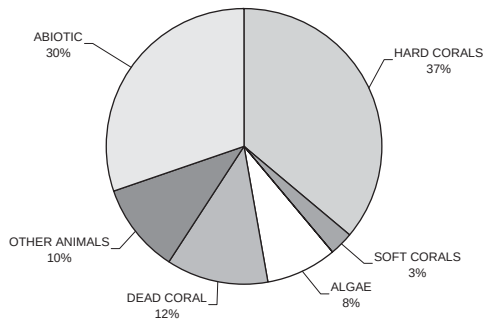


Figure 42. AG2 Benthic Cover

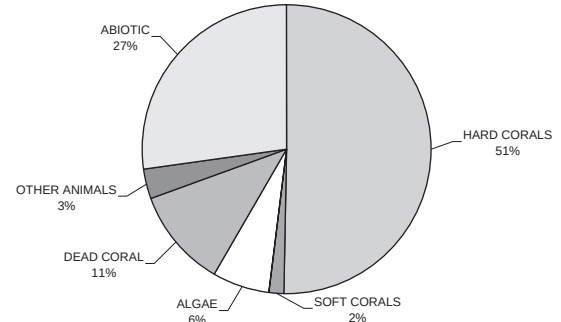


Figure 43. AG3 Benthic Cover

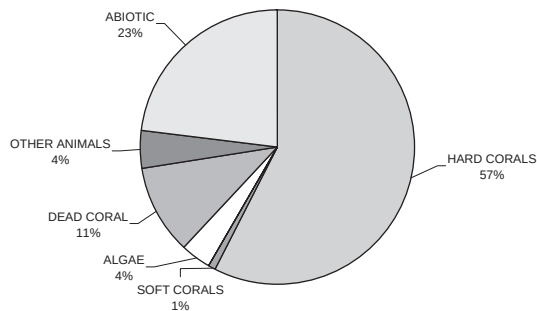


Figure 44. ELIn

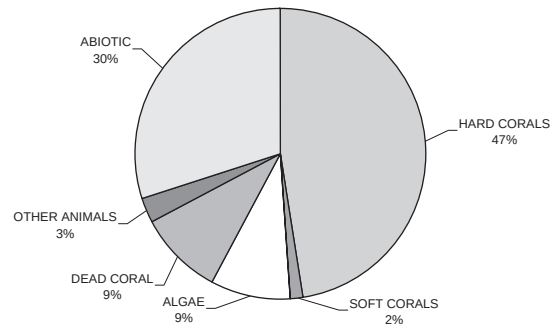
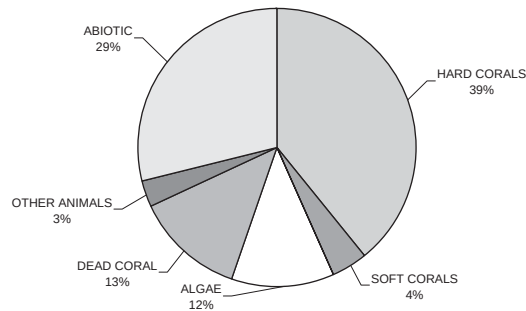
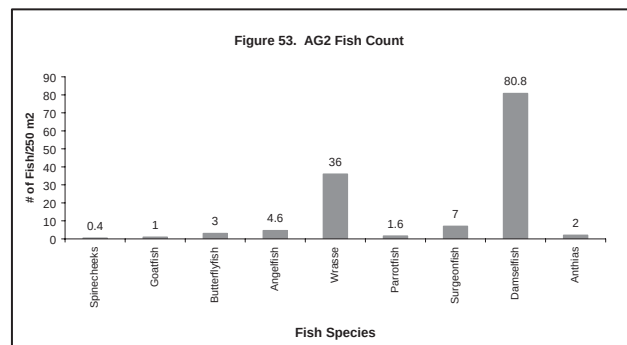
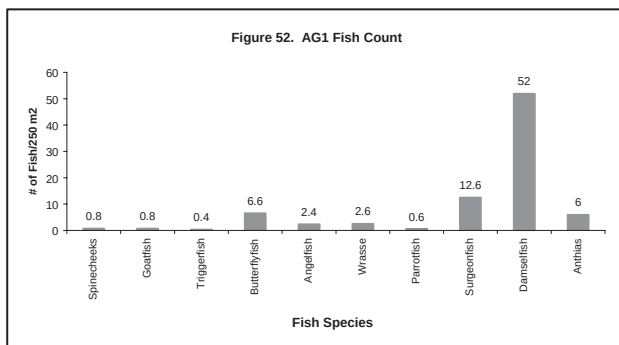
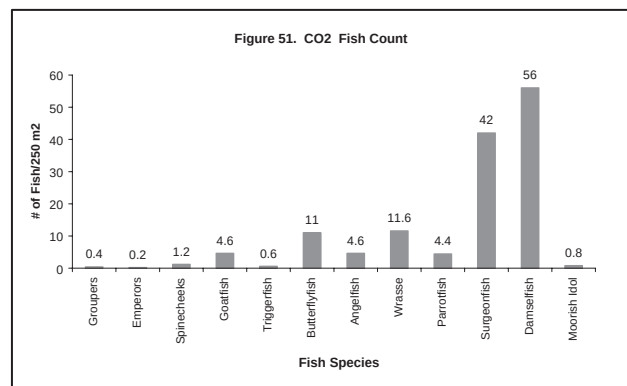
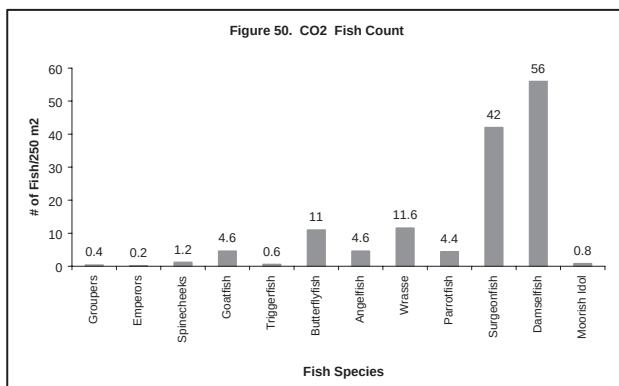
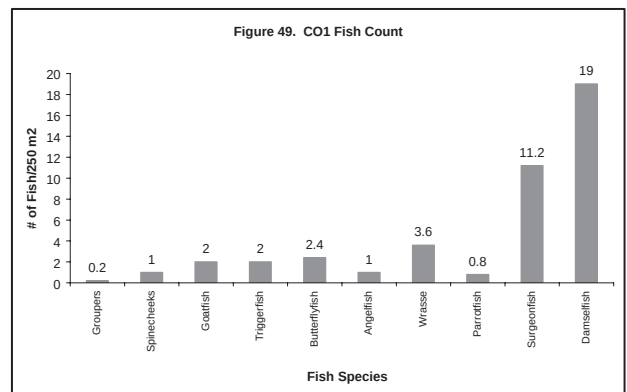
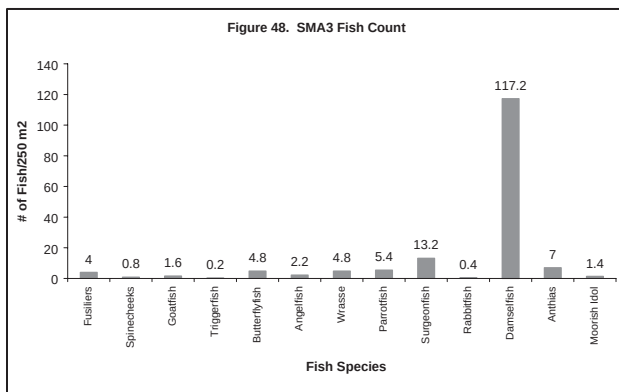
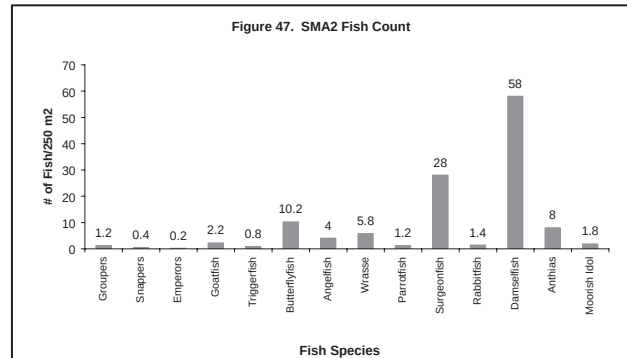
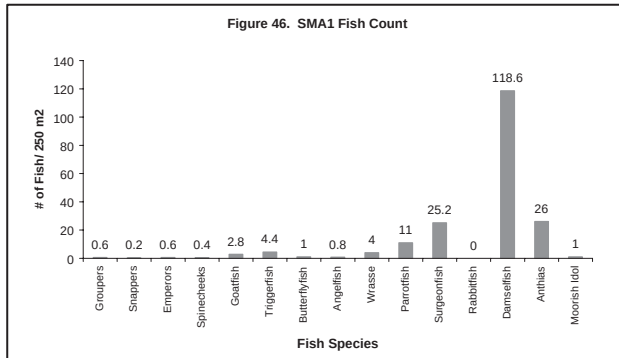


Figure 45. ELIout



February 2003

Figures 46-56. The following show the average number of fish per species observed during the February Survey.



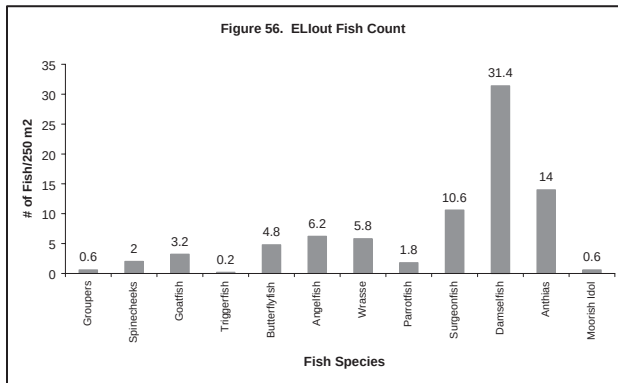
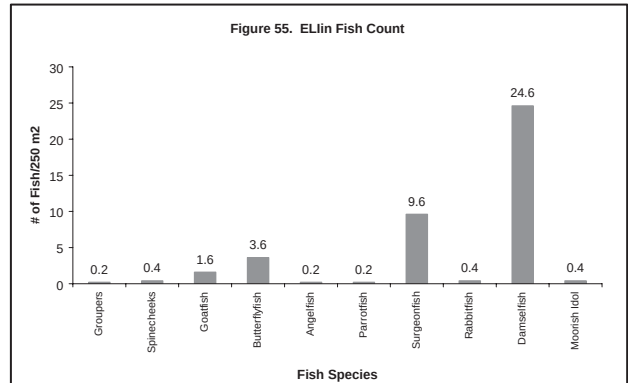
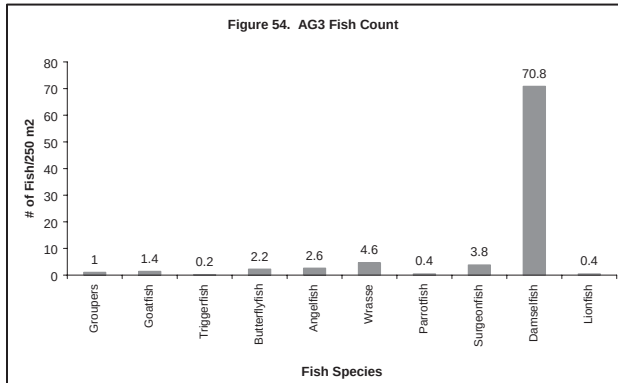
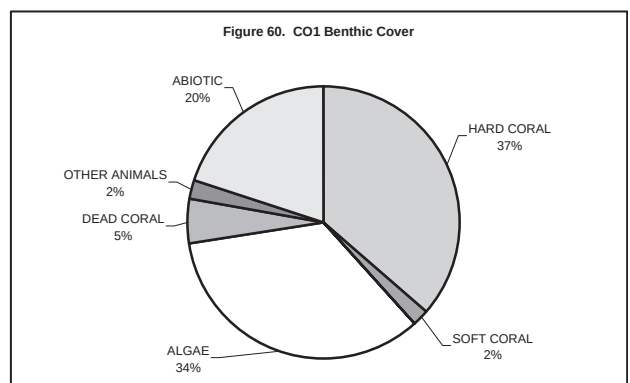
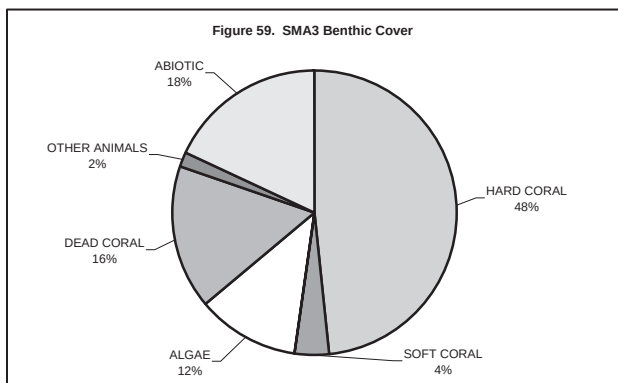
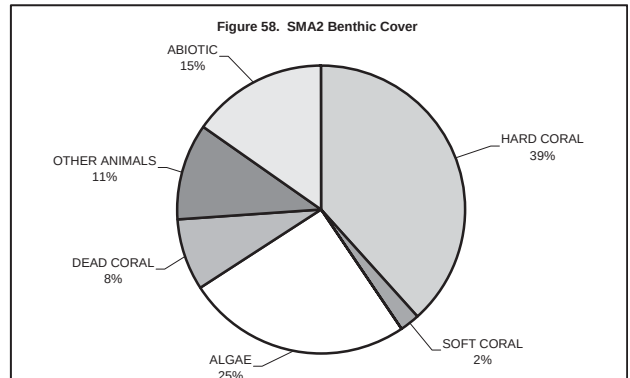
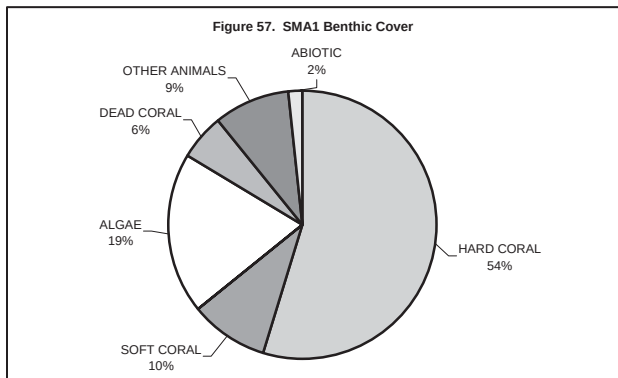
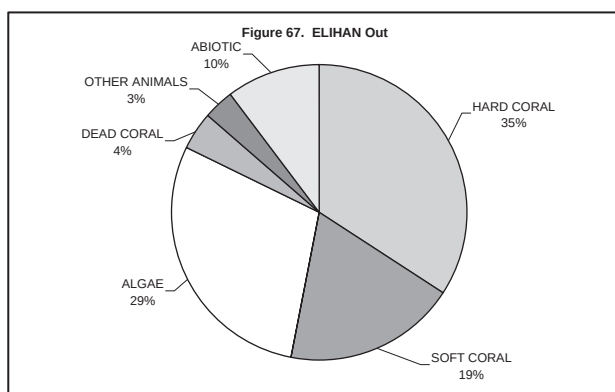
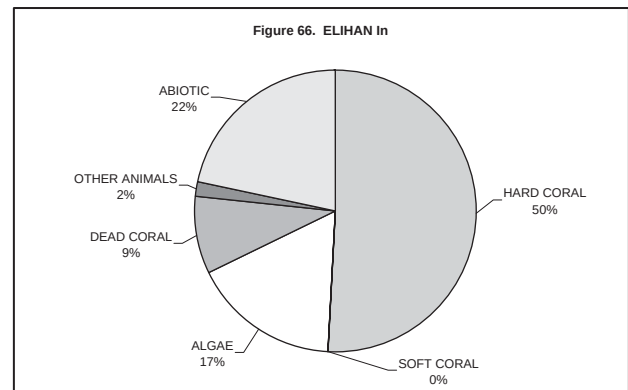
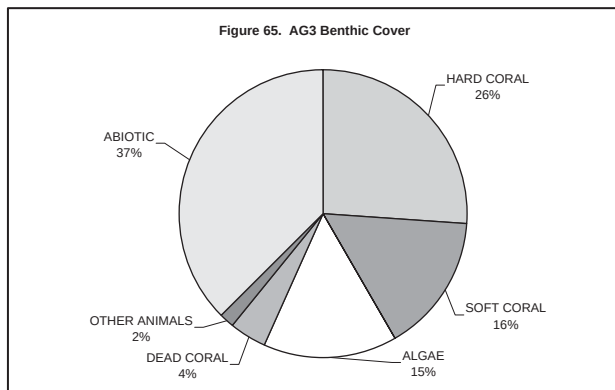
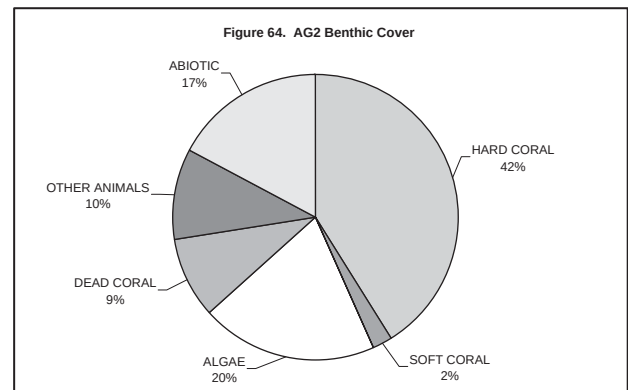
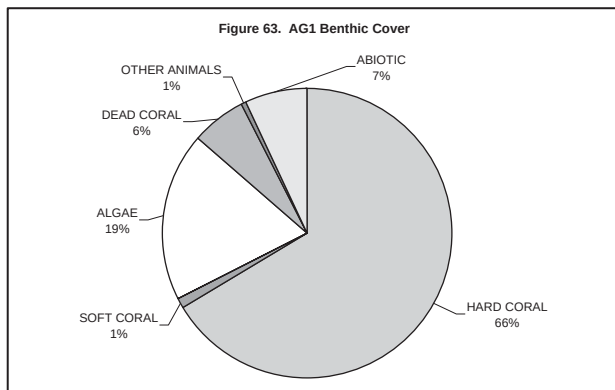
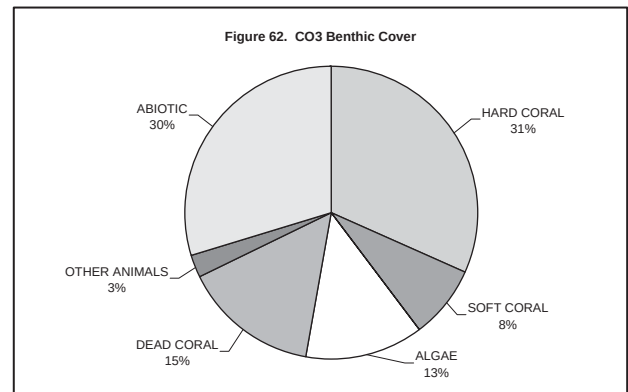
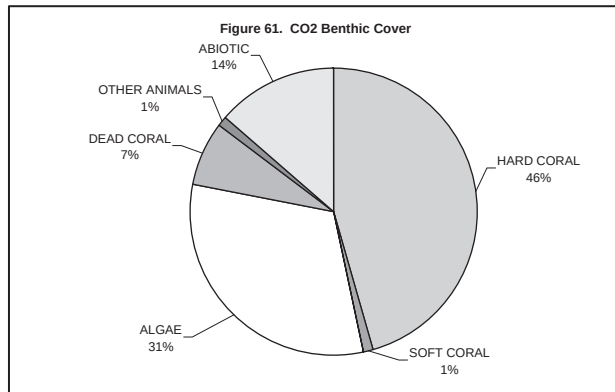


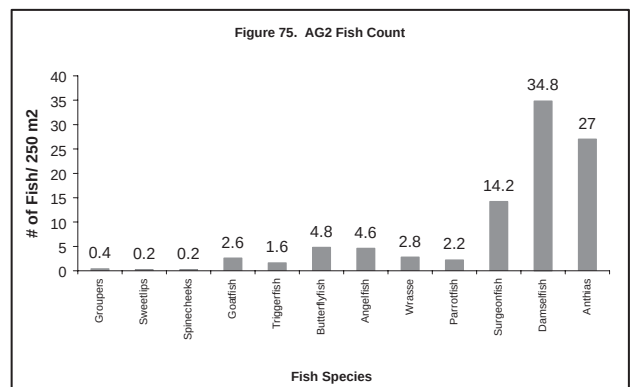
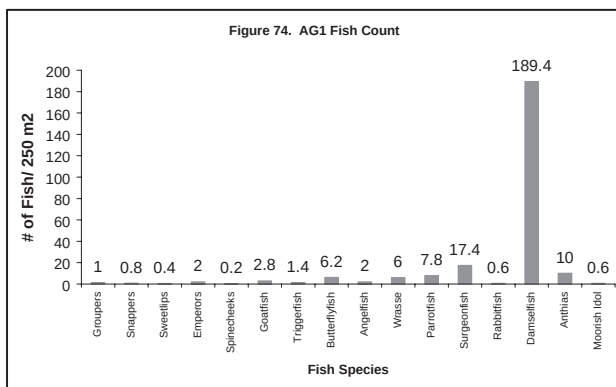
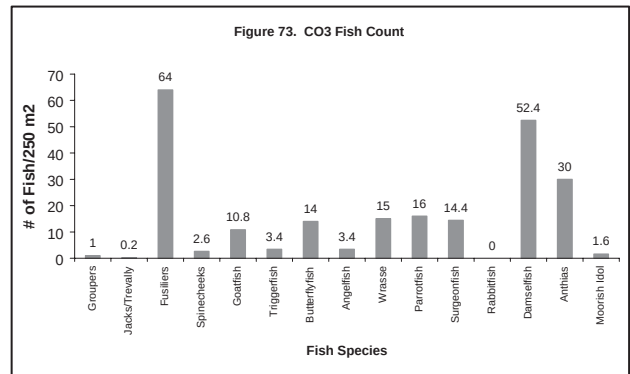
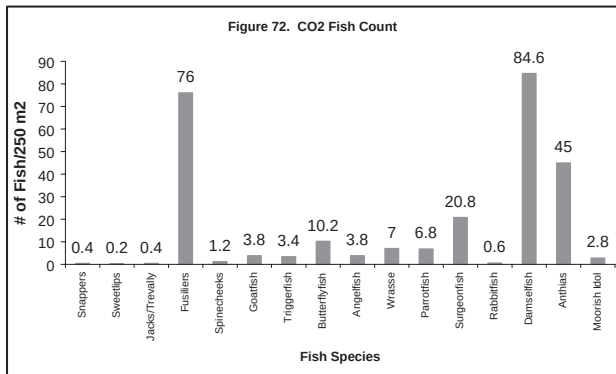
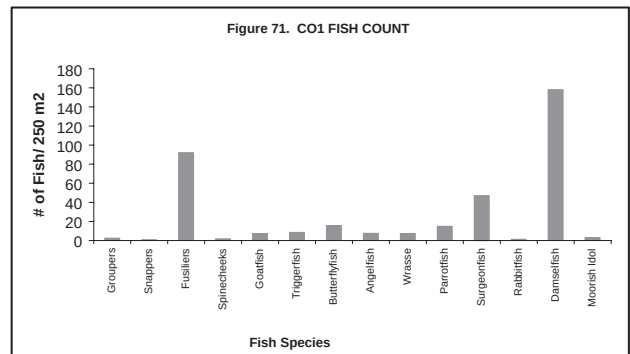
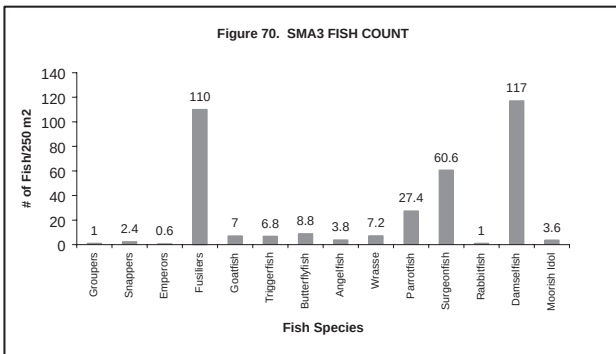
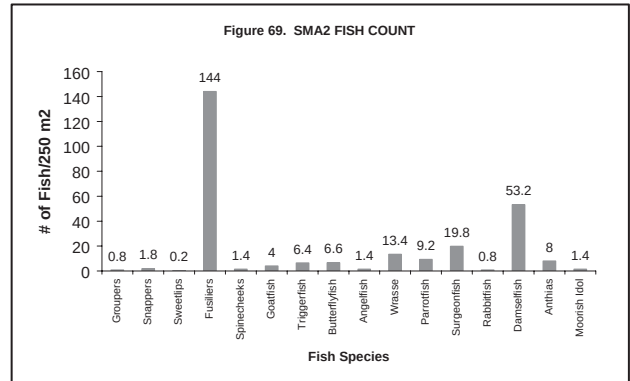
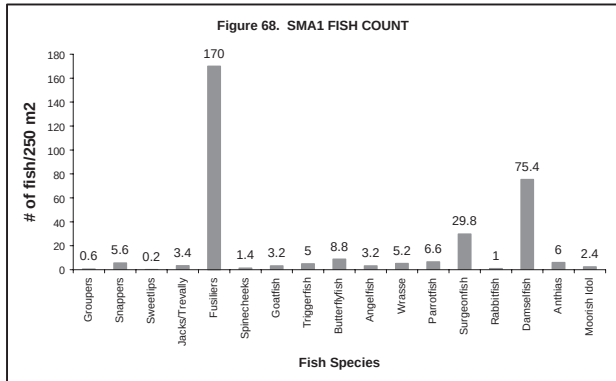
Figure 57-67. The following charts represent the average percentage of target benthic cover in each area for the month of February 2003.





May 2003

Figures 68-78. The following show the average number of fish per species observed during the May Survey.



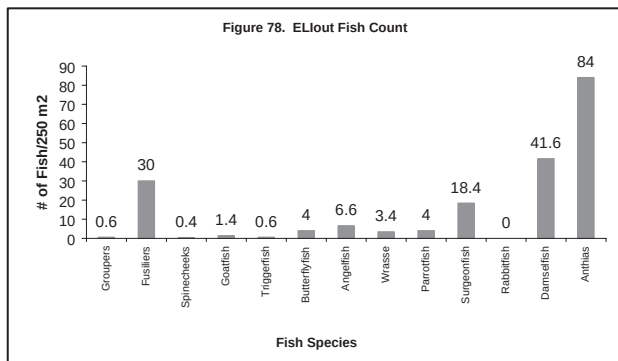
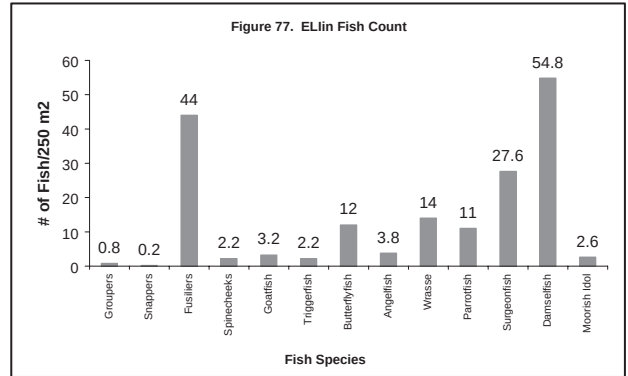
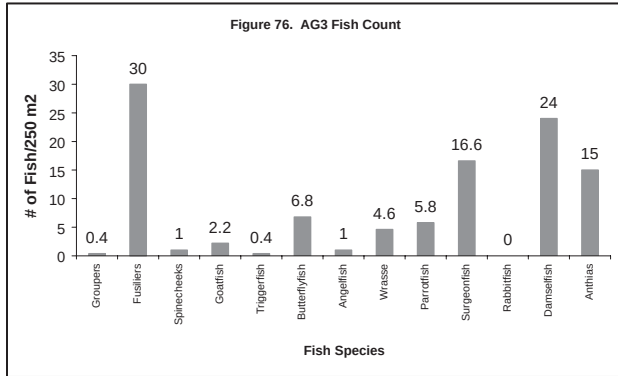


Figure 79-89. The following charts represent the average percentage of target benthic cover in each area for the month of May 2003.

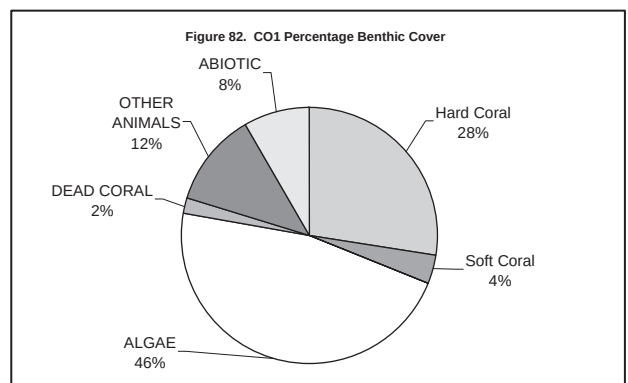
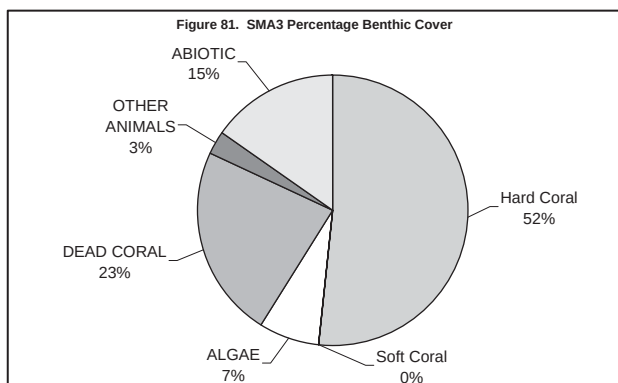
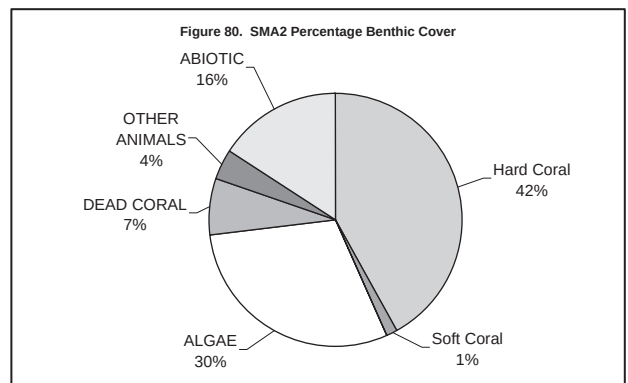
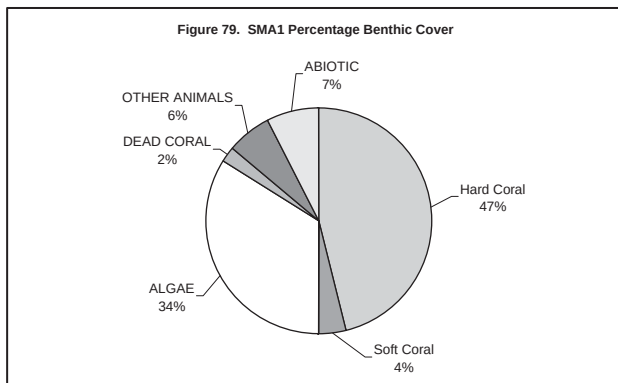


Figure 83. CO2 Percentage Benthic Cover

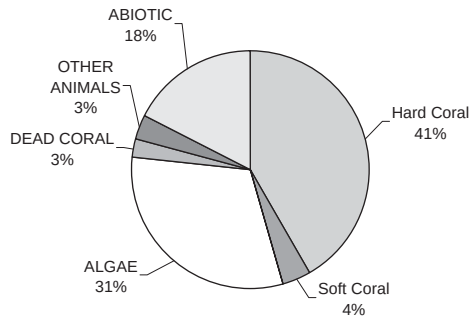


Figure 84. CO3 Percentage Benthic Cover

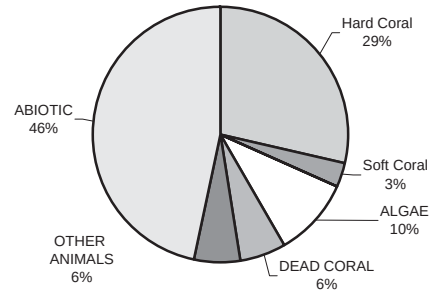


Figure 85. AG1 Percentage Benthic Cover

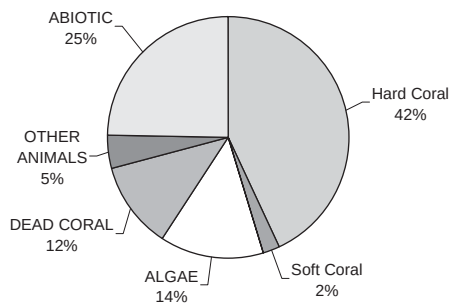


Figure 86. AG2 Percentage Benthic Cover

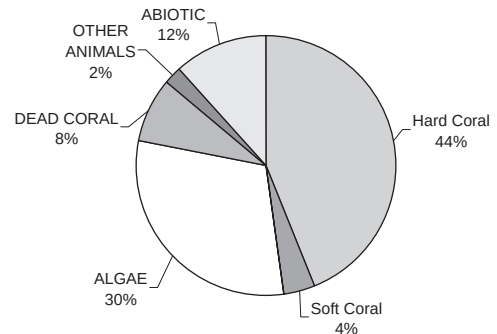


Figure 87. AG3 Percentage Benthic Cover

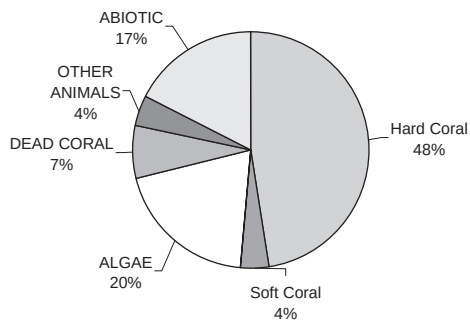


Figure 88. ELIin Percentage Benthic Cover

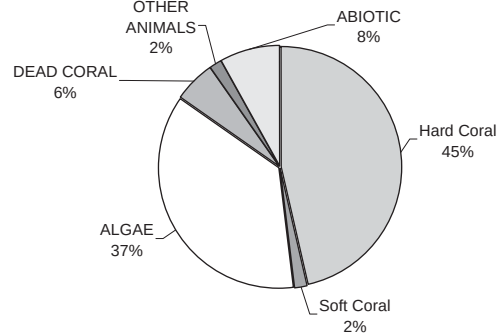
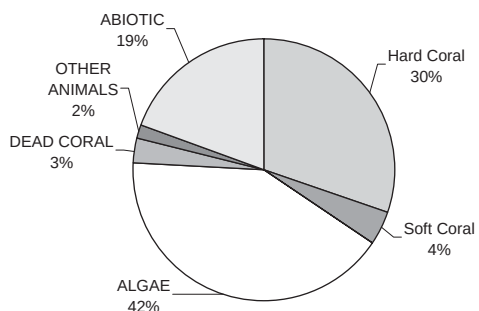


Figure 89. ELIout Percentage Benthic Cover



8. FISH CATCH AND LANDING MONITORING

8.1 *Daily Fish Catch Monitoring by Individual Fishermen*

Fish catch monitoring was implemented in 3 coastal barangays adjacent to Danjungan Island Marine Reserve & Sanctuaries (DIMRS). These are: (1) Brgy. Bulata (2), Brgy. Elihan and (3) Brgy. Inayauan. In each barangay, several fisher groups were organised as fish catch monitoring respondents, with a total of seven groups, three groups from Brgy. Bulata, two groups from Brgy. Elihan, and two groups from Brgy. Inayauan. Groups were organised for easier management of the programme, but monitoring was based on the daily fish catch of each individual fisherman.

8.2 *Youth Volunteers*

Before the actual daily fish catch monitoring commenced, a training seminar was conducted for 6 youth volunteers from the 3 barangays. These youth volunteers assisted in the implementation of the program, especially in the collection of survey forms and in data collation and analysis. Two youth volunteers were assigned to each of the barangays.

8.3 *Orientation Seminar for Fisher Groups*

Fisher groups from each barangay gathered for orientation seminars in each of their respective areas. The fish catch monitoring program was introduced during the orientation. Objectives were clarified and the value of monitoring was emphasized. The concepts of “catch per unit effort”, “total fishing effort” and “total catch” were also thoroughly explained. After the orientation, a list of respondents who were interested in monitoring their daily fish catch was generated. The location of fishing grounds, fishing gear types, and fish species were generated with input from the respondents. This data were used in the formation of the monitoring forms.

8.4 *Number of Respondents*

There were a total of 93 fish catch monitoring respondents from the 3 barangays. From Brgy. Bulata there were a total of 47 respondents, 28 respondents from Brgy. Elihan, and 18 respondents from Brgy. Inayuan. A more detailed breakdown is included in the annex.

8.5 *Distribution of Monitoring Forms to Respondents*

The fish catch respondents met one week after the initial consultation meeting. The monitoring form was presented to each group for validation during the meeting. After minor corrections, forms were distributed to the respondents so that they could begin monitoring their daily fish catch. Fish catch monitoring forms were distributed and collected by the youth volunteers on a monthly basis.

8.6 *Monthly Meeting With Youth Volunteers & Data Collation*

Regular meeting with youth volunteers was done monthly for regular updating. Problems encountered in the implementation were discussed and solved. The volunteers collated the data during the meetings and then entered into the computer.

8.7 *Mid Progress Meeting With the Respondents & Distribution of Incentives*

Fish catch monitoring respondents convened for a meeting in December 2002 for updates on the progress of the fish catch monitoring project. During the meeting, respondents who had consistently answered the fish catch monitoring forms were given incentives, in the form of goods, depending on the points they had earned. A point-system-incentive scheme was developed to encourage continual record keeping of their daily fish catch. Each monitoring form completed and submitted each week had a corresponding point. The points accumulated and the incentive that they would receive after each quarter depended on the points they had earned.

8.8 Installation of Fish Catch and Landing Monitoring & Community Billboard

Seven fish catch monitoring billboards were constructed and installed within the 3 barangays, one billboard for each fisher group. The initial purpose of the billboard was to give the respondents easy access to a map of the fishing grounds. Results of monitoring from both the fish catch landing monitoring and fish visual census and benthic survey are posted here as part of a semi-annual presentation. This is done by painting graphs onto the billboard. The billboards also function as a community-billboard for the posting of important information pertaining to the community.

8.9 Results

Figure 90. Average CPUE per month within and outside the reserve using gill net

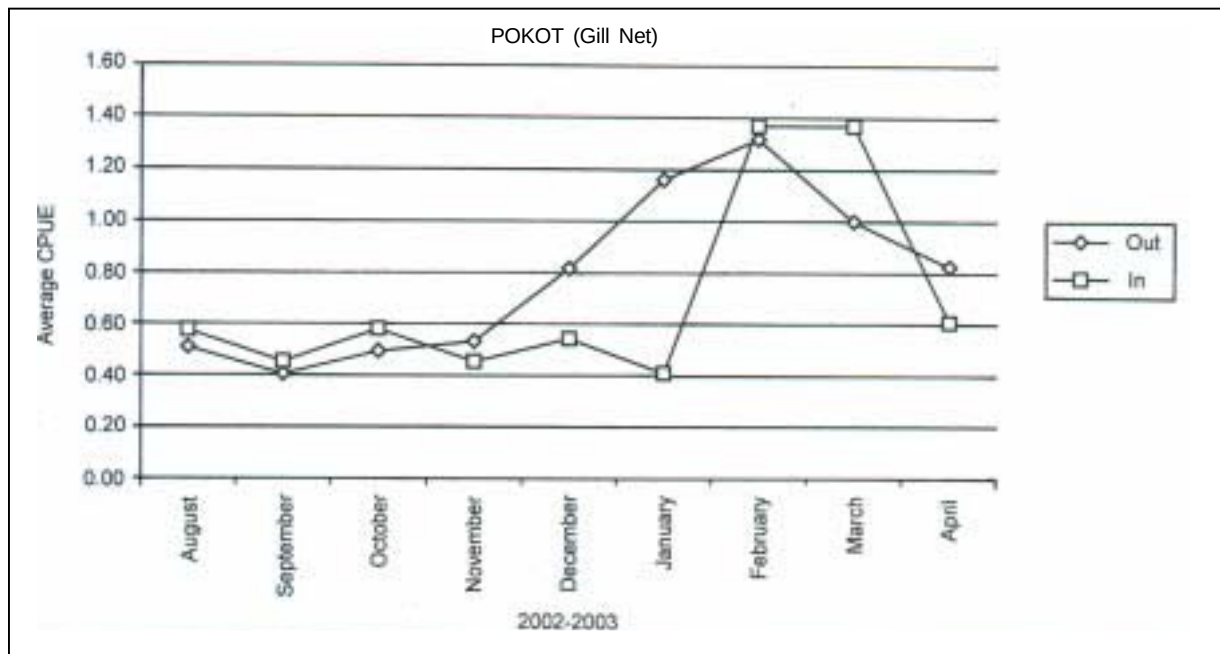


Figure 91. Average CPUE per month within and outside the reserve using hook & line

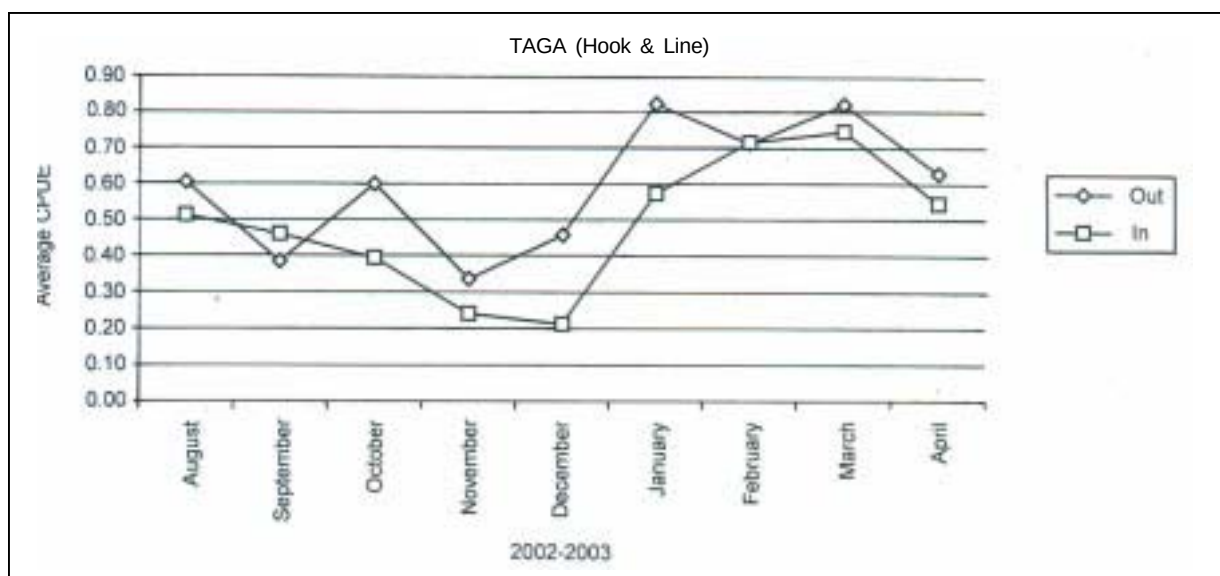


Figure 92. Average CPUE per month within and outside the reserve using spear gun

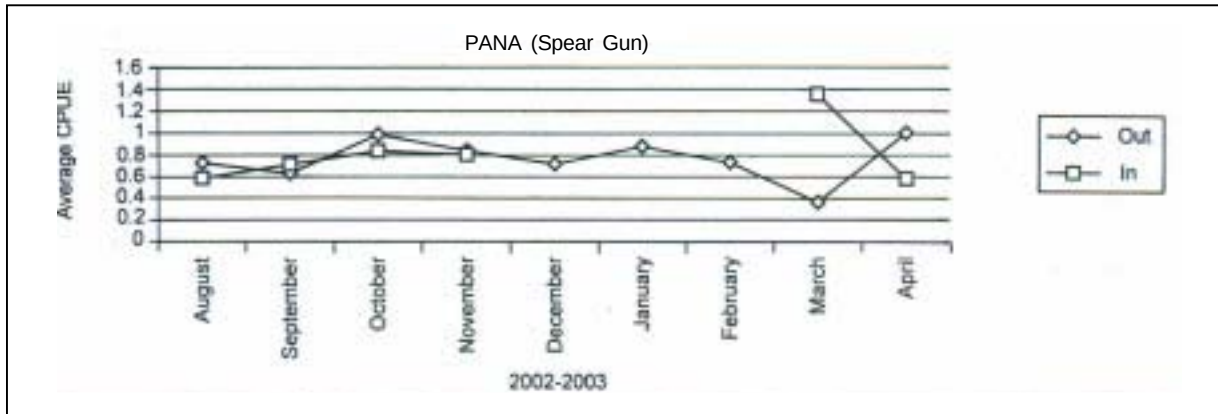


Figure 93. Average daily fish catch in kilos per month both inside and outside the reserve using gill nets

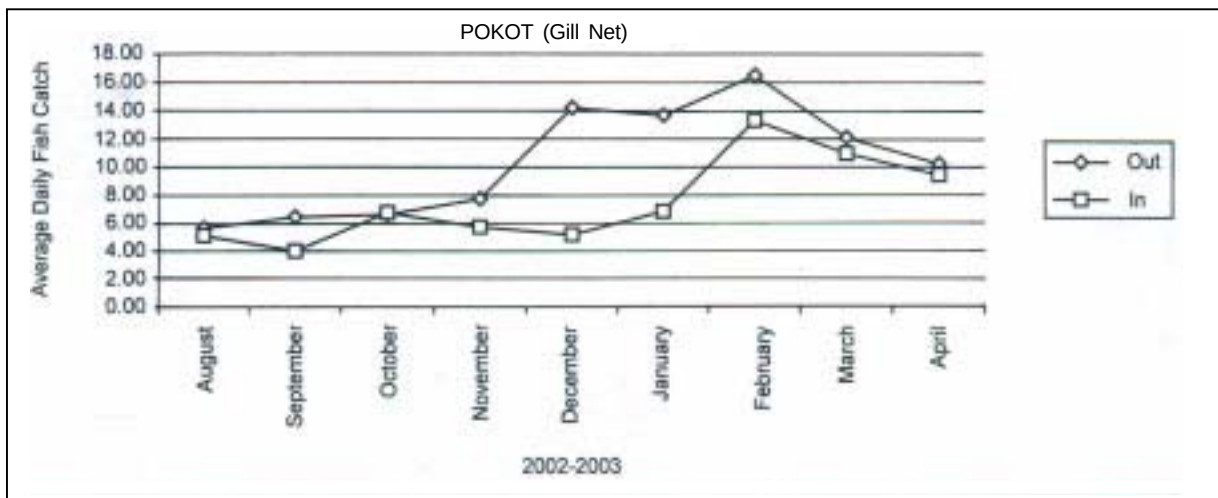


Figure 94. Average daily fish catch in kilos per month both inside and outside the reserve using hook and line

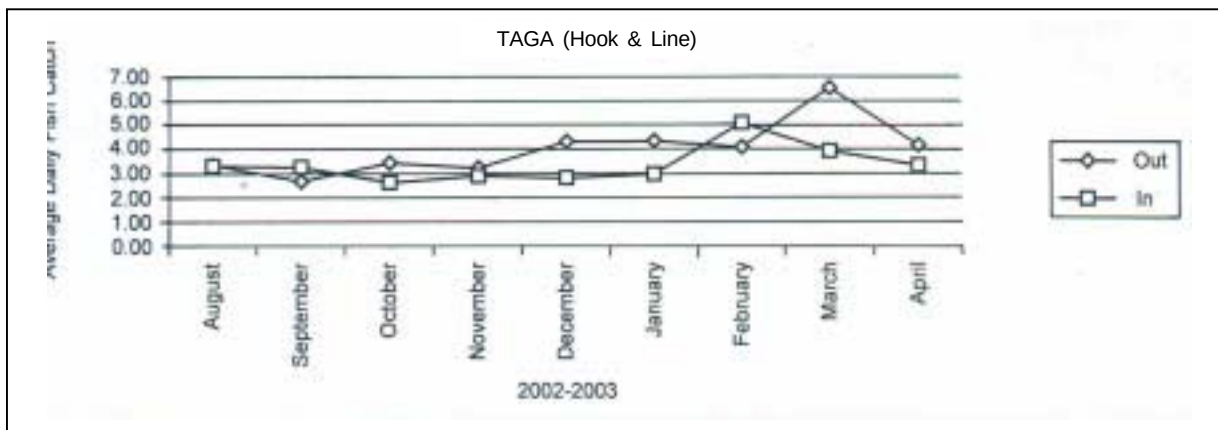


Figure 95. Average daily fish catch in kilos per month both inside and outside the reserve using spear gun

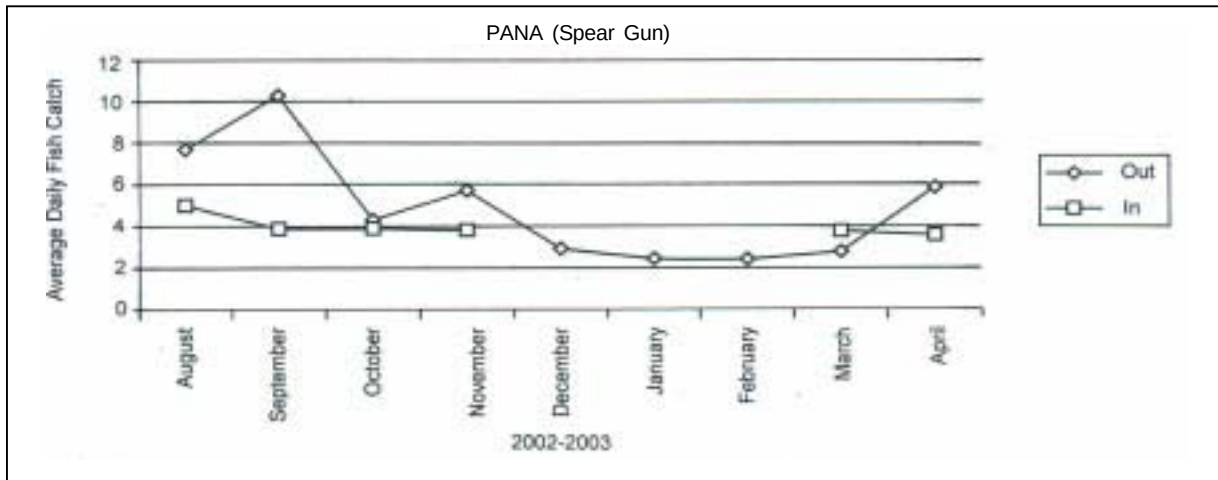


Figure 96. Total fish catch in kilos per month within and outside the reserve using gill net

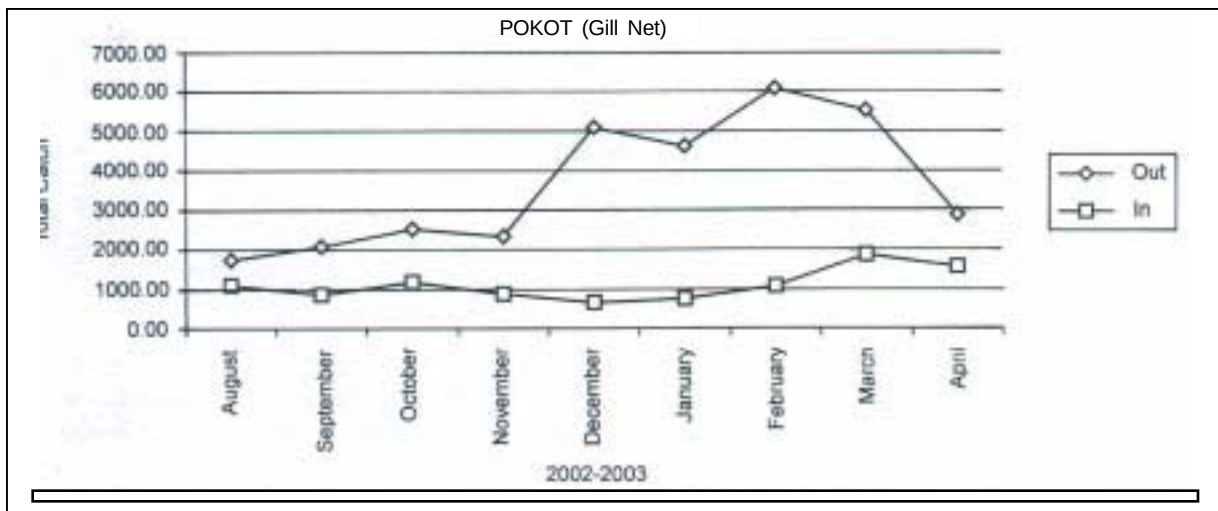


Figure 97. Total fish catch in kilos per month within and outside the reserve using hook & line

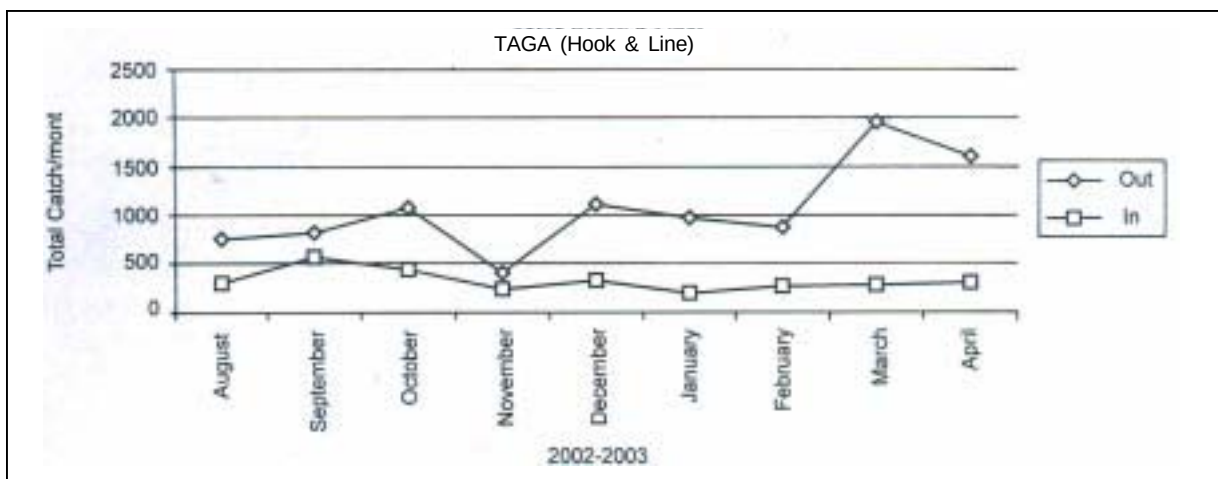
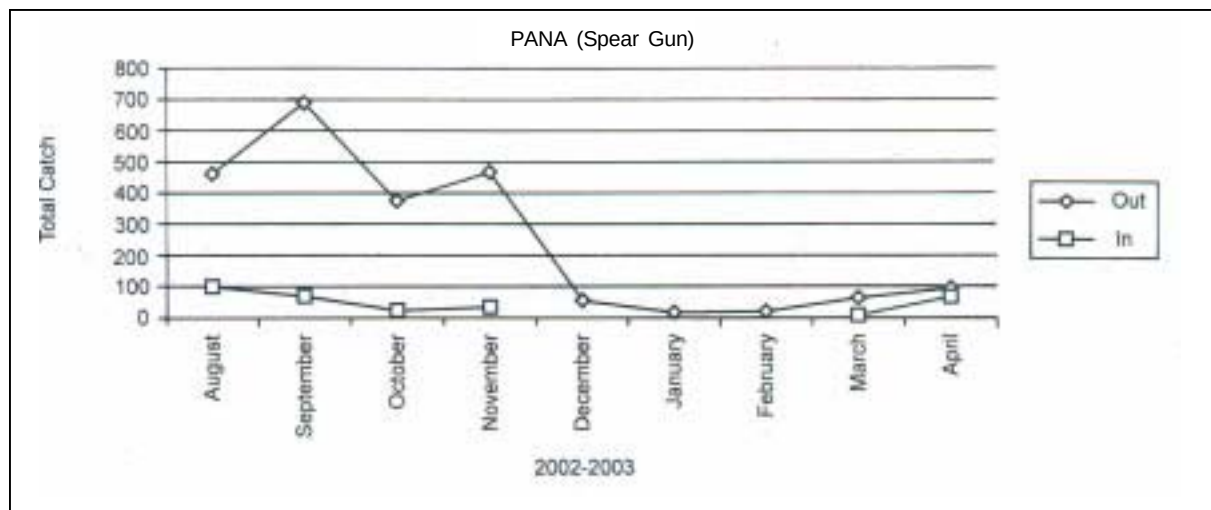


Figure 98. Total fish catch in kilos per month within and outside the reserve using spear gun



9. STATUS OF OTHER ACTIVITIES

9.1 Reef Bleaching

The decision was made not to perform reef bleaching quadrat surveys this year. During the fish visual census and benthic survey little to no bleaching was observed.

9.2 Crown of Thorns Sea Star Population Survey

Throughout the fish visual census and benthic survey relatively few crown of thorns sea star were observed. This is based on the invertebrate data from the fish visual census and benthic survey data. For this reason a separate comprehensive Crown of thorns sea star survey was not conducted.

9.3 Data Submission

Due to the fact that the final survey was completed in May 2003, the data are still being compiled into the correct format for ReefBase, FishBase, PhilReefs, and GCRMN. In addition, the final reporting of results to the community for both the fish visual census and benthic monitoring survey and the fish catch and landing monitoring has yet to be presented. This is also due to the fact that the monitoring project just recently came to an end. Proof of submission to the above mentioned agencies will be forthcoming upon completion.

10. EVALUATION OF MONITORING ACTIVITIES

- This project has assisted the DIMRS to continue its fourth year of fish and benthic survey since its establishment in 2000.
- Fish Catch Monitoring survey started by this project has complemented the underwater reef assessment in DIMRS.
- The training provided by the project in data management and analysis enabled the DIMRS through the community volunteers to begin documenting the progress of the marine reserve.
- The training enhanced the skills and knowledge of the DIMRS wardens, Bantay Dagat and local community volunteers in terms of reef assessment and fish catch monitoring.

- The project also developed local expertise coming from the adjacent LGU's in reef assessment and monitoring which will help them in establishing and monitoring their own marine reserves and sanctuaries. Trainees from this project have been assisting the PRRCFI and the Province of Negros Occidental in reef assessment of potential Marine Protected Areas in southern Municipalities and city in Negros Occidental.
- Sagay Marine Reserve has tapped local community volunteers (trainees from this project) to assist in the reef monitoring in Sagay City, north of Negros Occidental.
- Due to limitations of funds and logistics (SCUBA gears, guide books, computer), some of the LGU's may have difficulty in sustaining their monitoring program. However, the Foundation has been lobbying the Local Government Units to allocate more funds to support Coastal Resources Management and conservation initiatives.
- The project was constrained in the number of trainees due to lack of government personnel and community volunteers that are certified SCUBA divers.

Annexes

Annex 1. Training Schedule and Topics for Benthos and Fish Survey

Annex 2. Distribution of Fish Catch Monitoring (FCM) Respondents from the three Barangays in Cauayan, Negros Occidentale

Annex 3. Pictorials

Picture 1. February 2003 Fish and Benthic Survey. Divers working on benthic cover identification.

Picture 2. February 2003 Fish and Benthic Survey. Transect line.

Picture 3. Fish Catch Monitoring Billboards and respondents, Brgy. Bulata, Cauayan.

Annex 1

Training Schedule and Topics for Benthos and Fish Survey

Day 1 SKILLS REVIEW

AM:

- Orientation about UNEP Reef Monitoring Program
- Presentation of previous survey results
- Check on SCUBA skills (snorkelling/SCUBA diving)
- Safety Lecture
- Refresher dive

PM:

- Pre-test (Corals and Fish)
- Lecture in Reef Ecology
- Exam in the evening

Day 2 FISH REVIEW

AM:

- Fish Lecture
- Fish size estimation
- Methodology (Fish Visual Census)
- Dive

PM:

- Knowledge review
- Dive
- Evening Exam

Day 3 CORALS REVIEW

AM:

- Coral Lecture
- Basic Life form Identification techniques
- Coral trail (snorkelling)
- Evaluation

PM:

- Methodology (Point-Intercept Transect)
- Dive

Day 4 ALGAE & INVERTEBRATES

AM:

- Algae lecture and Identification
- Macro invertebrates lecture and identification
- Methodology
- Dive

PM:

- Knowledge review
- Dive

Day 5 PRACTICE RUN SURVEY

AM:

- Practice Survey Dive

PM:

- Practice Survey Dive

Annex 2

Distribution of Fish Catch Monitoring (FCM) Respondents From the Three Barangays in Cauayan, Negros Occidentale

Barangay with Corresponding Fisher Groups	# Of Respondents
Brgy. Bulata:	
Punta Bulata FCM Respondents	24
Sitio Payao-payao FCM Respondents	9
Sitio Hinobigon FCM Respondents	14
Brgy. Elihan:	
Sitio Elimnan Manok FCM Respondents	14
Sitio Sabang FCM Respondents	14
Brgy. Inayauan:	
Sitio Tambo FCM Respondents	12
Sitio Dinagsaan FCM Respondents	6
TOTAL	93

Picture 1. February 2003 Fish and Benthic Survey. Divers working on benthic cover identification.



Picture 2. February 2003 Fish and Benthic Survey. Transect line.

Picture 3. Fish Catch Monitoring Billboard and respondents, Brgy. Bulata, Cauayan.



**Coral Reef Monitoring for Sustainable Uses of Resources
Around the Islands Groups
in the Coastal Waters of Southwest Viet Nam**

Implementing Institution: Institute of Oceanography, Nha Trang, Viet Nam

Project Leader: Nguyen Van Long
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INTRODUCTION

Coral reefs are important habitats in the coastal waters of Viet Nam, playing important roles as reservoirs of biodiversity, for fisheries and tourist development in the coastal zone. In recent years, the economical development of Viet Nam has improved the living standard of many coastal communities. However, concomitant with this development, human impacts on coastal areas have increased and are considered as the main causes of degradation of marine ecosystems in general, and coral reefs in particular.

During the last several years, coral reefs in many areas of Viet Nam have suffered severe impacts from two catastrophes – Typhoon Linda in 1997 and bleaching in 1998. Additionally, outbreaks of crown-of-thorns sea stars, unmanaged tourism and some illegal activities such as dynamite and poison fishing have caused damage to reefs. Management activities are now being implemented to begin to address these impacts in some areas. As part of the management process, reef monitoring is being used as the primary tool for understanding changes of coral reef communities under natural and anthropogenic impacts, and for providing appropriate recommendations for coral reef management.

Monitoring activities of coral reefs have been established since 1998 at three sites along the coast of Viet Nam, in Nha Trang Bay, Cu Lao Cau and Con Dao islands, and extended to 4 more sites in Ha Long Bay, Van Phong Bay, Ninh Thuan and Phu Quoc. However, the existing activities have not sufficiently covered the areas with coral reefs, and have not provided enough data and information for coral reef management in Viet Nam.

Groups of islands in southwest Viet Nam, including Nam Du, Tho Chu and Phu Quoc are recognized as the important areas in terms of biodiversity and fisheries in Viet Nam. The diversity of habitats, marine organisms and the importance of fishing grounds has resulted in Nam Du, Tho Chu and Phu Quoc areas to become important MPAs in Viet Nam (ADB 2000). During the last few years, tourism has played an important role in terms of economical development and it still becomes the first priority in the development of the districts in the next five years. Together with tourism development, marine resources are heavily exploited. Coral reefs are very abundant but suffer the impacts from over fishing and other anthropogenic activities.

1. AIM OF THE PROJECT

The overall aims of the coral reefs assessment in the islands are:

- To provide a systematic framework to determine the status of coral reefs and to develop a system for monitoring changes in ecosystem health and marine resources. The baseline assessment of coral reefs is to establish a biophysical monitoring system to determine the impacts of the changes in the management regime within the islands. This will focus on the sessile coral reef benthos, e.g. corals, algae, sponges and reef-associated fish.
- To promote awareness of local communities on the status and need for marine conservation of coral reefs and related ecosystems through necessary knowledge and information from the training course.

The field and analytical methods chosen for the ecological monitoring form part of the Global Coral Reef Monitoring Network (GCRMN) standard protocols, ReefCheck and more detailed fish and coral census. Staff of the Institute of Oceanography, Nha Trang (NIO) is conducting the monitoring. The Community-based Monitoring Team (C-b MT) of Kien Giang Province has received detailed training in monitoring theory and practice from NIO (see later).

2. ACTIVITIES

2.1 Training of Marine Conservation for Local Stakeholders

A training workshop on Marine Conservation and Coral Reef Management for local stakeholders of Phu Quoc district was conducted from 25 to 29 March 2003 with collaboration from Institute of Oceanography and Phu Quoc Department of Agriculture, Forestry and Fisheries. Representatives from Phu Quoc Department of Agriculture, Forestry and Fisheries, Kien Giang Department of Fisheries Protection, Phu Quoc National Park, Phu Quoc Radio and Television Station, some leaders and fishers from An Thoi, Duong Dong fishing villages of Phu Quoc district attended the workshop.

3. REEFCHECK SURVEYS

3.1 Location of Monitoring Sites

This is an important consideration, as all other aspects follow from it. There are several key criteria that need to be met:

3.1.1 Locatability

Sites should be easily locatable, using landmarks, compass bearings and portable Geographic Positioning System (GPS) units.

3.1.2 Accessibility

Sites should be accessible, based on a realistic assessment of logistic and budgetary constraints, weather and sea conditions.

3.1.3 Representativeness – uniqueness

As much as is practicable given logistic constraints, sites should be representative of the different biotopes, habitats, and community types present. Similarities and variety in habitat and environmental attributes, known histories of the sites including effects of disturbance, likely future disturbances all need to be considered in site selection.

3.1.4 Present status

Sites should cover the range of different conditions in terms of disturbances, from recently impacted to “pristine,” rather than concentrating only on reefs in good condition.

3.1.5 Depth

Sites should as far as practicable be within standardized depth ranges 2-4 m and 5-10 m, consistent with the GCRMN recommendations for a depth stratified sampling design. It is important that transects within each of these 2 depth ranges are positioned randomly within homogeneous habitats, rather than across different habitats.

3.1.6 Positioning of transects

Transects should be initially positioned randomly within the chosen habitat types, rather than selected to intersect the “best” or “worst” areas, and should remain within relatively homogeneous biotopes as far as is practicable. Subsequent to initial selection, transects are fixed “permanently” using steel pegs hammered or cemented into the substrate.

3.1.7 Fixed “permanent” versus haphazard or “random” transects

The pros and cons of fixed versus haphazard transects are complex, involving both statistical and logistic considerations. Statistically, fixed transects are considered to eliminate one important source of variation (spatial differences within sites) during subsequent monitoring. It is crucial that tapes are laid tightly between the marker pegs on each monitoring survey. Potential problems with fixed transects

include dislodgment of markers during storms, removal by fishermen or difficulties of re-location in turbid conditions or with seasonal growth of macro-algae. Thus if transects are fixed, additional markers should be carried with the team on each visit for replacement of lost markers.

Haphazard rather than fixed transects have several advantages in terms of saving time, but introduce a second potential source of variance (spatial as well as temporal). Because of this, transects were marked “permanently” with steel marker pegs hammered into the reef at the start and end points. Maps were drawn of important noticeable features of the reef-scape, and portable GPS was used to record site locations for ease of re-location.

3.2 Field Methods

3.2.1 Site selection

The group of islands, including Nam Du, Tho Chu and Phu Quoc islands are located in Southwest Viet Nam, belonging to Kien Giang Province. Scientists from Institute of Oceanography collected information about the islands from interviewing local fishermen and rapid surveys. Four new monitoring sites were established at Nam Du (Figure 1) and four sites at Tho Chu islands (Figure 2). The surveys conducted at Nam Du and Tho Chu islands were carried out from 24 November to 7 December 2002. Six permanent monitoring sites of coral reefs at Phu Quoc islands established in 2002 were re-surveyed from 21 to 26 April 2003 (Figure 3).

These locations represent all major coral reef community types and a wide range of status, with several remaining in good condition, and others badly affected by destructive fishing and/or other activities. The locations thus provided an excellent opportunity to assess future changes to coral reefs in the islands and the effectiveness of management measures.

At each location, deep and shallow monitoring sites were established, and marked permanently with steel stakes hammered into the substrate. At each monitoring site, cover and composition of corals (to genus level) and other sessile benthos, and sizes and abundances of selected fish and invertebrates, including local “indicator” species, were assessed using standard methods based on the Global Coral Reef Monitoring Network and ReefCheck protocols.

3.2.2 Location description

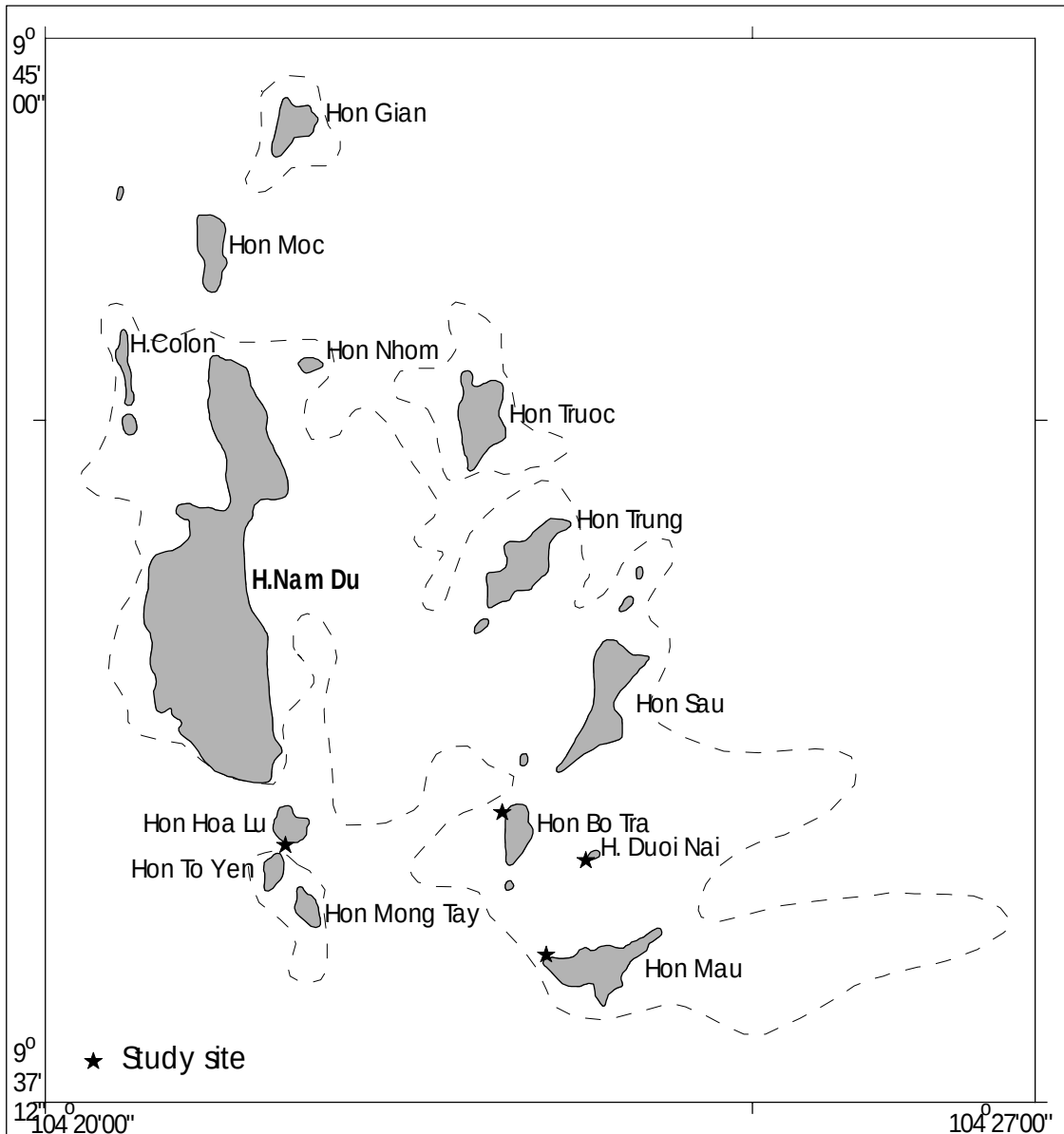
Various types of information were recorded on *pro forma* site description data sheets, for ease of re-location in future surveys and to aid understanding of present status of each location. These included:

- Reef name or other identifier (number etc.)
- Sample identity (ID)
- Location – GPS position, compass bearings, maps etc.
- Date, time, weather conditions
- Observers' names
- Status – any recent impacts
- Anecdotal information – local knowledge about the site
- Other observations – notes on location at time of survey
- History – previously published information on the site
- Other remarks

3.2.3 Corals and other sessile benthos – point intercept transects

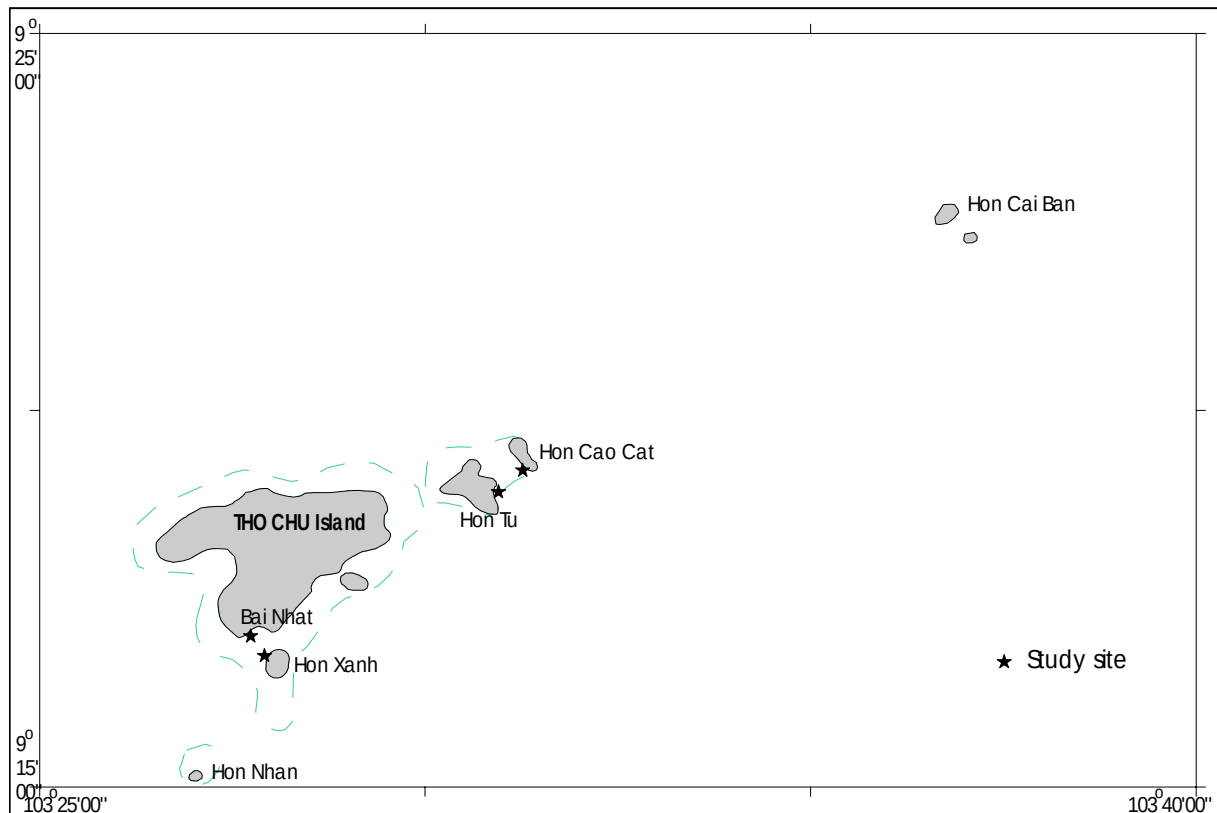
Quantitative assessment of the percentage cover of 10 categories of sessile benthos were made using four 20 m line transects, laid parallel to the selected depth contours at 2 depths at each site. The depths surveyed were 4-10 m and 2-4 m below the chart data of low water or reef crest where no

Figure 1. Map showing the study sites of coral reefs at Nam Du islands



data was known. Surveys were conducted by SCUBA using a 100 m long transect tape laid along the selected depth contour from a randomly selected starting point on the reef slope, with the first 20 m transect starting from the beginning of the tape. The second transect started after an interval of 5 m from the end of the first transect (i.e. 25 m) and similarly for the third (50 m) and fourth transects (75 m).

Figure 2. Map showing the study sites of coral reefs at Tho Chu islands



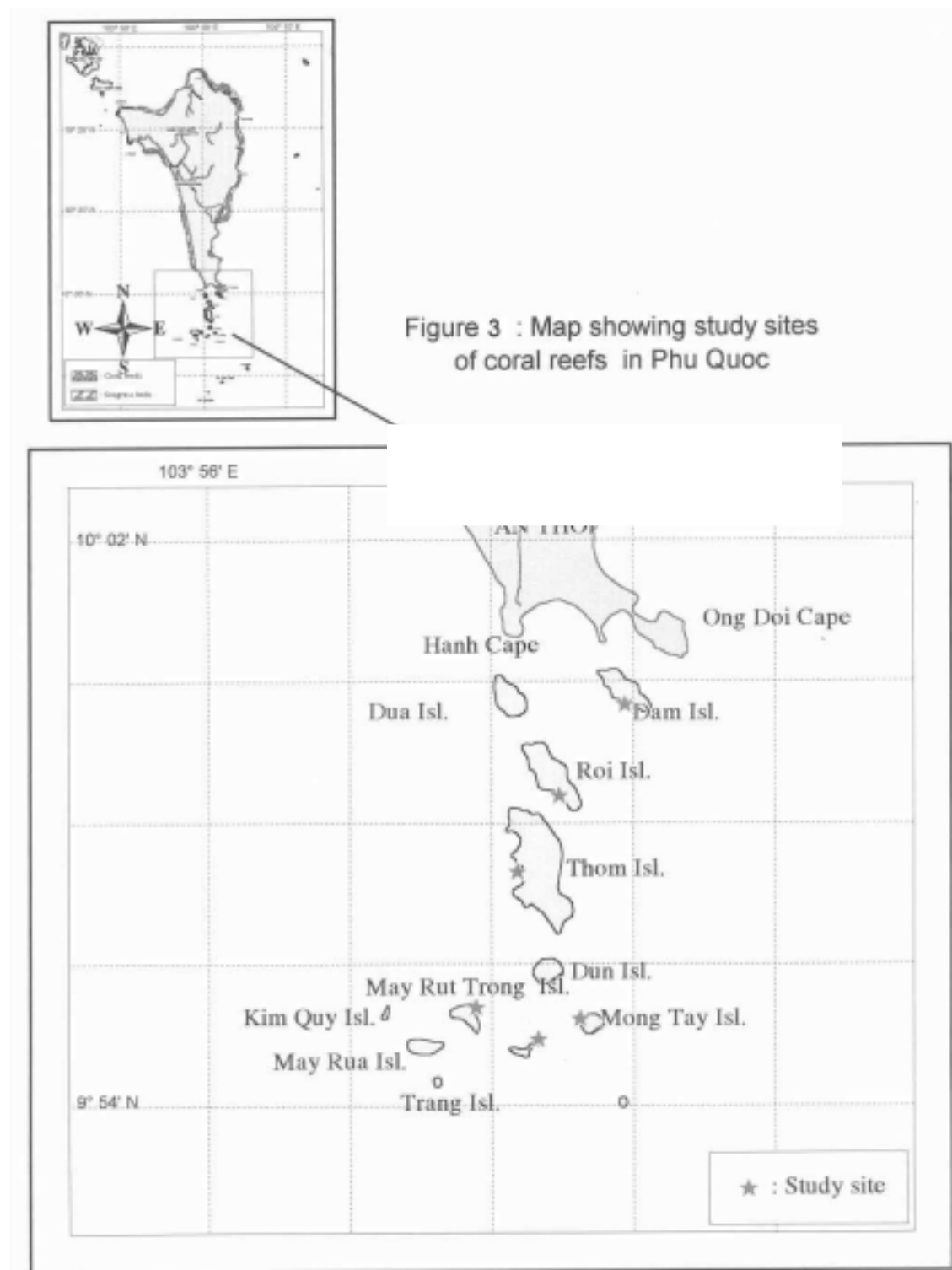
3.2.4 ReefCheck indicators of change

The aim of this study is to establish a community-based monitoring team of coral reefs for the local province and to monitor short-term (annual) and long-term (decadal) changes in habitats and marine resources as a result of the management activities. This will focus on the sessile coral reef benthos, e.g. corals, algae, sponge, reef-associated fish and invertebrates following ReefCheck methods below.

- Coral reef benthos: The 10 categories of benthos recorded on the transects were: live hard coral (HC), dead coral (DC), soft coral (SC), fleshy seaweed (FS), sponge (SP), rock (RC), rubble (RB), sand (SD), silt/clay (SI) and other (OT).
- Coral reef fish indicator: The target fish species counted in each transect include: Grouper (*Cephalopholis* and *Epinephelis* spp.) and coral trout (*Plectropomus* spp.) over 30 cm total length (all species), Baramundi cod (*Cromileptes altivelis*), Sweetlips (family Haemulidae – *Plectorhynchus* spp.), Humphead (Napoleon) wrasse (*Cheilinus undulatus*), Bumphead parrot fish (*Bolbometopon muricatum*), Butterfly fish (all species of family Chaetodontidae). Some additional families of fish were also counted along the transects.
- Invertebrate indicator species: The organisms included: giant clams (*Tridacna* spp.), pencil urchins (*Heterocentrotus mammillatus*), long-spined urchins (*Diadema* spp.), sea cucumbers, crown-of-thorns starfish (*Acanthaster planci*), giant triton (*Charonia tritonis*), top shell (*Trochus*), banded coral shrimps (*Stenopus hispidus*), lobsters (*Panulirus* spp.).

Items of human litter (trash) were also recorded. Photographs of the above species are provided on the ReefCheck web site.

Figure 3. Map showing study sites of coral reefs in Phu Quoc



3.2.5 Data storage

Field data were entered into purpose-designed EXCEL spreadsheets available from the ReefCheck web site.

4. RESULTS AND DISCUSSION

4.1 Training Workshop

4.1.1 Training workshop on marine conservation

A total of 12 participants attended the training workshop on 25 April 2003. At the opening ceremony of the workshop, Mr. Nguyen Hung Cuong, head of Phu Quoc Department of Agriculture, Forestry and Fisheries, a facilitator of the workshop, introduced and welcomed all participants, and gave a brief introduction about the aim of the workshop. Mr. Nguyen Hung Cuong thanked the Institute and the project for giving the participants opportunities to learn and enhance their knowledge on marine conservation. Next to that, Mr. Nguyen Van Long, leader of the Project, from Nha Trang Institute of Oceanography welcomed the participants on behalf of the Institute, and gave an overview on the status of coral reef management in Viet Nam, the importance of marine conservation and activities of the project.

Following the opening ceremony, some lectures were distributed to all participants. The aim of the lectures were:

- To promote knowledge of local stakeholders on marine conservation and coral reef management, and
- To discuss the prevailing problems of the province on coral reef conservation and management.

The lectures were mainly focused on:

- Food webs and the interaction between land and marine environment,
- Introduction on the roles and functions of tropical marine ecosystems such as coral reefs, mangroves and seagrass beds,
- Status of exploitation and utilization of marine resources,
- Impacts to marine resources and marine ecosystems, and
- The role of marine conservation and management to marine resources and marine ecosystems, especially coral reef management.

4.1.2 Training of the community-based coral reef monitoring team

After the lectures on marine conservation, the nine participants (Table 1) attended a ReefCheck training workshop on coral reef monitoring. All volunteers met the selection criteria, including good health and willingness to work in monitoring, including dissemination of results to villagers. Most of the participants also had extensive prior experience with hookah diving, and all were able to understand the lectures in Viet Nameese. The ReefCheck training was divided into two steps.

The first step was conducted on 26 March 2003. The local volunteers were trained in the specific methodology of ReefCheck technique, including draft practical with specimens and pictures, in a lecture room. This was followed by three days of field practice, diving on some reefs at An Thoi islands, south of Phu Quoc Island.

The second step was field practice, conducted from 27 to 29 March 2003. In the field, the Community-based Monitoring Team (C-b MT) was divided into two groups. Under supervision of the NIO trainers, the trainees conducted practice surveys underwater, identifying marine organisms such as fish, macro-benthos and substratum types (live corals, dead coral, rubble coral, sponges, seaweeds). Subsequent to the initial orientation dives, the trainees practiced the ReefCheck methods on the transect. The aim of the practical work was:

- To help the C-b MT identify different types of marine organisms underwater, and
- To train the C-b MT on data collection and analysis.

Figure 4. Practicing for ReefCheck survey, and ReefCheck volunteers in the field



Table 1. List of Community-base Coral Reef Monitoring Team

No.	Full name	Permanent address
1	Pham Ngoc Tuan	Kien Giang Department of Fisheries Protection
2	Nguyen Dinh Xuyen	Kien Giang Department of Fisheries Protection
3	Do Van Thanh	Phu Quoc National Park
4	Luu Duc Tuan	Phu Quoc National Park
5	Nguyen Ngoc Linh	Phu Quoc Department of Agriculture, Forestry and Fisheries
6	Tran Van Muoi	An Thoi Commune, Phu Quoc district
7	Pham Nghi	An Thoi Commune, Phu Quoc district
8	Tran Lam	Duong Dong Commune, Phu Quoc district
9	Tran Cung	Duong Dong Commune, Phu Quoc district

All trainees independently conducted their surveys on the transects at two reefs, Hon Roi and Hon Thom. Each of the trainees tried to record three different components including substratum types, fish and invertebrate belt transect at each reef.

4.1.3 Evaluation on training workshop

Through the training workshop, knowledge of all participants on marine conservation was improved. The two participants from Phu Quoc National Park were very satisfied with information on marine environment provided by the workshop.

They said, "It is a good opportunity for us to participate in the workshop. We are very grateful and benefited very much from the workshop. We have obtained a lot of new and useful information on marine environment that we have never known before."

They suggested that similar workshops should be organized at Phu Quoc National Park and other places in Phu Quoc in order to enhance knowledge of their colleagues and fishermen on marine conservation.

Participants from Duong Dong and An Thoi communes, Phu Quoc district added, "Now we are understanding the important role of coral reefs and the reasons why our marine living resources are rapidly declining during the last several years that we did not know before."

Practical data collected by trainees on the two reefs showed a large range in identifying of substratum types between trainees and scientists on the first practical day. The data have been improved and became better and more uniform on the following days. However, some problems generated from the workshop may be summarized as follows:

- Some of the trainees had difficulty distinguishing between recently killed corals and rock, even though this has received much attention from the first day of practical works.
- Some of the trainees were confused when the transect lines moved due to disturbances.
- Four or five trainees in each group were too much because they will disturb each other when they are underwater.
- More practical works underwater are needed in order to make the trainees more familiar with identifying substratum types, fish and invertebrates.
- Some indicators such as fish and invertebrates in ReefCheck method are absent on most of the reefs. So it is necessary to add some more local indicators when surveying or monitoring coral reefs.

4.2 Status of Coral Reefs in Southwest Islands Groups

4.2.1 Nam Du islands

4.2.1.1 Benthic components

Hard coral cover for all species at 4 study reefs conducted in 2002 ranged from 37.8 (Hon Mau) to 62.8% (Hon Hoa Lu), giving mean value of 47.4 , 11.7% (Table 2). This indicates that the condition of study reefs at Nam Du islands is good. Hon Hoa Lu and Hon Duoi Nai had higher values of coral cover compared to that at Hon Bo Tra and Hon Mau.

Soft coral cover was not recorded on the transects at all sites. Dead corals died within 1-2 years were recorded with less than 2% cover at all reefs while rock component including rock and old dead coral covered by algae had high values at most of reefs, ranging from 25.3 to 40.9% (Table 2). Cover of fleshy seaweeds had low value and this was less than 3% at all reefs. *Porites* was the most common genus found at all reefs and means cover of this genus occupied with very high values at Hon Hoa Lu (50.3%) and Hon Duoi Nai (36.3%). *Acropora*, *Montipora* and *Pavona* were also common on the reefs (Table 3).

Table 2. Cover (%) of coral and other benthos at 4 permanent monitoring sites, Nam Du islands, November 2002

Study site	Transect	Substratum									
		Hard Coral	Soft Coral	Dead Coral	Fleshy sea-weed	Sponge	Rock	Rubble	Sand	Mud	Other
Hon Hoa Lu	Shallow	64.4	0.0	1.9	3.1	0.0	23.1	0.0	0.0	0.0	7.5
	Deep	61.3	0.0	0.6	0.6	2.5	27.5	0.0	1.9	1.9	3.7
	Average	62.8	0.0	1.3	1.8	1.3	25.3	0.0	0.9	0.9	5.6
Hon Bo Tra	Shallow	31.9	0.0	0.0	0.6	0.0	42.5	6.9	13.1	1.3	3.7
	Deep	45.6	0.0	1.2	0.6	3.7	33.1	1.3	6.9	0.0	7.5
	Average	38.7	0.0	0.6	0.6	1.8	37.8	4.1	10.0	0.7	5.6
Hon Mau	Shallow	45.0	0.0	0.0	1.3	1.9	43.1	0.6	1.9	0.0	6.3
	Deep	30.6	0.0	0.6	0.0	10.0	38.8	0.6	10.0	0.6	8.7
	Average	37.8	0.0	0.3	0.7	5.9	40.9	0.6	5.9	0.3	7.5
Hon Duoi Nai	Shallow	50.0	0.0	1.3	0.0	0.0	44.4	1.9	0.0	0.0	2.5
	Deep	50.0	0.0	0.0	0.0	3.1	34.4	0.0	6.9	0.0	5.6
	Average	50.0	0.0	0.6	0.0	1.6	39.4	0.9	3.8	0.0	4.1

Table 3. Sites with some dominant genera of corals, Nam Du islands

Study site	Common genera (percentage cover)
Hon Hoa Lu	<i>Porites</i> (50.3%), <i>Montipora</i> (6.3%), <i>Acropora</i> (3.1%), <i>Pavona</i> (1.6%)
Hon Bo Tra	<i>Porites</i> (30.3%), <i>Acropora</i> (3.4%), <i>Pavona</i> (1.3%), <i>Montipora</i> (0.9%)
Hon Mau	<i>Porites</i> (24.7%), <i>Acropora</i> (30.3%), <i>Montipora</i> (30.3%), <i>Pavona</i> (30.3%)
Hon Duoi Nai	<i>Porites</i> (36.3%), <i>Acropora</i> (1.6%), <i>Montipora</i> (1.3%), <i>Pavona</i> (1.3%)

4.2.1.2 Coral reef fish

Density of coral reef fish at 4 reefs averaged 5,447.6 , 2760.5 individuals per 500 m², ranging from 2630 (Hon Bo Tra) to 7,871 individuals per 500 m² (Hon Hoa Lu) (Table 4). Fish less than 10 cm at the majority of the transects were composed of over 96% of this smallest size group which were dominated by pomacentrids and labrids. *Chromis ternatensis* was the main contributor to the density of fish at this area. Mean density of this species reached up to 2,000-3,000 individuals per 500 m² at some reefs such as Hon Hoa Lu, Hon Mau and Hon Duoi Nai. *Pomacentrus* spp., *Hipposcarus longiceps*, *Caesio caeruleurea* and *Caesio teres* that contributed respectively 100 to 300 fish at both shallow and deep transects.

Larger fish (size categories 21-30 cm and >30 cm) were very scarce at all location. *Hipposcarus longiceps*, *Caesio cuning*, *Caesio teres* and *Siganus virgatus* of >20 cm were mainly dominated fish. Some commercial fish in the more than 30 cm size range such as groupers, sweetlips, snappers, emperors have been scarce at all reefs.

Some important target fish such as barramundi cod *Cromileptes altivelis*, sweetlips, humphead wrasse *Cheilinus undulatus* and bumphead parrot fish *Bolbometopon muricatum* in ReefCheck method were not recorded on the reefs during the survey 2002. Grouper >30 cm in length was recorded at very low number. One big grouper *Epinephelus* spp. over 50 cm in length and one individual of *Plectropomus maculatus* (>35 cm) were found at shallow and deep transect of Hon Mau. Sweetlips were only recorded at Hon Hoa Lu with mean density being 0.5 , 1.0 individuals per 400 m² (Table 5).

Table 4. Density of fish (individuals per 500 m²) in different size classes at permanent monitoring sites, Nam Du islands, November 2002

Size classes	Size classes				Total
	1-10 cm	11-20 cm	21-30 cm	>30 cm	
Hon Hoa Lu	7656	207	8	0	7871
Bai Bo Tra	2536	92	2	0	2630
Hon Mau	7487	275	0	1	7763
Hon Duoi Nai	3357	169	1	0	3527
Average/site , s.d.	5259 , 2692.1	185.7 , 76.3	2.7 , 3.6	0.2 , 0.5	5447.6 , 2760.5
%	96.53	3.41	0.049	0.011	100

Table 5. Density of ReefCheck indicator fish (individuals per 400 m²) at permanent monitoring sites, Nam Du islands, November 2002

Location	Indicator fish					
	Butterfly-fish Chaetodontidae	Grouper >30 cm Serranidae	Barramudi cod Cromileptes altivelis	Sweetlips Haemulidae	Hump- headfish Chelinus undulatus	Bumphead parrot fish Bolbometopon muricatum
Hon Hoa Lu	58	0	0	2	0	0
Hon Bo Tra	38	0	0	0	0	0
Hon Mau	50	1	0	0	0	0
Hon Duoi Nai	90	0	0	0	0	0
Average/site	59 , 22.2	0.25 , 0.5	0.0 , 0.0	0.5 , 1.0	0.0 , 0.0	0.0 , 0.0

Mean abundance of ornamental fish such as butterfly fish, damselfish and wrasses were recorded with a high value. Of these, damselfish reached up to 4321.4 , 2160.9 individuals per 500 m² in average and wrasses ranged from 71 to 171 individuals per 500 m². Groupers were recorded at relatively high number of more than 30 individuals per 500 m² in average, of which *Cephalopholis boenak*, *Cephalopholis microprion*, *Cephalopholis formosa* and *Epinephelus fasciatus* were the main contributors. Snappers, sweetlips, parrot fish and rabbit fish occurred with low number at most of the reefs (Table 6). Angelfish and surgeon fish were not found at all study reefs.

Table 6. Density of various families of fish (individuals per 500 m²) at permanent monitoring sites, Nam Du islands, November 2002

Family of fish	Study site				
	Hon Hoa Lu	Hon Bo Tra	Hon Mau	Hon Duoi Nai	Average/site
Damselfish	6138	2259	6236	2652	4321.4 , 2160.9
Wrasses	71	128	171	116	121.5 , 40.9
Groupers	17	15	44	50	31.4 , 17.9
Snappers	1	1	8	7	4.1 , 3.6
Parrot fish	56	1	14	1	18.0 , 26.1
Rabbit fish	6	0	2	2	2.5 , 2.5

4.2.1.3 Invertebrates

Density of the ReefCheck indicator invertebrates ranged widely among sites, 262 to 723 individuals per 400 m² (Table 7), with mean value being 465 , 191.1 individuals per 400 m². Hon Duoi Nai supported the highest density (723 individuals per 400 m²) (Table 7).

Density of mollusc indicators recorded at 4 study reefs in 2002 following ReefCheck method, including *Tridacna*, *Trochus* and triton shell *Charonia*, averaged 2.7 , 1.3 individuals per 400 m², ranging from 1.0 to 4 individuals per 400 m². This mean value shows a very low number of molluscs remaining on coral reefs in this area compared to that in other areas in coastal waters of Viet Nam. *Tridacna* have been found at almost reefs with density averaging 0.75 individuals per 400 m².

Lobsters (*Parulinus*) and banded coral shrimp (*Stenopus hispidus*) were not found at the 4 study reefs in 2002. Lobsters are exploited for food and aquaculture and that reached the levels of being over-harvested at the area.

Density of echinoderms indicators ranged from 261 (Hon Hoa Lu) to 719 individuals (Hon Duoi Nai) per 400 m², with mean value being 462.5 , 189.9 individuals per 400 m², of which sea urchin (*Diadema*) occurred in high number, ranging from 260 to 716 individuals per 400 m² (Table 7). Crown-of-thorns sea star *Acanthaster planci* was only recorded at Hon Hoa Lu with low number. Edible sea cucumbers were absent at all reefs while inedible species occurred on some reefs, giving rise of mean value of 1.25 , 1.25 individuals per 400 m².

The results indicate that invertebrate densities at all sites were dominated by sea urchins (*Diadema* spp.). By contrast, the economically important species, e.g. edible holothurian sea cucumbers, lobsters (*Parulinus* spp.), giant clams (*Tridacna* spp.), Triton trumpet shell (*Charonia tritonis*) and cone shell (*Trochus*), were all extremely rare or absent from the sites, another strong indicator of the intense overexploitation occurring in Nam Du waters.

Table 7. The density of macro-invertebrates (individuals per 400 m²) at permanent monitoring sites, Nam Du islands, November 2002

Indicator invertebrate group or species	Study site				
	Hon Hoa Lu	Hon Bo Tra	Hon Mau	Hon Duoi Nai	Average/ site
Banded shrimp	0	0	0	0	0.0 , 0.0
Lobster	0	0	0	0	0.0 , 0.0
Sea urchin (<i>Diadema</i>)	260	448	420	716	461 , 189.1
Pencil urchin	0	0	0	0	0.0 , 0.0
Crown-of-thorns starfish	1	0	0	0	0.25 , 0.5
Sea cucumber	0	1	1	3	1.25 , 1.25
Cone shell	0	2	2	4	2.0 , 1.6
Giant clam	1	1	1	0	0.75 , 0.5
Triton trumpet	0	0	0	0	0.0 , 0.0
Total	262	452	424	723	465 , 191.1

4.2.2 Tho Chu Islands

4.2.2.1 Benthic components

Hard coral cover for all species at both shallow and deep transects at 4 study reefs conducted in 2002 were very low. Mean cover at individual reefs ranged from 4.6 (Hon Tu) to 15.9% (Bai Nhat), giving mean value of 11.3 , 4.8% (Table 8). This indicates that the condition of study reefs at Tho Chu islands is very poor. The reefs at Tho Chu islands were heavily damaged by Typhoon in the past. However, many colonies of corals, mainly *Acropora*, were recovering. Recovery of new *Acropora* corals at Bai Nhat and Hon Cao Cat was better than that at Hon Xanh and Hon Tu.

Cover of fleshy seaweeds ranged from 10.9 (Hon Xanh) to 36.3% (Hon Tu), giving rise of mean value of 19.7 , 11.3% (Table 8). This shows a relative high value of fleshy seaweeds covering on the reefs at Tho Chu islands compared to that at Nam Du and Phu Quoc islands (results of present study). Soft coral cover was not also recorded on the transects at all sites. Dead corals died within 1-2 years were recorded with less than 1% at both shallow and deep transects of all reefs while rock component (including rock and old dead coral covered by algae) had high values at most of reefs, ranging from 43.2

to 60.0% (Table 8). Cover of sponges had low value with the highest value being less than 4%. *Acropora* was the most common genus found at all reefs while *Porites* was commonly found at Nam Du and Phu Quoc islands. Mean cover of *Acropora* occupied with very high values at Bai Nhat (13.4%), Hon Xanh (6.6%) and Hon Cao Cat (7.5%). *Montipora*, *Pocillopora* and *Diploastrea* were also common on the reefs but mean cover of each genus at individual sites was less than 2% (Table 9).

Table 8. Cover (%) of coral and other benthos at 4 permanent monitoring sites, Tho Chu islands, December 2002

Study site	Transect	Substratum									
		Hard Coral	Soft Coral	Dead Coral	Fleshy sea-weed	Sponge	Rock	Rubble	Sand	Mud	Other
Hon Xanh	Shallow	15.6	0.0	0.0	14.4	0.0	62.5	7.5	0.0	0.0	0.0
	Deep	9.3	0.0	0.0	7.5	0.0	57.5	19.4	4.3	0.0	1.8
	Average	12.5	0.0	0.0	10.9	0.0	60.0	13.4	2.2	0.0	0.9
Bai Nhat	Shallow	13.1	0.0	0.0	20.6	0.0	66.3	0.0	0.0	0.0	0.0
	Deep	18.8	0.0	0.6	10.6	0.6	52.5	16.9	0.6	0.0	0.0
	Average	15.9	0.0	0.3	15.6	0.3	59.4	8.5	0.3	0.0	0.0
Hon Tu	Shallow	3.7	0.0	0.0	44.4	0.6	46.9	3.7	0.6	0.0	0.0
	Deep	5.6	0.0	0.0	28.8	1.3	39.4	19.4	5.0	0.0	0.6
	Average	4.6	0.0	0.0	36.3	0.9	43.2	11.6	2.8	0.0	0.3
Hon Cao Cat	Shallow	8.1	0.0	0.0	30.6	3.8	46.3	7.5	0.0	0.0	3.8
	Deep	16.3	0.0	0.0	1.3	2.5	46.3	24.4	8.7	0.0	0.6
	Average	12.2	0.0	0.0	15.9	3.2	46.3	15.9	4.4	0.0	2.2

Table 9. Sites with some dominant genera of corals, Tho Chu islands

Study site	Common genera (percentage cover)
Hon Xanh	<i>Acropora</i> (6.6%), <i>Montipora</i> (1.9%), <i>Pocillopora</i> (1.9%), <i>Diploastrea</i> (1.6%)
Bai Nhat	<i>Acropora</i> (13.4%), <i>Diploastrea</i> (1.3%), <i>Pocillopora</i> (0.6%), <i>Montipora</i> (0.3%)
Hon Tu	<i>Acropora</i> (1.3%), <i>Pocillopora</i> (1.3%), <i>Montipora</i> (0.3%), <i>Pavona</i> (0.3%)
Hon Cao Cat	<i>Acropora</i> (7.5%), <i>Pocillopora</i> (0.9%), <i>Montipora</i> (0.3%)

4.2.2.2 Coral reef fish

Density of coral reef fish at 4 reefs averaged 6922.7 , 2999.4 individuals per 500 m², ranging from 3884 (Bai Nhat) to 11,063 individuals per 500 m² (Hon Xanh) (Table 10). Fish less than 10 cm were the most abundant, making up over 96% of this smallest size group which were dominated by pomacentrids and labrids. Pomacentrids *Dascyllus reticulatus*, *Pomacentrus* spp., *Chromis ternatensis* and *Chromis weberi* were the main contributors to the density of fish at this area. *Stegastes lividus* occupied with high number (100-200 individuals per 500 m²) at some reefs such as Hon Tu and Hon Cao Cat. Fish of 21-30 cm and >30 cm were mainly Scarids, Siganids and Serranids. Serranids such as *Cephalopholis formosa*, *Cephalopholis microprion* and *Epinephelus fasciatus* with the size of 20-30 cm were common found at all reefs. *Lutjanids* *Lutjanus decussatus* with the size larger than 30 cm was recorded out of the transects at Hon Tu and Hon Cao Cat. Scarids *Hippocampus longiceps* and Caesionids *Caesio cuning* and *Caesio teres* that contributed respectively high numbers at the deep transects of all reefs.

With the exception of butterfly fish, some important target fish such as barramundi cod (*Cromileptes altivelis*), sweetlips, humphead wrasse (*Cheilinus undulatus*) and bumphead parrot fish (*Bolbometopon muricatum*) were not recorded by the ReefCheck method on the reefs during the survey 2002. Only one grouper >30 cm in length was recorded at deep transects of Hon Cao Cat while some groupers with the size range of 20-30 cm belonging to *Cephalopholis formosa*, *Cephalopholis microprion* and *Epinephelus fasciatus* were found at all reefs. Sweetlips were not observed at all reefs (Table 11).

Table 10. Density of fish (individuals per 500 m²) in different size classes at permanent monitoring sites, Tho Chu islands, December 2002

Location	Size classes				Total
	1-10 cm	11-20 cm	21-30 cm	>30 cm	
Hon Xanh	10854	201	6	2	11063
Bai Nhat	3718	165	1	0	3884
Hon Tu	5958	348	0	0	6306
Hon Cao Cat	6239	196	3	1	6439
Average/site , s.d.	6692 , 2995.0	227.5 , 81.8	2.5 , 2.6	0.7 , 0.9	6922.7 , 2999.4
%	96.67	3.28	0.04	0.01	100

Table 11. Density of ReefCheck indicator fish (individuals per 400 m²) at permanent monitoring sites, Tho Chu islands, December 2002

Location	Indicator fish					
	Butterfly-fish Chaetodontidae	Grouper >30 cm Serranidae	Barramundi cod Cromileptes altivelis	Sweetlips Haemulidae	Hump-headfish Cheilinus undulatus	Bumphead parrot fish Bolbometopon muricatum
Hon Xanh	10	0	0	0	0	0
Bai Nhat	13	0	0	0	0	0
Hon Tu	20	0	0	0	0	0
Hon Cao Cat	9	1	0	0	0	0
Average/site	13 , 4.9	0.25 , 0.5	0.0 , 0.0	0.0 , 0.0	0.0 , 0.0	0.0 , 0.0

Damselfish were the most abundant in the group of ornamental fish. Mean abundance of this family ranged from 3501 to 10,727 individuals per 500 m², giving rise of mean value of 6329.9 , 3086.3 individuals per 500 m². Wrasses occupied with a relative low number, ranging from 175 to 245 individuals per 500 m². Groupers were recorded at high number, ranging from 22 to 57 individuals per 500 m² (Table 12), but fish of *Cephalopholis boenak* (size range: 10-20 cm) was the main contributor of the density. Although, groupers had high number at all reefs. Snappers and rabbit fish have been absent at both transects at most of the reefs while parrot fish were found at 26.6 , 8.7 individuals per 500 m² (Table 12). Angelfish and surgeon fish were not found at any study reefs.

Table 12. Density of various families of fish (individuals per 500 m²) at permanent monitoring sites, Tho Chu islands, December 2002

Family	Study site				
	Hon Xanh	Bai Nhat	Hon Tu	Hon Cao Cat	Average/ site
Damselfish	10727	3501	5506	5585	6329.9 , 3086.3
Wrasses	245	175	210	212	210.5 , 28.8
Groupers	39	28	22	57	36.4 , 15.5
Snappers	0	0	0	0	0.0 , 0.0
Parrot fish	17	33	26	15	26.6 , 8.7
Rabbit fish	0	0	3	0	0.6 , 1.3

4.2.2.3 Invertebrates

Mean abundance of the ReefCheck indicator invertebrates at individual reefs ranged from 10 (Hon Xanh and Bai Nhat) to 290 individuals (Hon Cao Cat) per 400 m², with mean value being 465 , 191.1 individuals per 400 m², of those sea urchin *Diadema* was the main contributor (Table 13).

Density of mollusc indicators following ReefCheck method, including *Tridacna*, *Trochus* and triton shell *Charonia*, was recorded at very low number. Mean abundance of giant clams, cone and triton shells at all sites was less than 1.0 individual per 400 m². This indicates a very low number of molluscs remaining on coral reefs in this area compared to that in other areas in coastal waters of Viet Nam. *Tridacna* were found at some reefs with density averaging 0.5 individuals per 400 m².

Lobsters and banded coral shrimp were absent at all reefs.

Echinoderms are the main contributors to the density of macro-benthos. Density of some indicators ranged from 8 (Bai Nhat) to 290 individuals (Hon Cao Cat) per 400 m², giving a mean value of 92.5 , 134.1 individuals per 400 m², of which sea urchin *Diadema* occurred in high number, ranging from 7 to 285 individuals per 400 m² (Table 13). Crown-of-thorns sea star *Acanthaster planci* was recorded at almost reefs with mean density being 1.25 , 1.25 individuals per 400 m² (Table 13). Hon Cao Cat supported the highest number of crown-of-thorn sea stars. Density of sea cucumbers averaged 2.5 , 2.5 individuals per 400 m², ranging from 0 to 6 individuals per 400 m² (Table 13), of which inedible species were the main contributors on the reefs.

The results also indicate that commercial macro-benthos were heavily over-harvested at almost reefs. Although mean density of macro-benthos remaining on the reefs at Tho Chu islands was high, but mostly dominated by sea urchins (*Diadema* spp.). One of a big consideration that crown-of-thorn sea stars occurred with relative high number at some reefs and that will cause big problem to coral reefs in Tho Chu waters, especially dangerous to new recruits of *Acropora* corals.

Table 13. The density of macro-invertebrates (individuals per 400 m²) at permanent monitoring sites, Tho Chu islands, December 2002

Indicator invertebrate group or species	Study site				
	Hon Xanh	Bai Nhat	Hon Tu	Hon Cao Cat	Average/ site
Banded shrimp	0	0	0	0	0.0 , 0.0
Lobster	0	0	0	0	0.0 , 0.0
Sea urchin (<i>Diadema</i>)	7	7	56	285	87.5 , 132.8
Pencil urchin	0	0	0	0	0.0 , 0.0
Sea cucumber	2	0	6	2	2.5 , 2.5
Crown-of-thorns starfish	1	1	0	3	1.25 , 1.25
Cone shell	0	1	0	0	0.25 , 0.5
Giant clam	0	1	1	0	0.5 , 0.5
Triton trumpet	0	0	0	0	0.0 , 0.0
Total	10	10	63	290	93.2 , 133.5

4.2.3 Phu Quoc islands

4.2.3.1 Benthic components

Data collected from 12 transects in April 2003 showed a low overall average value of living coral cover. According to the division of English et al. (1997), 25% reefs were in good condition, 41.7% reefs in fair condition and 33.3% reefs in poor condition.

Average hard coral cover at individual sites ranged from 19.1 to 49.4% (Table 14), giving a mean value for the area of 36.6 , 10.7%. The mean value of hard coral cover indicates that the condition of reefs at Phu Quoc islands are generally fair. The sites at north of Hon May Rut Trong, north of Hon Dam Ngang and south-west of Hon Dam had high cover of hard coral (42.2-49.4%) while west of Hon Thom, west of Hon Mong Tay and south-west of Hon Roi had relatively low cover of hard corals (<36%) (Table 14).

Soft corals were not recorded at all transects. However, a few colonies of soft corals were found in shallow waters at Hon Dam Ngang and Hon May Rut Trong.

Mean cover of recent dead corals (1-2 years) were not also recorded on most of the reefs, except only 0.6% recorded at Hon Thom. By contrast cover of rock (including rock and old dead coral covered by algae) had very high values at all locations (24.1-59.1%) (Table 14). Rubble corals occupied with 0.9 to 10% of mean cover at individual sites. Cover of fleshy seaweeds was not recorded at all sites. However, fleshy seaweeds growing over old dead coral reef destroyed by blast fishing were found in some places of reefs at Hon Dam. This indicates that most of dead corals were killed by natural and human impacts in the past some years.

In general, shallow transects usually supported higher coral cover than deeper sites, with the exception of Hon Roi (Table 14). *Porites* is the most common genus at all sites with percentage cover being 5.4 to 34.1%. *Pavona*, *Acropora*, *Montipora* and *Galaxea* were also common genera of corals found at all sites (Table 15).

Table 14. Cover (%) of coral and other benthos at 6 permanent monitoring sites, Phu Quoc islands, April 2003

Study site	Transect	Substratum									
		Hard Coral	Soft Coral	Dead Coral	Fleshy sea-weed	Sponge	Rock	Rubble	Sand	Mud	Other
Hon Dam Ngang	Shallow	60.6	0.0	0.0	0.0	1.3	23.7	2.5	11.3	0.0	0.6
	Deep	23.8	0.0	0.0	0.0	3.8	13.1	16.9	36.9	0.0	5.6
	Average	42.2	0.0	0.0	0.0	2.6	18.4	9.7	21.4	0.0	3.1
Hon May Rut Trong	Shallow	57.5	0.0	0.0	0.0	0.0	57.5	2.5	2.5	0.0	3.7
	Deep	41.3	0.0	0.0	0.0	0.6	55.6	1.9	5.6	0.6	8.1
	Average	30.7	0.0	0.0	0.0	0.3	56.5	2.2	4.1	0.3	5.9
Hon Mong Tay	Shallow	33.8	0.0	0.0	0.0	0.0	39.4	0.0	0.6	0.0	2.5
	Deep	27.5	0.0	0.0	0.0	0.0	47.5	2.5	6.3	0.0	2.5
	Average	49.4	0.0	0.0	0.0	0.0	43.4	1.3	3.4	0.0	2.5
Hon Thom	Shallow	53.7	0.0	0.6	0.0	0.0	39.9	0.0	0.6	0.0	3.1
	Deep	19.6	0.0	0.0	0.0	0.0	68.7	5.0	35.0	0.0	2.5
	Average	35.3	0.0	0.0	0.0	0.0	54.3	2.5	17.8	0.0	2.8
Hon Roi	Shallow	15.6	0.0	0.0	0.0	0.6	73.1	4.4	5.0	0.0	3.1
	Deep	22.5	0.0	0.0	0.0	1.3	62.5	6.3	2.5	0.0	5.0
	Average	19.1	0.0	0.0	0.0	0.9	67.8	5.4	3.8	0.0	4.0
Hon Dam	Shallow	45.0	0.0	0.0	0.0	0.0	49.0	1.3	5.0	0.0	3.8
	Deep	40.6	0.0	0.0	0.0	2.5	0.0	0.6	2.5	2.5	0.0
	Average	42.8	0.0	0.0	0.0	1.3	24.5	0.9	3.8	1.3	1.9

Table 15. Cover (%) of some common genera of corals at individual sites, Phu Quoc islands, April 2003

Location	Genera				
	Porites	Pavona	Acropora	Montipora	Galaxea
Hon Dam Ngang	32.8	1.3	4.4	1.0	0.6
Hon May Rut Trong	15.3	1.0	10.3	0.0	0.6
Hon Mong Tay	34.1	0.0	9.1	0.6	0.0
Hon Thom	22.9	9.4	0.6	1.3	0.6
Hon Roi	5.4	10.1	2.8	0.0	1.3
Hon Dam	20.1	6.3	7.2	0.0	1.8

4.2.3.2 Coral reef fish

Density of fish ranged from 1077 (Hon Thom) to 6901 (Hon Dam Ngang) individuals per 500 m² with a mean value being 2830 , 2147.6 individuals per 500 m² (Table 16). Of those, the small fish (1-10 cm) were dominated at both shallow and deep transect, making up to 93.7% of density of fish at individual sites. Notably *Chromis ternatensis* were present in relatively high density at all sites and mean abundance reached up to 2000-4000 individuals per 500 m² at some reefs. Another Pomacentrids *Stegastes lividus* and *Pomacentrus* spp. were also commonly found at Hon Thom, Hon Mong Tay and Hon May Rut Trong. Hon Thom and Hon Roi hosted the lowest density of fish, consistent with the high impact of destructive fishing, anchoring and pollution impacts there.

Large fish (>30 cm) were scarce at all sites, except one individual of *Lutjanus decussatus* recorded at Hon Mong Tay and one individual of *Hemigymnus melapterus* at Hon Thom (Table 16). Fish (21-30 cm) were also recorded at low number, ranging in density from 1 to 4 individuals per 500 m² (Table 16), of which parrot fish (*Scarus bleekeri*), groupers such as *Plectropomus maculatus*, *Cephalopholis formosa*, *Epinephelus quoyanus* and *Epinephelus fasciatus* were the main contributors of this size group.

Table 16. Density of fish (individuals per 500 m²) in different size classes, permanent monitoring sites, Phu Quoc islands, April 2002

Location	Size classes				Total
	1-10 cm	11-20 cm	21-30 cm	>30 cm	
Hon Dam Ngang	6718	181	2	0	6901
Hon May Rut Trong	1468	176	1	0	1645
Hon Mong Tay	2819	261	3	1	3084
Hon Thom	923	149	4	1	1077
Hon Roi	1287	145	3	0	1435
Hon Dam	2698	139	2	0	2839
Average/site , s.d.	2652.2 , 2136.2	175 , 45.4	1.1 , 1.1	0.3 , 0.5	2830 , 2147.6
%	93.7	6.2	0.09	0.01	100

Some of the ReefCheck indicator fish were also rare or absent at all sites, with the notable exception of chaetodontid butterfly fish (Table 17). Density of butterfly fish ranged from 36 to 101 individuals per 500 m², giving mean value of 70.8 , 21.7 individuals per 500 m² (Table 17), of which *Chaetodon octofasciatus* was the main component. This was relatively high at most sites, being highest at Hon May Rut Trong and Hon Dam. Grouper >30 cm was only found one individual at Hon Mong Tay. Sweetlips, Barramudi cod, Humpheadfish, Bumphead parrot fish were absent at all reefs. This indicates that commercial reef fish around Phu Quoc waters are over-exploited.

Table 17. Density of ReefCheck indicator fish (individuals per 400 m²) at permanent monitoring sites, Phu Quoc islands, April 2002

Location	Indicator fish					
	Butterfly-fish Chaetodontidae	Grouper >30 cm Serranidae	Barramudi cod Cromileptes altivelis	Sweetlips Haemulidae	Hump- headfish Chelinus undulatus	Bumphead parrot fish Bolbometopon muricatum
Hon Dam Ngang	78	0	0	0	0	0
Hon May Rut Trong	101	0	0	0	0	0
Hon Mong Tay	79	1	0	0	0	0
Hon Thom	36	0	0	0	0	0
Hon Roi	49	0	0	0	0	0
Hon Dam	82	0	0	0	0	0
Average/site , s.d.	70.8 , 21.7	0.16 , 0.4	0.0 , 0.0	0.0 , 0.0	0.0 , 0.0	0.0 , 0.0

Most of the targeted fish families collected for food and aquarium trades were either scarce or absent. Density of groupers (Serranidae) at each site ranged from 11 to 30 individuals per 500 m² (Table 18), giving mean value of 19.3 , 6.6 individuals per 500 m², of which *Cephalopholis boenak* (<15 cm in length) was the main component. Snappers (Lutjanidae) were very scarce from all reefs, ranging in density from 1 to 7 individuals per 500 m² (Table 18), of which *Lutjanus adetii* and *Lutjanus* spp. were common species. Surgeon fish (Acanthuridae) and angelfish (Pomacanthidae) were not recorded on the transects at all sites, except one individual of *Pomacanthus annularis* (20 cm long) was found out of the transects at Hon May Rut Trong and Hon Dam Ngang. Parrot fish (Scaridae) are considered as common large fish remaining on the reefs in Phu Quoc waters. Mean abundance of these fish ranged 39 to 102 individuals per 500 m² (Table 18), of which *Hipposcarus longiceps* was the most abundant species. Rabbit fish (Siganidae) occurred in relatively high numbers at most sites (Table 18).

4.2.3.4 Invertebrates

Density of the ReefCheck indicator invertebrates ranged widely among sites, 127 to 596 individuals per 400 m², with mean value being 23.7 , 26.4 individuals per 400 m² (Table 19). Hon Dam Ngang and Hon Mong Tay supported the highest density (596 and 571 individuals per 400 m², respectively) (Table 19).

Density of mollusc indicators recorded at 6 permanent monitoring sites in 2003 following ReefCheck method, including *Tridacna*, *Trochus* and triton shell *Charonia*, averaged 3.3 , 2.2 individuals per 400 m², ranging from 1.0 to 6 individuals per 400 m², of which cone shell *Trochus* was the most abundant in this group. This mean value shows a very low number of mollusc remaining on coral reefs in this area compared to that in other areas in coastal waters of Viet Nam such as Con Dao. *Tridacna* have been found at almost reefs with low density, ranging from 0 to 3 individuals per 400 m².

Some crustacean indicators, including lobsters and banded coral shrimp *Stenopus hispidus*, were not found at the 6 study reefs in 2003. Lobsters are exploited for food and aquaculture and that reached the levels of being over-harvested at the area.

Density of echinoderms indicators ranged from 121 (Hon Dam) to 595 individuals (Hon Dam Ngang) per 400 m², with mean value being 427 , 171.3 individuals per 400 m², of which sea urchin *Diadema* occurred in high number, ranging in density from 121 to 595 individuals per 400 m² (Table 19). Pencil urchin and triton shell *Charonia* have been absent at all reefs. Crown-of-thorns sea star *Acanthaster planci* was only recorded at Hon May Rut Trong with density being 1 individual per 400 m² (Table 19). Edible sea cucumbers were absent at all reefs while inedible species occurred at Hon May Rut Trong and Hon Roi, with density being 0.5 , 0.8 individuals per 400 m² (Table 19).

The results indicate that invertebrate densities at all locations were dominated by sea urchins (*Diadema* spp.). By contrast, the economically important species, e.g. edible holothurian sea cucumbers, lobsters (*Panulirus* spp.), giant clams (*Tridacna* spp.), Triton trumpet shell (*Charonia tritonis*), were all extremely rare or absent from the sites, another strong indicator of the intense overexploitation occurring in Phu Quoc waters.

Table 18. Density of various families of fish (individuals per 500 m²) at permanent monitoring locations, Phu Quoc islands, April 2002

Study site	Family					
	Damsel-fish	Wrasses	Groupers	Snappers	Parrot-fish	Indicator fish
Hon Dam Ngang	6528	108	30	3	67	0
Hon May Rut Trong	1181	154	23	1	102	1
Hon Mong Tay	2407	224	15	7	72	5
Hon Thom	632	123	11	0	88	1
Hon Roi	1136	97	24	7	39	2
Hon Dam	2443	145	13	4	100	2
Average/site , s.d.	2387.8 , 2156.5	141.6 , 45.8	19.3 , 6.6	3.7 , 2.7	78.1 , 21.7	1.6 , 1.6

Table 19. The density of macro-invertebrates (individuals per 400 m²) at permanent monitoring sites, Phu Quoc islands, April 2003

Indicator invertebrate group or species	Study site						Average/site
	Hon Dam Ngang	Hon May Rut Trong	Hon Mong Tay	Hon Thom	Hon Roi	Hon Dam	
Banded shrimp	0	0	0	0	0	0	0.0 , 0.0
Lobster	0	0	0	0	0	0	0.0 , 0.0
Sea urchin (<i>Diadema</i>)	595	445	570	457	370	121	426.3 , 171.3
Pencil urchin	0	0	0	0	0	0	0.0 , 0.0
Sea cucumber	0	1	0	0	2	0	0.5 , 0.8
Crown-of-thorns starfish	0	1	0	0	0	0	0.2 , 0.4
Cone shell	1	4	0	0	2	6	2.2 , 2.4
Giant clam	0	1	1	2	3	0	1.2 , 1.2
Triton trumpet	0	0	0	0	0	0	0.0 , 0.0
Total	596	452	571	459	377	127	430.3 , 169.3

4.2.3.5 Trend of change

Comparisons of the results from 2003 for permanent individual monitoring sites with those of previous survey in 1994 (WWF 1994), 2000 and 2002 indicate that although some reefs have remained in good condition, others have deteriorated (Table 20). The trend of change in coral cover for all species between 1994 and 2003 at 6 permanent monitoring sites at Phu Quoc islands was not clear. This indicates a very little change in coral cover on the reefs of the area, except Hon May Rut Trong, Hon Mong Tay and Hon Roi (Table 20).

Density of reef fish at 6 permanent monitoring sites in 2003 was higher than that in 2002 (Figure 5). Total density of fish increased from 1494.5 , 589.8 individuals per 500 m² in 2002 to 2830 , 2147.6 individuals per 500 m² in 2003. Of those, main contribution of the trend was from damselfish. Comparison of the density of some families of reef fish between 2002 and 2003 at 6 permanent monitoring sites showed an increase in density of ornamental fish such as butterfly fish, damselfish and wrasses (Figure 6).

Although density of each family increased but some valuable species belonging to ornamental group such as *Chelmon rostratus*, *Heniochus acuminatus* (Chatodontidae), *Pomacentrus annularis*, *Centropyge vrolikii* (Pomacanthidae) have been scarce or absent at many reefs. The decline in density or absence of these ornamental fish at many reefs may be related to a big harvest during February – March 2003. According to local fishermen, during February-March 2003, a big Philippino vessel did collected some thousands of ornamental fish around Phu Quoc waters. Groupers increased in mean density between 2002 and 2003 while parrot fish decreased in density (Figure 7). The trend of change in density of snappers and rabbit fish was not clear (Figure 7).

Table 20. Comparison of hard coral cover on contour transects from 1994 to 2003 at Phu Quoc waters. +ve indicates an increase in live coral cover from 1994-2003; –ve indicates a decline in cover. s indicates shallow transect and d indicates deep transect.

(Percentage)

Site name	Year of study				Direction of change
	1994	2000	2002	2003	
Hon Dam Ngang	s:9.0 d:23.2		s:63.8 d:30.6	s:60.6 d:23.8	+ve
Hon May Rut Trong	s:82.6 d:60.0		s:45.0 d:37.5	s:33.8 d:27.5	–ve
Hon Mong Tay	s:68.0 d:71.2		s:59.4 d:45.6	s:57.5 d:41.3	–ve
Hon Thom	No data	s:40.0 d:31.3	s:39.4 d:20.0	s:53.7 d:16.9	No change
Hon Roi	s:41.6 d:60.8	s:32.5 d:36.3	s:21.3 d:36.3	s:15.6 d:22.5	–ve
Hon Dam	s:34.2 d:46.2	s:38.4 d:50.6	s:29.4 d:55.0	s:45.0 d:40.6	No change
Average/site	45.7 , 26.2	38.2 , 13.5	42.4 , 13.1	36.6 , 10.7	–ve

Figure 5. Change in density of coral reef fish (individuals per 500 m²) at permanent monitoring sites between 2002 and 2003, Phu Quoc islands

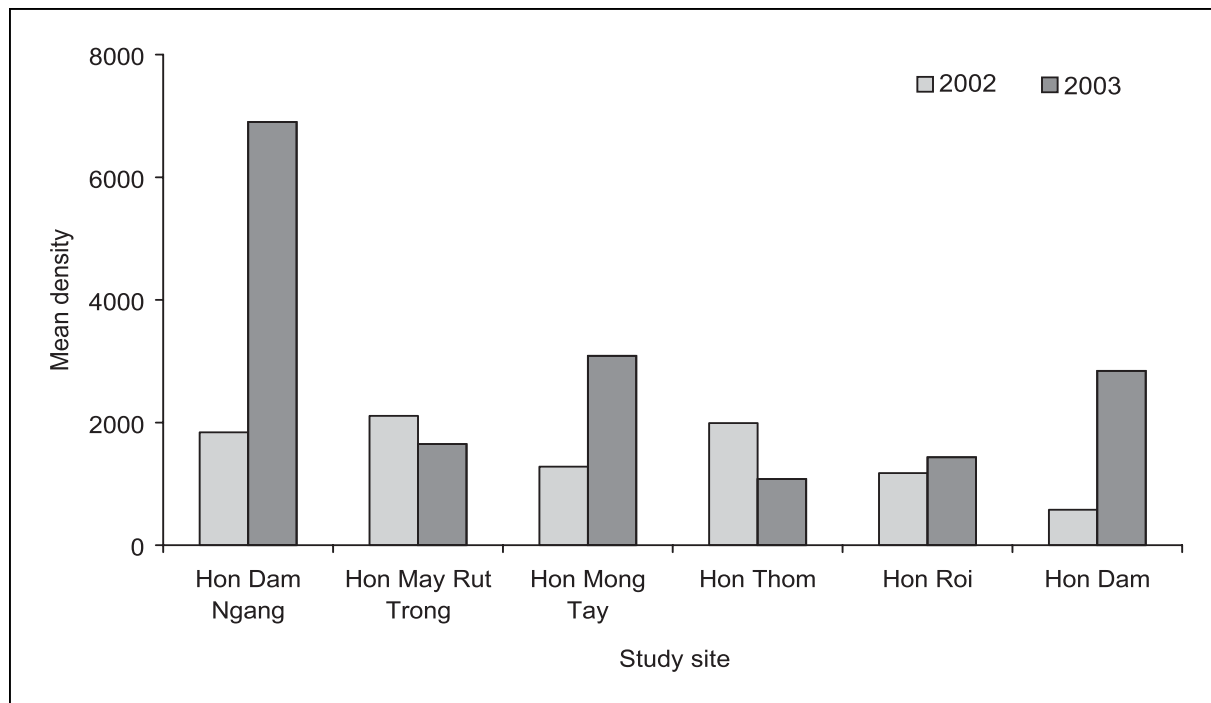


Figure 6. Change in density of some ornamental fish (individuals per 500 m²) at permanent monitoring sites between 2002 and 2003, Phu Quoc islands

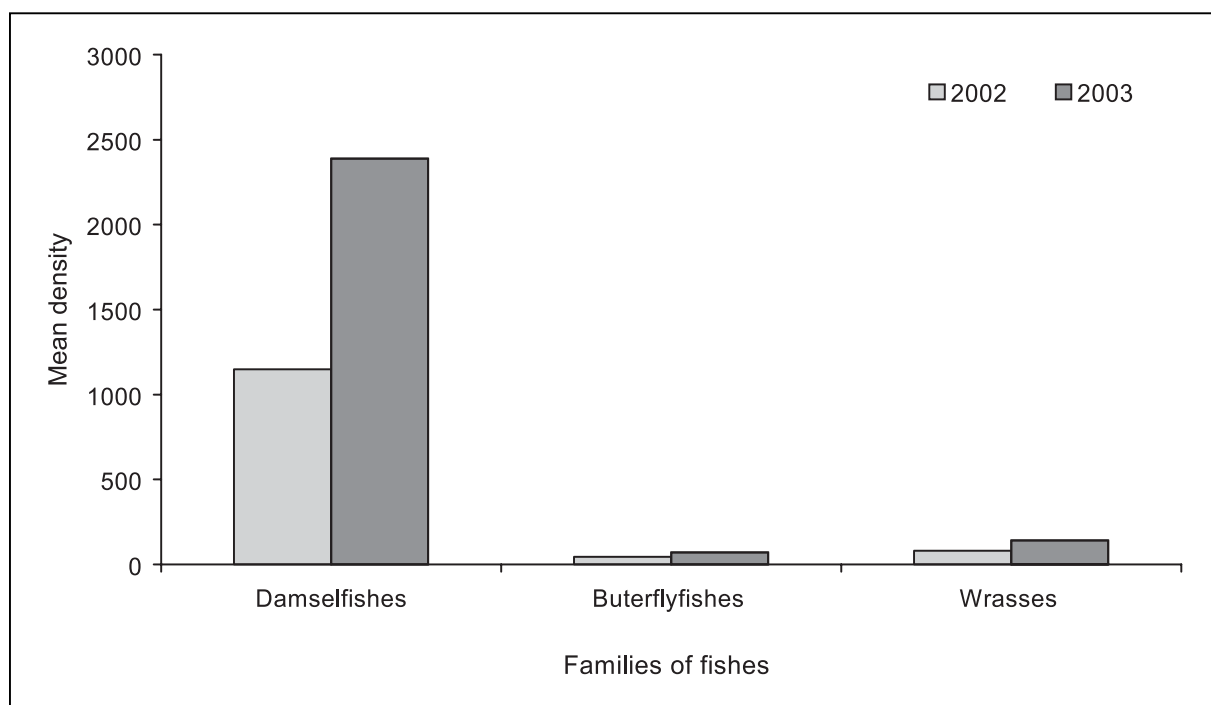
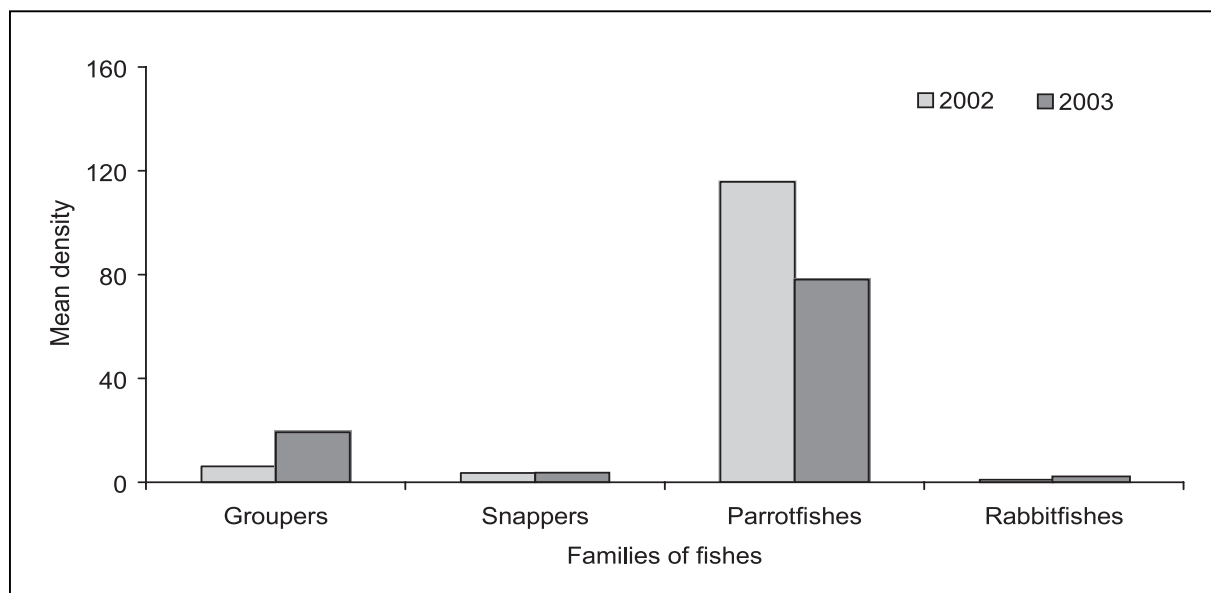
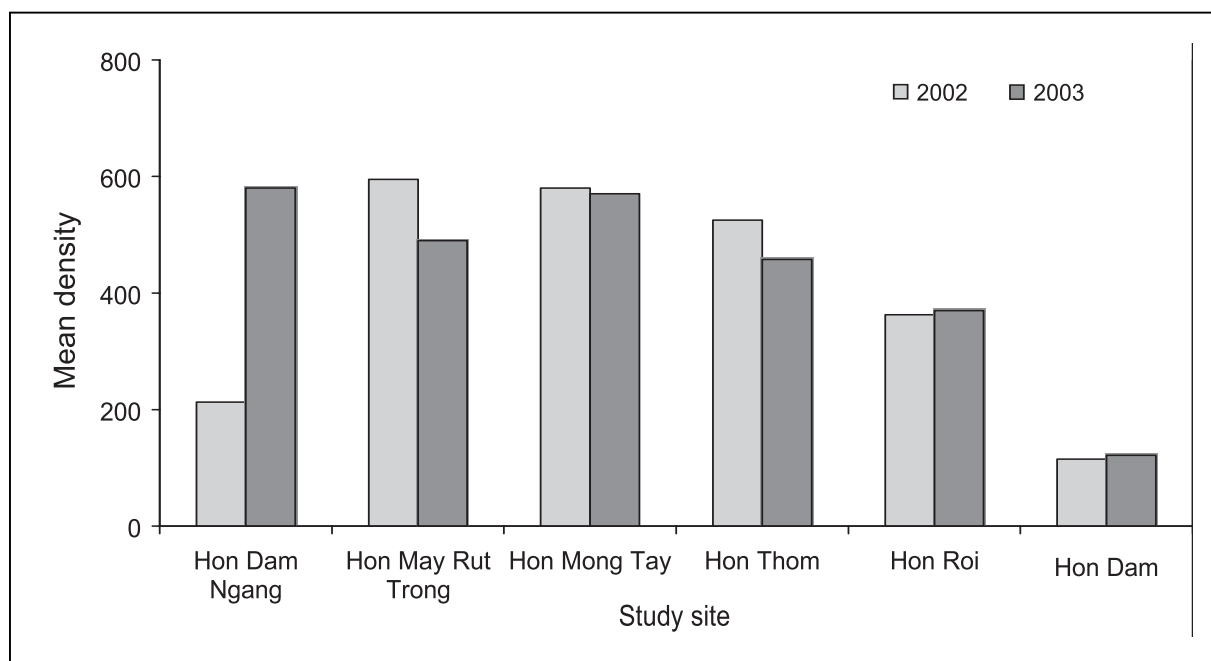


Figure 7. Change in density of some commercial fish (individuals per 500 m²) at permanent monitoring sites between 2002 and 2003, Phu Quoc islands



Trend of change in macro-benthic organisms such as sea cucumber and giant clams at 6 permanent monitoring sites between 2002 and 2003 was not clear due to over-exploitation in the past. Sea urchin *Diadema setosum* showed a little decrease in density at individual sites between 2002 and 2003, except Hon Dam Ngang (Figure 8). Density of cone shell *Trochus* at almost reefs was declined between 2002 and 2003 with the highest decline being at Hon Dam Ngang, decreasing from

Figure 8. Change in density of sea urchin *Diadema setosum* (individuals per 400 m²) at permanent monitoring sites between 2002 and 2003, Phu Quoc islands



20 individuals per 500 m² in 2002 to 2 individuals in 2003. The reasons of decrease in density of cone shell could be explained by a big harvest occurred during April and May 2001 (information from local fishermen). Although crown-of-thorns sea stars have been found at some reefs in Phu Quoc waters. However, density of this species was very low and this value did not change between 2002 and 2003.

5. THREATS AND IMPACT

5.1 Present Threats

5.1.1 Over fishing

Fishing boats and the total engine power of Kien Giang Province and Phu Quoc district have been increased since 1984. Some 1,894 fishing vessels with a total power of 27,961 horse power (hp) of Phu Quoc district recorded in 1998 were increased to 1,700 vessels with a total power of 61,585 HP in September 2002 (Data from Phu Quoc Department of Agriculture, Forestry and Fisheries). Although total fisheries yield of both Kien Giang province and Phu Quoc district are still on the rise but catch per unit effort (CPUE) has declined considerably. CPUE for Kien Giang province has dropped from 1.69 tons/hp in 1984 to 0.74 tons/hp in 1993. Information interviewed from local fishermen indicate that fisheries yield of the areas at present have declined about 50-70% compared to that in the past 5-10 years. Commercially fish with the size range >30 cm long, lobsters and edible sea cucumbers on coral reefs around group of the islands have been over-caught. The average size of squids caught has fallen from 25-30 cm to <20 cm. Collecting groupers from nature for cage culturing have been developed at Phu Quoc, Nam Du and Tho Chu. This activity will be possibly developed in the near future due to a big demand of groupers. There were 4-5 flakes for keeping live and culture groupers in Phu Quoc islands and 3 flakes in Nam Du islands. The groupers with the size range 20-30 cm and >30 cm long bought from local fishermen were kept in the flakes for some days before exporting to other places. If the fish are less than 20 cm long, then they will kept in the flakes for some months before selling to the markets. During the survey in April 2002, we heard at least 2 times of dynamite fishing per day occurring at the island group in the southern part of Phu Quoc.

5.1.2 Destructive harvestation

Bombing and poisoning

There were no available information related to the use of dynamites and poisons to catch fish around the islands from managers and authorities. However, local fishermen did say that dynamiting and poisoning are still appearing in the areas, both by local and outside fishermen. The hookah divers from Hon Thom, Phu Quoc islands and Hon Ngang, Nam Du islands have often used cyanide to catch live groupers and other commercially species on coral reefs for both local consumption and international export.

5.2 Future Threats

Phu Quoc, Nam Du and Tho Chu are the big fishing centres in all provinces in Viet Nam. Duration and frequency of fishing boats from nearby localities in the province and outside from almost provinces in the southern part of Viet Nam, and even foreign boats from Thailand visiting the area have increased since the last decade. Besides, the fast growth in number of high-powered boats of the district have put heavy pressure to marine resources, especially in the shallow waters surrounding groups of the islands. Although fisheries production has still increased during the last decade but CPUE has seriously dropped. This indicates that the area is being over-exploited. As predicted, the trend of decline of marine resources will be found in the next future.

Marine living resources on coral reefs are now becoming rare, especially to commercial species. Marine habitats including coral reefs, seagrass beds, soft bottoms are degraded because of natural and human impacts. Destructive fishing activities including dynamiting, poisoning and collecting live corals for souvenir, have been controlled since many years but these activities are still appearing on coral reefs

around the islands. Signs of negative impacts to marine environment by sedimentation and pollution from mainland agricultural have been recorded in recent studies. Pollutants from primary processing facilities of sea products and fishing ports discharged into the water have been caused many problems to the environment.

Phu Quoc is emphasized as an important site in the National Master Plan. Tourism in the area has high potential and is identified as the first priority in economic development of the district in the next ten years. Infrastructure construction such as roads, airport, fishing ports, hotels and resorts to meet the development plan will be the major causes to changes in the environment.

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7. ACKNOWLEDGEMENT

The authors particularly thank UNEP EAS/RCU for their financial support, Kien Giang Department of Fisheries Protection and Phu Quoc Department of Agriculture, Forestry and Fisheries for their effective collaboration during conduct of the training workshop and this study.

Coral Reef Monitoring and Coral Campaign by REEFCHECK Program in Karimunjawa Marine National Park

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1. ABSTRACT

The ReefCheck Karimunjawa 2002 program is a sequel from the same program that has been done by Marine Diving Club under auspices of WWF Wallacea Bioregion as the ReefCheck coordinator in Indonesia, since 1999. This program's focus activity is to monitor the condition of coral reefs in Karimunjawa National Park by involving public people (volunteer), local community, local government and NGO. This program has three main activities: Training of Trainers (ToT), Field Data Collection (monitoring) and Socio-economic survey. Results of this program are carrying out information about condition of coral reef and local community behaviour that can contribute policy for management of Karimunjawa National Park.

2. BACKGROUND

The coral reef is one of the most productive habitats on Earth with high value and diversity, comparable to tropical rainforests. Coral reefs stretched out in the Indonesian Archipelago and the Philippines have high species diversity and reef-associated organisms (Veron, 1994). But the pressure of the fast economic and population growth in Southeast Asia have resulted in a negative impact to the reef ecosystem. It is predicted that less than 3% of coral reefs in Indonesia can be classified in a good condition (per cent cover of coral reef less than 75%), and it is reduced rapidly from marine protected areas that are supposed to help preserve coral reefs (Wilkinson et. al. 1994; Chou 1997).

ReefCheck (RC) is the biggest global coral reef monitoring program in the world. It was established in 1996 to facilitate local community efforts to monitor coral reefs. This program was done through volunteer and cooperation from all participants. Since the launch in Indonesia in August 1997, RC has shown a good development. It's appreciated from numbers of site and volunteers that are increasing year by year. In 1999, WWF Wallacea organized a Training of Trainers program for the first time, and involved 31 participants from different regions in Indonesia. All participants carried out RC in their own regions and collected data from 8 locations and 33 sites with 134 volunteers. In the year 2000, the number of sites increased to 11 locations and 40 sites. This activity was supported by 246 volunteer divers and 5 scientists from August to December 2000, and also supported by local government, NGO, academic institution and media. Karimunjawa is one of the sites that has been monitored by Marine Diving Club (MDC) since 1999 to 2001 through ReefCheck program. To keep a sustainable data about Karimunjawa, it needs to be monitored every year, that is the reason this program will done in the year 2002.

Karimunjawa archipelago, as national park confirmed by the Conclusion Letter of the Forest Ministry number 185/KPTS-11/1997 on February 29th, is a group of islands that contains 27 islands, and have a distances 45 mile in the south-east side from Jepara. The geographical position is 5°40' – 5°57' and 110°4' – 110°4' stretched out from west to east, 114.345 ha and contains 2120 ha soil area and 107.225 ha water area (Istanto, 1998). Karimunjawa Sea is relatively still pure and free from pollution that supports the coral ecosystem. It provides habitat for 242 species of fish and 133 genera aquatic fauna (Sunarto, 1998).

Administratively, Karimunjawa archipelago is one of the districts in Jepara that contains 3 villages (Karimunjawa, Kemojan, and Parang). Only 5 out of 27 islands are inhabited by humans (Karimunjawa, Kemojan, Genting, Parang, Nyamuk). Karimunjawa archipelago is convenient for tourism, as it is located 45 miles from Jepara and about 60 miles from Semarang. The estimated population level in Karimunjawa in 1998 was 8,557 persons, and now 4,183 persons in Karimunjawa village (Karimunjawa and Genting Island), and 2,548 persons in Kemojan village (Parang and Nyamuk Island). In education, 50% of adults graduated from junior high school, 4% from senior high school, and less than 15% from college.

3. OBJECTIVE

The main goal for this program is monitoring the condition of coral reefs in Karimunjawa, and providing information that can be use by local government and National Park Authority to make decision, rules and policies for the management of Karimunjawa National Park.

4. ACTIVITY SUMMARY

Table 1. Summary of activities

Activities	Deadline	Date of activities	Achievement
Scuba Diving Training	July 2002	14-16 August 2002	20 participants were trained on basic SCUBA diving skill in pool.
ReefCheck Method Training	July 2002	27-29 August 2002	20 participants were trained on ReefCheck Method in Karimunjawa.
Data Collection	January 2003	September-October 2002	Data collected from six islands and total there are 24 point sampling.
Drawing Competition	September 2003	30 October 2002	50 participants from 9 Elementary School Karimunjawa.
Printing Material	April 2003	September-November 2002	Printed and distributed 100 leaflets, T-Shirts and installed 9 awareness board in Karimunjawa.
Socio-economic Survey	October 2002 & February 2003	November 2002	200 respondents have been interviewed in 2 main islands in Karimunjawa.
Seminar	February 2003	13 March 2003	There is agreement to support monitoring activities in next years.

4.1 Capacity Building

4.1.1 Scuba diving training (in house/class training)

Three days training on scuba diving was conducted in August 2002 followed by more than 20 participants from diving clubs (6), Government Search and Rescue Team (2), university (5) and local peoples of Karimunjawa (7) (Table 2). The Training materials were ranging from basic skill for diving, basic knowledge on coral reef ecosystem and conservation, sampling method, to fish and benthos organism identification based on ReefCheck monitoring method. The venue was conducted in Jatidiri swimming pool, Semarang.

4.1.2 ReefCheck training (field training)

This training was conducted in Karimunjawa National Park for 3 days (27-29 August 2002). The training was aimed to bring the participants to the real coral reef ecosystem, in learning how to protect it by doing a simple thing like not throw any thrash to sea and stop buying souvenir made from coral and apply sampling methods they received during the in-house scuba diving training.

During this activity, the main problem was that most of the volunteers were not familiar with the marine environment, such as names of fish and benthos organisms.

4.2 Data Collection

4.2.1 Method

The survey method was point sampling method. The survey team looked at a series of points where the transect tape touches the reef and recorded what lay under these points. Substrate cover was recorded at 0.5 m intervals along the 100 m transect line. The transect was spread at 3 m and 10 m depth each on two sites windward and leeward.

Substratum was categorized as hard coral (HC), soft coral (SC), dead coral (DC), recently killed coral (RKC), fleshy seaweed (FS), sponge (SP), rock (RC), rubble (RB), sand (SD), silt (SI) and Other (OT). Other benthic organisms as indicators were recorded during the reef transect, including Giant clam, Sea urchin, Pencil urchin, sea cucumber, Crown of thorns starfish and Triton shells.

The method for fish survey was visual census. Target fish species were recorded at every 5 m interval along the transect line deployed in 3 m and 10 m depths, with maximum 3 minutes observation stop. All the target fish to be recorded were Grouper over 30 cm, Barramundi cod, Sweet lips, Hump head/Napoleon, Bump head/parrotfish, Butterfly fish, Snapper and other parrotfish (over 20 cm).

This field activity in Karimunjawa took place in six diving locations as the ReefCheck surveys of 1999, 2000, and 2001. It consisted of Burung Island-represent good core zone, Geleang Island-represent bad core zone, Cemara Kecil Island-represent bad protection zone, and Menyawakan Island-represent good protection zone and another six new sites. One team with ten to fifteen people surveyed each island.

Table 2. Training Participants

Name	Institution
Rina Kurniawati	Semarang University
Dani Nugroho	Sebelas Maret University
Eka Aria P	Sebelas Maret University
Alif Widyo Aryasri	Soegiopranoto Catholic University
Vivi Yanti Mamuko	Gadjahmada University
Melania Hanny Aryantie	Gadjahmada University
Adi Triatmoko	Giribahama Diving club
Bonafentura Wijaya	Atma Jaya Diving Club
Eko Santoso	Atma Jaya Diving Club
Drs. Nono Widihartono	SAR Diving Club
Drs. Nono Widihartono	Search and Rescue
Drs. Suryanto	Search and Rescue
Dra. Anita Andriantini M	Local People
Arif Rahman, SE	Local People
Nor Soleh E.P.	Local People
Muslikhan	Local People
Mustakin	Local People
Sutrisno	Local People
Mukhlis	Local People
Limaryadi	Karimunjawa National Park

4.3 Survey Result

Reef checking was conducted in Menjangan Kecil, Menjangan Besar, Cemara Kecil, Menyawakan, Burung and Geleang Island as a representative of six conservation zonation area applied for Karimunjawa National Park. There were twenty participants from MDC that have been trained with ReefCheck Method from last year's activities to collect the data. Participants from the current training program joined to learn how the activity works (we have to make sure that diver didn't make coral damage).

In total there were 24 points of coral reef, fish and other indicator data. The results showed that the per cent cover of live coral varied between 12.8% (Menjangan Kecil, West) to 64.4% (Menjangan Besar, West). The mean coverage for the whole area was 37.1%.

4.3.1 Ecology data analysis

Coral Reef Health Evaluation Standard used by WWF Wallacea is based on percentile (Bad, medium, good, very good). Division is based on frequency distribution of each category, which is quartile 1 (<25%), quartile 2 (26-50%), quartile 3 (51-75%), and quartile 4 (>76%). The result is frequency distribution for each category.

Based on evaluation standard and Table 3, the condition of coral reef in Burung Island is Medium, with Hard Coral (HC) Cover Percentage 27.9% in West side and 29.7% in East side. Recently Killed Coral dominated this area with a percentage 44.4% in West side and 35.3% in East side.

Coral Reef condition in West Side of Cemara Kecil Island is medium (HC percentage 38.1) and in East side is included good (HC percentage 52.5%). Hard coral dominated both site, although Rubble in East side is high (39.7%).

Coral Reef condition in Geleang Island is in the Medium Category with hard coral (HC) percentage in West side is 48.1% and in East side in Bad Category with Hard Coral (HC) percentage 24.1%. Recently Killed Coral can be found in East side as much as 31.3%.

Condition of coral reef in Menjangan Besar Island in west side is good with Hard Coral cover percentage 64.4% and in East Side is Medium with HC percentage 41.9%.

Coral Reef condition in West side of Menjangan Kecil is Bad with Hard Coral Cover percentage 57.7%, while in East side is good with HC cover percentage 63.4%.

Coral reef condition in Menyawakan Island is Bad, both West side and East sides with HC cover percentage 21.6% and 20.6%. Recently Killed Coral (RKC) dominated West side with 23.8% while Soft Coral dominated East side with 30.0%.

The worst coral reef condition is in Menyawakan Island, which is a buffer zone. Menjangan Besar and Menjangan Kecil Island (Usage Zone) and Cemara Kecil Island (Protection Zone) have better coral reef condition compared to other islands including Burung Island and Geleang Island (Core Zone).

Coral Reef Cover percentage of ReefCheck 2002 shows better condition compared to ReefCheck 2001 (Table 4). The reefs are probably entering recovery phase after the storm in February, 2001 that caused coral reef damage at west side of Menyawakan, Cemara Kecil, Burung and Geleang Island.

Coral Reef Damage can be seen in several islands that have high percentage of Recently Killed Coral (RKC). Storm, anchor from boats and destructive fishing are suspected to cause damage.

Coral Reef Damage was observed through the existence of indicator organisms that live in coral reef ecosystem. Indicator organisms being observed in ReefCheck Karimunjawa 2002 are organisms associated with coral reef, so that bad coral reef condition cause a decrease of certain organisms associated with coral reef.

Coral Reef condition being recorded in ReefCheck 2002 is much better compared to ReefCheck 2001, but population of indicator organisms show significant decrease compared to ReefCheck 2001. Karimunjawa people and outsiders suspect this is due to fishing of reef fishes for aquarium or food and fishing of other organisms such as lobster for economical reasons.

Table 3. Hard Coral Cover Percentage of Karimunjawa Island (ReefCheck 2002)

Category	Burung Island		Cemara Kecil Island		Geleang Island		Menjangan Besar Island		Menjangan Kecil Island		Menyawakan Island	
	West	East	West	East	West	East	West	East	West	East	West	East
HC	27.5	29.7	38.1	52.5	48.1	24.1	64.4	41.9	12.8	63.4	21.6	20.6
SC	3.1	4.4	1.9	0.9	13.4	15.6	2.2	6.3	0.3	2.5	6.3	30.0
RKC	44.4	35.3	24.7	0.3	22.5	31.3	13.4	26.9	57.5	20.6	23.8	18.1
FS	0.0	0.3	32.2	0.0	8.4	10.0	0.0	0.0	15.3	0.0	6.9	4.4
SP	0.0	0.0	0.0	0.3	0.0	0.6	0.0	0.0	0.3	0.0	0.0	0.0
RC	0.3	0.0	0.0	0.0	0.0	0.6	0.6	0.3	0.6	2.2	0.6	0.3
RB	9.7	29.1	3.1	39.7	6.6	17.2	13.8	19.1	6.3	0.0	18.8	20.6
SD	13.1	1.3	0.0	5.3	0.3	0.3	5.3	5.0	6.6	11.3	20.3	5.6
SI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	1.9	0.0	0.0	0.9	0.6	0.3	0.3	0.6	0.3	0.0	1.9	0.3

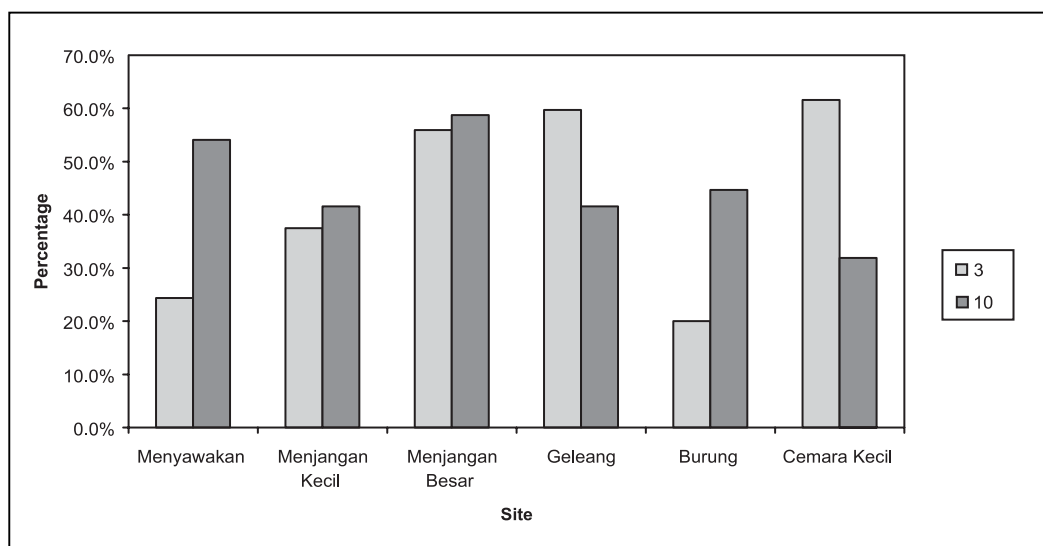
Figure 1. Graphic representation of live coral cover


Table 4. Hard Coral Cover Percentage of Karimunjawa Island (ReefCheck 2001)

Category	Burung	Cemara Kecil	Geleang	Menjangan Besar	Menjangan Kecil	Menyawakan	Total
HC	20.6	27.2	12.5	61.3	37.2	14.7	28.9
SC	4.4	1.3	1.9	0.9	0.9	0.3	1.6
RKC	46.6	38.4	44.1	33.1	37.5	40.3	38.3
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RC	0.0	0.3	3.1	0.0	0.0	0.0	0.6
RB	14.7	32.8	27.2	11.3	20.6	37.2	24.0
SD	13.4	0.0	11.3	3.4	3.8	7.2	6.5
SI	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.3	0.0	0.0	0.0	0.0	0.3	0.1

Source: ReefCheck Karimunjawa 2001 Final Report.

4.4 Public Awareness

4.4.1 Drawing competition

A drawing competition was conducted in Karimunjawa Island on 30 October 2002. The competition was followed by 50 school children of nine elementary schools (SD) in Karimunjawa. Three winners were chosen and received a trophy, gift and certificate. A coral reef campaign was also introduced through a quiz during the competition. From the quiz we know that most of the people in the islands think that coral is a plant.

4.4.2 Coral reef campaign

The campaign was conducted by planting coral reef awareness boards and distributing 100 leaflets and T-shirts in Karimunjawa (Figure 2). Leaflets were distributed in University, School, Public Place, (Book store, swimming pool, travel agency). T-shirts were distributed to local fisherman (mostly), tourist boatman and diving guides.

Nine awareness boards were installed in Karimunjawa, Kemujan, Menjangan Kecil, Menjangan Besar and Tengah Island.

Figure 2. Outputs of coral campaign



4.4.3 Socio-economic research

Socio-economic data related to coral reef conservation in Karimunjawa was been conducted in November 2002. In total, there were 200 respondents from 2 main islands in Karimunjawa that were interviewed. Education background, occupation, and activities and knowledge related to marine life were the main information investigated. Most of the respondents (98%) were fishermen, and the rest were government employees, teachers and traders (but sometimes they go for fishing, too). Education level is very low, 48% have graduated from Elementary School and only 4% from Senior High School. The main target for fishing is tuna fish that are caught between July and November. In a day, they can yield 10-100 Kg fish depending on their equipment. Most of the fishermen use Long Line Fishing and small boat.

From the past two years, fishermen said the fish population has been decreasing. Thus, the fishermen have to travel further to catch more fish. The survey results showed that most people don't know what coral reefs are, but they know coral reefs are houses for fish. They think that coral damage is caused by poison (in the past, they used poison to catch Lobster and reef fish). When we asked who should be responsible for the coral reef protection, most of them answered that responsibility is with National Park Authorities and NGOs.

The main problem is there are fishermen from outside islands that catch fish using the Muroami net. These activities began during the past two years, but the impact is very fast for local fishermen. Fish population decreased and caused large damage to coral reef. The local government cannot do anything because there are no rules or laws about this.

4.5 Seminar

This activity was conducted on 13 March 2003 and took place at Gracia Hotel, Semarang. At this seminar, Marine Diving Club as the implementing institution presented the monitoring activities results to government agencies (Marine and Fisheries, Environment, National Park Authorities), Diponegoro University, NGOs, News Media, (Kompas, Kedaulatan Rakyat). Speakers at the Seminar included Mr. Wisnu Widjatomoko from MDC (Survey Result), Mrs. Puspa Dewi Liman, Chief of Karimunjawa Marine National Park (National Park program and policy), Prof. Sudharto Hadi (Environment Law) and Mr. Ary Suhandi (Indonesian Ecotourism Network).

At this seminar, all stakeholders made an agreement to support monitoring activity and coral reef management. This agreement was signed by:

- Wisnu Widjatomoko (Marine Diving Club)
- Agus Indarjo (Diponegoro University)
- Lalu Muhammad S (Marine and Fisheries Agency)
- Puspa Dewi Liman (Karimunjawa Marine National Park)
- Arief Rahman (Local People of Karimunjawa)
- Ary Suhandi (Indonesia Ecotourism Network)

This seminar was written up in "Kompas Daily Newspaper" on 14 March 2003.

5. CONCLUSION AND RECOMMENDATION

Based on survey results, we can conclude that the condition of coral reef in Karimunjawa Marine national park is medium (37.1%), but still looks bad in a few sites.

Damage to coral reefs is probably caused by storms that come during wet season (December-April). These storm could make a coral garden became a rubble field. If we connected the field data and socio-economic survey, we can conclude that there is a decrease in fish population in Karimunjawa Island, mainly for reef fish. Activities such as using Muroami net decreases the number of fish population and increases coral reef damage.

A recommendation for local government is to make a regulation about fishing area and fishing gear that have negative impacts to coral reef ecosystem. Environmental NGOs are needed to increase local people's awareness about conservation. There should be a work plan that involves all stakeholders in coral reef management. Governments should make an evaluation about marine park zonation and laws that protect coral reef ecosystem. More research is needed to do, such as spawning aggregation sites, coral growth, aquaculture, etc. so we can get more information to conserve the Karimunjawa Islands.

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FISHERMAN QUESTIONNAIRE

Name:

Address:

Age:

Number of Family:

Occupation:

Education:

1. In which island do you usually catch fishes?
2. What is your main target?
 - Shrimp/Lobster
 - Reef Fish (mention).....
 - Tuna Fish
 - Clam/Mussels
3. How much do you yield every year?
4. Is there any decrease or increase of fish caught for last year?
5. What gears do you use?
6. Where do you sell your catch?
7. When do you get the best yield in one last year? (Jan – Dec)
8. Do you know what is coral reef?
9. What is coral reef used for?
10. Do you think coral reefs are damaged or not?
11. What do think the damage is caused by?
12. Is there any effect of the damage to you?
13. Is there any organization that cares for this damage?
14. How do you think you can prevent this damage?
15. Who do you think is responsible for coral reef management?

Site Description	ReefCheck 2002			
Site Name	West Menjangan Kecil			
Date	8 September 2002			
Time of day that work started	11.25			
Time of day that work ended	13.42			
Longitude of transect start point	110,4046700			
Latitude of transect start point	– 5,8864700			
From chart or GPS? (if GPS, indicate units)	Chart		GPS ✓	
Orientation of transect	N-S	NE-SW	E-W	SE-NW ✓
Distance from shore	200 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ✓	Cloudy	Raining	
Air temperature	27 degrees Celsius			
Water temperature at surface	17 degrees Celsius			
Water temperature at 3 m	17 degrees Celsius			
Water temperature at 10 m	16 degrees Celsius			
Distance from nearest population centre	3.5 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	6 m			
Why was this site selected?	Time series data			
Is this site	Sheltered		✓ Exposed	
Any major coral damaging storm in past years?	Yes ✓	No	Unknown	
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ✓	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ✓	Moderate	Heavy
Poison fishing	None	Low ✓	Moderate	Heavy
Aquarium fish collection	None	Low ✓	Moderate	Heavy
Harvest of invertebrates for food	None	Low	Moderate ✓	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ✓	Heavy
Tourist diving	None	Low	Moderate ✓	Heavy
Sewage pollution	None ✓	Low	Moderate	Heavy
Industrial pollution	None ✓	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ✓	Heavy
Other impact (specify)	None ✓	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ✓	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Hendry			

Site Description

ReefCheck 2002

Site Name	East Menjangan Kecil			
Date	8 September 2002			
Time of day that work started	16.17			
Time of day that work ended	17.45			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW	E-W	SE-NW ☒
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒	Cloudy	Raining	
Air temperature	25 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3 m	18 degrees Celsius			
Water temperature at 10 m	16 degrees Celsius			
Distance from nearest population centre	2.45 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	6.01 m			
Why was this site selected?	Other side			
Is this site	Sheltered		☒ Exposed	
Any major coral damaging storm in past years?	Yes ☒	No	Unknown	
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None	Low ☒	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ☒	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Fajar			

Site Description	ReefCheck 2003			
Site Name	West Burung			
Date	9 September 2002			
Time of day that work started	13.00			
Time of day that work ended	14.40			
Longitude of transect start point	110,3388200			
Latitude of transect start point	– 5,8885000			
From chart or GPS? (if GPS, indicate units)	Chart			GPS ☒
Orientation of transect	N-S ☒	NE-SW	E-W	SE-NW
Distance from shore	75 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒	Cloudy	Raining	
Air temperature	29 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3 m	18 degrees Celsius			
Water temperature at 10 m	18 degrees Celsius			
Distance from nearest population centre	10.85 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	2.16 m			
Why was this site selected?	Time series data			
Is this site	☒ Sheltered		Exposed	
Any major coral damaging storm in past years?	Yes ☒	No	Unknown	
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None ☒	Low	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None ☒	Low	Moderate	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Protected zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Danik			

Site Description

ReefCheck 2003

Site Name	East Burung			
Date	9 September 2002			
Time of day that work started	12.45			
Time of day that work ended	14.21			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S ☒	NE-SW	E-W	SE-NW
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	29 degrees Celsius			
Water temperature at surface	19 degrees Celsius			
Water temperature at 3 m	19 degrees Celsius			
Water temperature at 10 m	18 degrees Celsius			
Distance from nearest population centre	10.15 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	3.6 m			
Why was this site selected?	Other side			
Is this site	☒ Sheltered		Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None ☒	Low	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None ☒	Low	Moderate	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Protected zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Andi			

Site Description	ReefCheck 2003			
Site Name	West Geleang			
Date	9 September 2002			
Time of day that work started	9.17			
Time of day that work ended	11.30			
Longitude of transect start point	110,3516400			
Latitude of transect start point	– 5,8713200			
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW ☒	E-W	SE-NW
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	25 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3 m	18 degrees Celsius			
Water temperature at 10 m	17 degrees Celsius			
Distance from nearest population centre	9.45 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	4.2 m			
Why was this site selected?	Time series data			
Is this site	☒ Sheltered		Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None ☒	Low	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None ☒	Low	Moderate	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Protected zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Hipzul			

Site Description

ReefCheck 2003

Site Name	East Geleang			
Date	9 September 2002			
Time of day that work started	9.25			
Time of day that work ended	11.42			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW ☒	E-W	SE-NW
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	27 degrees Celsius			
Water temperature at surface	22.5 degrees Celsius			
Water temperature at 3 m	22.5 degrees Celsius			
Water temperature at 10 m	20 degrees Celsius			
Distance from nearest population centre	8.75 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	3.8 m			
Why was this site selected?	Other side			
Is this site	☒ Sheltered		Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None ☒	Low	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None ☒	Low	Moderate	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Protected zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Doni			

Site Description	ReefCheck 2003			
Site Name	West menyawakan			
Date	10 September 2002			
Time of day that work started	10.20			
Time of day that work ended	12.05			
Longitude of transect start point	110,3388200			
Latitude of transect start point	– 5,7941100			
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW ☒	E-W	SE-NW
Distance from shore	75 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	29 degrees Celsius			
Water temperature at surface	17 degrees Celsius			
Water temperature at 3 m	17 degrees Celsius			
Water temperature at 10 m	16 degrees Celsius			
Distance from nearest population centre	12.25 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	5.8 m			
Why was this site selected?	Time series data			
Is this site	Sheltered		☒ Exposed	
Any major coral damaging storm in past years	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None ☒	Low	Moderate	Heavy
Poison fishing	None ☒	Low	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for curio sales	None	Low ☒	Moderate	Heavy
Tourist diving	None	Low	Moderate ☒	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Resort zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Safrizal			

Site Description

ReefCheck 2003

Site Name	East Menyawakan			
Date	10 September 2002			
Time of day that work started	10.48			
Time of day that work ended	11.37			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW ☒	E-W	SE-NW
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	29 degrees Celsius			
Water temperature at surface	17 degrees Celsius			
Water temperature at 3 m	17 degrees Celsius			
Water temperature at 10 m	16 degrees Celsius			
Distance from nearest population centre	11.20 Km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	6.40 m			
Why was this site selected?	Other side			
Is this site	Sheltered		☒ Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None ☒	Low	Moderate	Heavy
Poison fishing	None ☒	Low	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for curio sales	None	Low ☒	Moderate	Heavy
Tourist diving	None	Low	Moderate ☒	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes ☒		No	
If yes, what type of protection?	Resort zone			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Sarles			

Site Description	ReefCheck 2003			
Site Name	West Cemara kecil			
Date	10 September 2002			
Time of day that work started	13.30			
Time of day that work ended	15.08			
Longitude of transect start point	110,3740800			
Latitude of transect start point	– 5,8299400			
From chart or GPS? (if GPS, indicate units)	Chart		GPS ✓	
Orientation of transect	N-S	NE-SW ✓	E-W	SE-NW
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ✓		Cloudy	Raining
Air temperature	28 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3 m	18 degrees Celsius			
Water temperature at 10 m	18 degrees Celsius			
Distance from nearest population centre	9.10 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	5.4 m			
Why was this site selected?	Time series data			
Is this site	✓ Sheltered		Exposed	
Any major coral damaging storm in past years?	Yes ✓		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low ✓	Moderate	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ✓	Moderate	Heavy
Poison fishing	None	Low ✓	Moderate	Heavy
Aquarium fish collection	None	Low ✓	Moderate	Heavy
Harvest of invertebrates for food	None	Low ✓	Moderate	Heavy
Harvest of invertebrates for curio sales	None	Low ✓	Moderate	Heavy
Tourist diving	None	Low ✓	Moderate	Heavy
Sewage pollution	None ✓	Low	Moderate	Heavy
Industrial pollution	None ✓	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ✓	Heavy
Other impact (specify)	None	Low ✓	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ✓	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Duhita			

Site Description

ReefCheck 2003

Site Name	East Cemara Kecil			
Date	10 September 2002			
Time of day that work started	13.55			
Time of day that work ended	15.15			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW ☒	E-W	SE-NW
Distance from shore	75 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	28 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3m	18 degrees Celsius			
Water temperature at 10m	18 degrees Celsius			
Distance from nearest population centre	8.40 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	5.7 m			
Why was this site selected?	Other side			
Is this site	☒ Sheltered		Exposed	
Any major coral damaging storm in past years	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur ☒				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for curio sales	None	Low ☒	Moderate	Heavy
Tourist diving	None	Low ☒	Moderate	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None	Low ☒	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ☒	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Endang			

Site Description	ReefCheck 2003			
Site Name	West Menjangan Besar			
Date	8 September 2002			
Time of day that work started	11.27			
Time of day that work ended	13.45			
Longitude of transect start point	110,4236100			
Latitude of transect start point	– 5,8989900			
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW	E-W	SE-NW ☒
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	28 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3 m	18 degrees Celsius			
Water temperature at 10 m	17 degrees Celsius			
Distance from nearest population centre	1.05 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	6.2 m			
Why was this site selected?	Time series data			
Is this site	Sheltered		☒ Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None	Low	Moderate ☒	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ☒	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Dhani			

Site Description

ReefCheck 2003

Site Name	East Menjangan Besar			
Date	14 October 2002			
Time of day that work started	10.50			
Time of day that work ended	13.20			
Longitude of transect start point				
Latitude of transect start point				
From chart or GPS? (if GPS, indicate units)	Chart		GPS ☒	
Orientation of transect	N-S	NE-SW	E-W	SE-NW ☒
Distance from shore	100 m			
Distance from nearest river	– km			
River mouth width	<10 m –	11-50 m –	51-100 m –	101-500 m –
Weather	Sunny ☒		Cloudy	Raining
Air temperature	27 degrees Celsius			
Water temperature at surface	18 degrees Celsius			
Water temperature at 3m	17 degrees Celsius			
Water temperature at 10m	17 degrees Celsius			
Distance from nearest population centre	0.35 km			
Approximate population size	– X 1000 people			
Horizontal visibility in water	3.4 m			
Why was this site selected?	Other side			
Is this site	Sheltered		☒ Exposed	
Any major coral damaging storm in past years?	Yes ☒		No	Unknown
How do you rate this site overall in terms of ant anthropogenic impact	None	Low	Moderate ☒	Heavy
What types of impact do you believe occur?				
Dynamite fishing	None	Low ☒	Moderate	Heavy
Poison fishing	None	Low ☒	Moderate	Heavy
Aquarium fish collection	None	Low ☒	Moderate	Heavy
Harvest of invertebrates for food	None	Low	Moderate ☒	Heavy
Harvest of invertebrates for curio sales	None	Low	Moderate ☒	Heavy
Tourist diving	None	Low	Moderate ☒	Heavy
Sewage pollution	None ☒	Low	Moderate	Heavy
Industrial pollution	None ☒	Low	Moderate	Heavy
Other forms of fishing? (Specify)	None	Low	Moderate ☒	Heavy
Other impact (specify)	None ☒	Low	Moderate	Heavy
Is there any form of protection (statutory or other) at this site?	Yes		No ☒	
If yes, what type of protection?	–			
Other comments	–			
Submitted by (TI/TS and your name)	MDC/Imam			

**Coral Reef Survey & Monitoring for Management in
Central Sulawesi, Indonesia**

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1. OVERVIEW

From June 2002 to May 2003, Yayasan Adi Citra Lestari (YACL) implemented a programme of marine survey training, and survey/monitoring work in Central Sulawesi, Indonesia, designed to support management of the region's coastal resources, especially the coral reefs. This programme was implemented with grant support from UNEP EAS/RCU.

During the course of this programme, opportunities arose to work together with other local programmes in order to maximise the effectiveness of each, so that some changes were made to the schedule and activities. The two main projects were the Central Sulawesi branch of the national Marine and Coastal Resources Management Program (MCRMP), a 5 year ICZM programme with GOI and ADB funding, and the evaluation of two areas as potential national level MPAs by the Marine and Fisheries Department (DPK), in co-operation with the Institut Pertanian Bogor (IPB), a major Indonesian University with one of the main marine research centres in the country.

The training activities carried out were all aimed at increasing local capacity to carry out survey and monitoring work in GCRMN approved methodologies. The activities included training for 9 people both from within the organisation and from local coastal communities in Palu Bay and Ampana in Manta Tow survey methodology, improving the skills of 6 people in ReefCheck survey work, and training 6 people in LIT Lifeform transect survey work.

Monitoring was carried out at 4 locations within the Province, where permanent markers had been placed in 2001/2002. These included 4 ReefCheck and 2 Manta Tow surveys.

Data was collected at 17 new locations within the Province: 2 under this programme independently; 3 locations in collaboration with the DPK/IPB team; and 10 locations under the collaboration with MCRMP. In addition, new survey data using LIT methodology was collected at all 4 existing monitoring sites.

Data was collected using ReefCheck methods at 2 new sites with placing of permanent markers at one site. Manta Tow surveys were conducted at 12 sites, with 3 ReefCheck and LIT survey sites (Kakafu in Donggala, Talise and Kadongo in Tawaeli) included in the Palu Bay Manta Tow area. The Lifeform LIT method was used at 8 new and 4 existing sites. In addition, at 14 of the sites, additional data using the lifeform categories and ReefCheck indicator organisms were collected for use in the MCRMP and IPB/DPK programmes. Video and/or photographic data was collected at most sites, but because the underwater camera leaked part of the way through the programme and video battery charging was limited, the underwater photographic record is incomplete. During the MCRMP project, socio-economic data for the selected sample villages were also collected.

The monitoring and survey results confirm the conclusion of the 2000/2001/2002 survey work carried out previously, which is that the overall condition of reefs in the areas surveyed gives great cause for concern. None are in the very good category, and all are under threat from factors that are not being addressed by any current management activities. It is possible that some reefs may already be irreversibly damaged, or damaged beyond the capacity for recovery within the foreseeable future by both direct and indirect results of human activities. In most areas, the threats are increasing, and it is likely that the number of reefs in this heavily impacted category could increase dramatically over the next few years if there is no change in human use/behaviour patterns.

The causes and effects of damage vary between reefs and areas, but based on survey results, it is felt that most could still realistically be addressed. The good news is that some reefs are still in the "good" category, and quite a few are in the "average" category. The generally high number of juvenile corals and other organisms would indicate that the majority still retain the potential to become what they once were – vibrant, beautiful and productive resources – without significant intervention other than removing the causes of destruction.

The urgency and gravity of the situation really needs to be taken to heart by people whose decisions directly or indirectly influence the threats identified. By using a science-based approach, YACL has been able to gain the attention of policy-makers and is now beginning to have some impact

in the field of applying data to marine and coastal natural resource management within the Province. There is now growing awareness and concern from decision makers, such that political will to tackle at least some of the root causes has been expressed. Though still in the very early stages, programmes to address some of the threats to coral reef and related ecosystems are under way, or at least being drawn up.

The data and data products produced both independently and in conjunction with other programmes have contributed to the initiating of the Pulau Pasoso MPA initiative, and are being used in the processes of establishing status, regulations and management systems for two MPAs (Pulau Pasoso and the Togean Islands), and in MCRMP, the pilot ICZM programme for the Province. Participating in the "Fisheries Expo 2003," an exhibition organised by one of the local universities, was an excellent opportunity for reaching out to a wider audience at relatively low cost, and other such opportunities are being sought.

Ongoing involvement in activities related to management of marine resources is planned for 2003/2004. These include follow-up of activities to date, such as continuing our monitoring programme, in conjunction with other activities at the sites, ongoing involvement in the Pasoso MPA programme and hopefully continued participation in the MCRMP programme.

YACL survey/monitoring and other skills are increasingly in demand locally, and it is likely that over the 2003/2004 period there will be further joint programmes, possibly in Regencies outside the Palu/Donggala and Poso Regencies where all activities to date have taken place. Support for some of the activities planned for 2003/2004 has already been obtained from The David & Lucille Packard Foundation South Pacific fund and NOAA International Coral Reef Conservation Fund, and activities under these agreements are already underway. In addition, support for turtle conservation activities at Pulau Pasoso MPA has been obtained from the BP Conservation Award scheme by a group of students working with YACL.

With regards to destructive fishing and other marine infractions, the official response of the authorities in all survey/monitoring site areas is that they do not have the resources, especially infrastructure, for effective control. In addition, current legislation is complex, confusing and cumbersome, and it is often unclear which agency should deal with what activity/issue, so that there is much "passing of the buck." Members of the law enforcement or other government bodies are frequently implicated in illegal activities related to natural resource use. These problems and others related to the legal system are supposed to be addressed through the MCRMP ICZM programme in which YACL is involved, for the two pilot areas selected and supposedly to some extent for the Province. Local regulations are being drawn up, and implementation systems devised. This could be a long process, and has not had any effect yet even within the pilot areas. It seems unlikely to have any impact outside MCRMP pilot areas, e.g. in the Tanjung Api area.

One very clear message from local community members in all areas was that although many of them are involved in illegal practices, nearly all would welcome proper regulation, however strict, so long as it was seen to be clear, justified, fair, and above all, fairly enforced. Most people participate on the basis "if they are going to do it and get away with it, it is going to be taken/happen anyway. So I might as well get what I can now." This means that however "aware" people become, their behaviour does not change noticeably. They usually refers to people in positions of power, with superior technology, from other areas, etc. This was a common theme at the recent Second International Tropical Marine Ecosystems Management Symposium (ITMEMS 2) in Manila. It was also part of the YACL report to the local government in 2002. In this regard, raising awareness among decision-makers and community leaders is a priority, to gain the necessary support for effective control measures.

2. TRAINING REPORT

Training was the main thrust of the 2001/2002 programme, and formed the basis on which the 2002/2003 programme was able to run. In 2002/2003, although training was no longer the major focus in terms of allocated funds, in terms of use of human resources, especially time, training was still a major programme component and will continue to be so for the foreseeable future. Human capacity building both internally and externally is a pillar of YACL's founding mission statement.

For the marine survey and monitoring programme, suitable training materials in the Indonesian language were already available for many of YACL's needs in 2002/2003, both from YACL's own previous activities and from a variety of other sources. It was still necessary to produce and/or refine further training products during the 2002/2003 programme, though this was a relatively minor activity compared to 2001/2002.

A number of the 2001/2002 trainees were no longer fully active in 2002/2003, some because they are not currently living within the area, short or long term, but still participate when their other commitments allow. Therefore, the core team number is less than the number of trainees to date. This was anticipated, and is one reason why YACL expects to undertake ongoing training on a long term basis.

Some training originally planned for 2002/2003 has been postponed to the 2003/2004 programme as the supporting funding was delayed, and the opportunity of MPA and MCRMP joint work took up much team time. In particular, ReefCheck without SCUBA and Manta Tow training of trainers (ToT) has been postponed. Lessons learned in 2001/2002 were taken into account in the planning and execution of the 2002/2003 programme, although in some areas there is still room for improvement, and the team is still learning.

Training in YACL's 2003/2004 programme includes SCUBA, survey methodologies, data management and analysis, for new and existing members and other skills such as English language, audio-visual editing, GIS use and financial management. Additional training capacity is needed, which means more ToT in-house and in some cases, planning for external training of members.

YACL has already become involved in external capacity building though to date, the majority of activities in this field have been outside the marine programme. In the long-term, YACL anticipates increasing its participation in capacity building for non-members, including government employees, community members and school children/teachers, through formal and informal means.

Training in 2002/2003 focused on two main areas: improving the skills of the existing survey team members, and the training of additional members, and is summarised in Table 1 below.

Table 1. Training activities and results

Training Type	Month/Year	Location	No of Trainees	Results
ReefCheck Fine tuning	July/August 2002	Palu	6	All proficient in all ReefCheck skills including transect marker placement
Manta Tow	September/October 2002 (members & community)	Palu Bay Pasoso	6	4 proficient in data collection 2 tow as buddy/need more training, but proficient in surface work (GPS etc.) 4 proficient as tow boat driver
Manta Tow Revision	May 2003 (community)	Ampana	3	2 proficient to tow for data 2 proficient for GPS 1 to tow as buddy/needs more training
LIT	March 2003	Palu Bay	6	5 proficient 1 needs further training/confidence building
Manta Tow TOT	–	–	–	Deferred to later date, to be included with training of additional members

The present YACL team and the status of members/community members trained in the programme since 2001 is summarised in Table 2 below. Note some individuals are in several or all columns. This table does not include the instructor(s).

Table 2. YACL team skills as at 15th March 2003

Competency level	Manta Tow	ReefCheck	LIT	SCUBA	GPS
Active & Competent	4	6	5	7	3
Active & Partly Competent	4	1	1	0	3
Trained/partly trained but often unavailable	3	3	0	3	4
Trained but not currently or no longer active	0	0	0	2	1
Total	11	10	6	14	11

The major problems encountered in training were:

1. The conflict between the need for training to increase the capacity due to extra current and future workload, and the need to use existing capacity to complete this work within schedule – chicken and egg syndrome. For example, because LIT was needed for the IPB/DPK and MCRMP programmes, the LIT trainer had to complete the technical part of this work alone, and was not available on schedule for other trainings.
2. Lack of synchronisation between schedules of various supporting and partner agencies, resulting in a need to alter schedules in one programme due to alterations in the schedule of another. e.g., the SCUBA training has been postponed to 2003/2004 due to the delay in funds from The David & Lucille Packard Foundation and NOAA. Tanjung Api monitoring was delayed due to the demands of participating in the MCRMP and IPB/DPK programmes.
3. Unseasonable weather and gear failures.

In spite of all these challenges, YACL feels that progress was made in 2002/2003 on the training front, and is committed to continuing and improving training activities.

Attendance in May 2003 at “Fisheries Expo 2003,” an exhibition organised by one of the local universities, revealed that the local desire and perceived need for training in SCUBA and marine survey work is high, well in excess of current YACL capacity to fulfil. YACL won the award for “best stand” in terms of educational and informational content, but more importantly was able to reach out to a cross-section of the local population, including students, academics, government staff and decision-makers, and general community members.

3. MONITORING REPORT

YACL has carried out monitoring at a total of 4 locations in Central Sulawesi during this programme, for which baseline surveys were carried out in 2000-2002. Details of numbers of transects, methods used, etc. are given in Table 3 below. Note that each ReefCheck Transect includes a 3 m and 10 m transect.

Table 3. Monitoring surveys carried out

Location & Date	Manta Tow in 2001/2002	Manta Tow in 2002/2003	No. of ReefCheck Transects	Remarks
Kadongo, Tawaeli August 2002	No	Yes	1	Four permanent markers lost and replaced Manta Tow as part of Palu Bay Survey
Talise, Tawaeli August 2002	No	Yes	1	Two permanent markers lost and replaced Manta Tow as part of Palu Bay Survey
Pasoso Island September 2002	Yes	Yes not 100%	4	No permanent markers lost Manta Tow survey in 2000 MPA program underway
Labuana September 2002	No	No	3	No permanent markers lost Community programme in planning stage
Tanjung Api Nature Reserve May 2003	Yes	Yes not 100%	4 (TR2 only 50 m @ 10 m)	Many permanent markers shattered by bombs Manta Tow survey in 2000 Community participation in Manta Tow

Indonesian reports using some of these data, together with new survey results and in some cases including the previous survey/monitoring results, have been produced and disseminated in a variety of ways. Further use of the data is anticipated, and a number of other data products and events/processes where the data will be used are in preparation.

3.1 General Remarks

It should be noted that since the 2000/2002 surveys, general overall living conditions for coastal people and for the population of the area generally have become substantially harder with rising fuel and other costs and little or no increase in income. This has led to an increase in all kinds of illegal or unsustainable practices both on land and at sea, both by local people and people from other areas.

There was a five-month drought period prior to the 3 monitoring surveys at Tawaeli, Pasoso and Labuana that caused additional hardship and caused many "fisher-farmer" families who make up the majority of the West Coast population to concentrate more on the sea. The reduction in sedimentation during the dry season was also most noticeable, with increased visibility and reduced or absent sediment plumes, both in Palu Bay and along the West Coast generally.

The drought and other social effects were even more severe in the area surrounding the Tanjung Api site. Much of the land along the coast road was cleared, largely by land-hungry "refugees" from the Poso civil unrest, though in reality this was mainly a cover story for sheer greed, with (often influential) people taking advantage of the circumstances to order for people to clear land for subsistence but in reality on their behalf. The number of bomb fishing incidents increased dramatically according to local sources, within and without the reserve. Involvement of law enforcement personnel and other officials in both marine and terrestrial infractions of natural resource related regulations is common according to local people, and is especially a problem for traditional fishermen.

The bomb fishers have now started using new types of more powerful bombs with remote detonation at this site. These are harder to detect in operation and cause pretty much total devastation on quite a large scale. Craters seen were 10-30 meters across and some had resulted in entire cliff faces sloughing off to create underwater landslides of rubble and sand.

The only prosecution to date for any type of infraction in this reserve as far as we were able to ascertain is that of a forestry official convicted of illegally harvesting timber within the reserve. However he "got off" eventually with a suspended sentence, and no fine, not a deterrent to anyone.

Monitoring at Tanjung Api was not carried out during the drought season because of pressure of other work. By the time of the monitoring survey, the land clearance of the protected forest within the Reserve had already spread considerably, relative to the area affected at the time of the 2001/2002 survey, and was still ongoing. Chainsaw activity and fires were in evidence throughout the survey. The authorities are apparently “unable” or unwilling to do anything to stop this clearly illegal activity being carried out quite openly. “Investigations” were carried out in response to many reports including YACL’s 2001/2002 report and even an attempt to extinguish the clearing fires by local “Friends of Tanjung Api” group, but no action, either to stop the activities or to prosecute the offenders, has been taken to date.

A clearly visible result of the felling was significant soil erosion, with much bare rock already showing through what had been seemingly fertile loam-covered areas last year. Although it was already into the dry season, the water quality in front of the felled area was poor, with visibility in some parts reduced by suspended sediments to less than 5 m, where it had previously been 30 m or more. Possibly as a result of this enrichment, the water was full of micro-organisms that caused a most unpleasant rash on the skins of most team members. This phenomenon was not in evidence in the clear waters surrounding the non-felled sections of the reserve headland.

3.2 Benthic Cover Data

Summaries of the Manta Tow and ReefCheck data collected and comparison with previous data is given in the following tables and figures.

Table 4a. Manta Tow benthic cover summary – Tanjung Api

(Percentage)

Average Category	Tj Api 2000	Tj Api 2002	Tj Api 2003	Average	Variance
Hard Coral	22	22	22	22	0
Soft Coral	0	0	4	1	3
Dead Coral/Rock	10	10	8	9	2
Rubble	25	25	25	25	0
Sand/Silt	33	32	33	33	1
Other	10	11	8	10	2

Table 4b. Manta Tow benthic cover summary – Pulau Pasoso

(Percentage)

Average Category	Pasoso 2000	Pasoso 2001/02	Pasoso 2002/03	Average	Variance
Hard Coral	25	22	28	25	0-3
Soft Coral	18	20	15	18	0-3
Dead Coral/Rock	15	13	11	13	0-2
Rubble	19	21	15	18	1-3
Sand/Silt	13	15	18	15	0-3
Other	10	9	13	11	1-3

Table 5. Coral condition categories

Category code	1	2	3	4	5
Per cent Cover	<10%	11-30%	31-50%	51-75%	76-100%
Description	Very Poor	Poor	Average	Good	Very Good

Table 6a. Manta Tow hard coral cover category in Tanjung Api as percentage

Cover Category	T Api 2000	T Api 2002	Change 2000 to 2002	T Api 2003	Change 2002 to 2003	Change 2000 to 2003
1	13	15	+2	10	-5	-3
2	47	60	+13	51	-9	4
3	35	21	-14	34	13	-1
4	3	4	+1	5	1	2
5	2	0	-2	0	0	-2

Table 6b. Manta Tow hard coral cover category in Pulau Pasoso as percentage

Cover Category	Pasoso 2000	Pasoso 2001/02	Change 2000 to 2001/02	Pasoso 2002/03	Change 2001/02 to 2002/03	Change 2000 to 2002/03
1	0	11	+11	8	-3	+8
2	37	43	+6	36	-7	-1
3	54	42	-12	40	-2	-14
4	9	4	-5	16	+12	+7
5	0	0	0	0	0	0

The indication is that for both Tanjung Api and Pulau Pasoso there is little change in the overall category repartition, with the majority of tows in the poor and average categories. However although small in number, the loss of the remaining very good areas at Tanjung Api is felt to be significant, and reflects the general impression of overall decline. At Pasoso there are indications of seasonal variation, a hypotheses that needs further monitoring to verify or reject.

Figure 1. Tanjung Api Manta Tow monitoring data

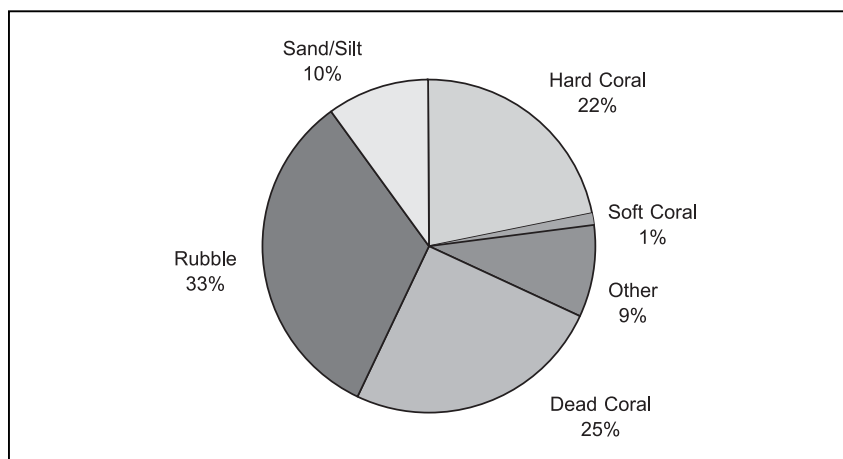
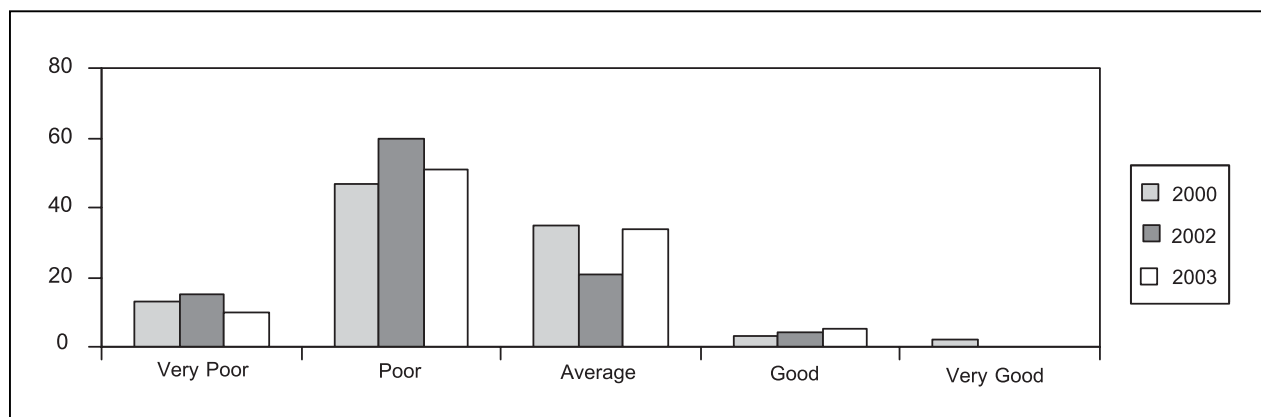


Figure 2. Tanjung Api benthic cover 2000-2003 (<3% difference over time period)



3.3 Tanjung Api Coral Condition Categories 2000/2002/2003

The diagrams above show very clearly the predominance of dead coral and rubble, and of poor condition at this site. More detail on the repartition of categories is given in the survey report, where areas within the Reserve are compared to the areas without.

Visually, the most noticeable changes were the increase in number of very large bomb sites, with total devastation, in some cases whole areas of cliff had been sheared away. This was especially bad between ReefCheck Transects 2 and 3. This area was previously one of the more attractive areas, especially around transect 2, though the area immediately around transect 3 had already been very badly damaged by carpet bombing with small bombs in 2002. This damage shows clearly on the Manta Tow breakdown in the Survey Section.

Another notable point was the appearance of some soft corals, a cover type that had seemingly been totally absent in 2000 and 2002. This soft coral increase consisted of a few sizeable patches rather than a general colonisation.

Figure 3. Pulau Pasoso Manta Tow monitoring data

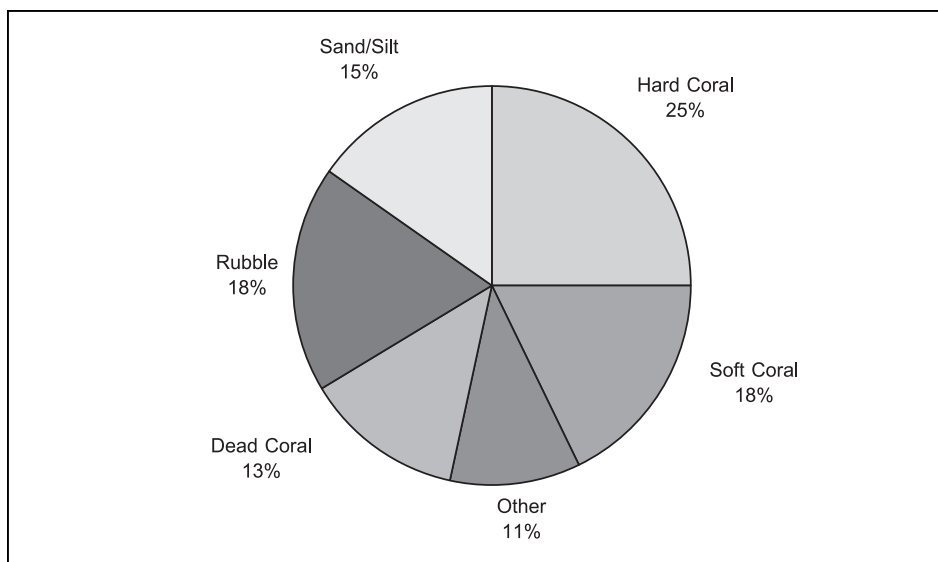
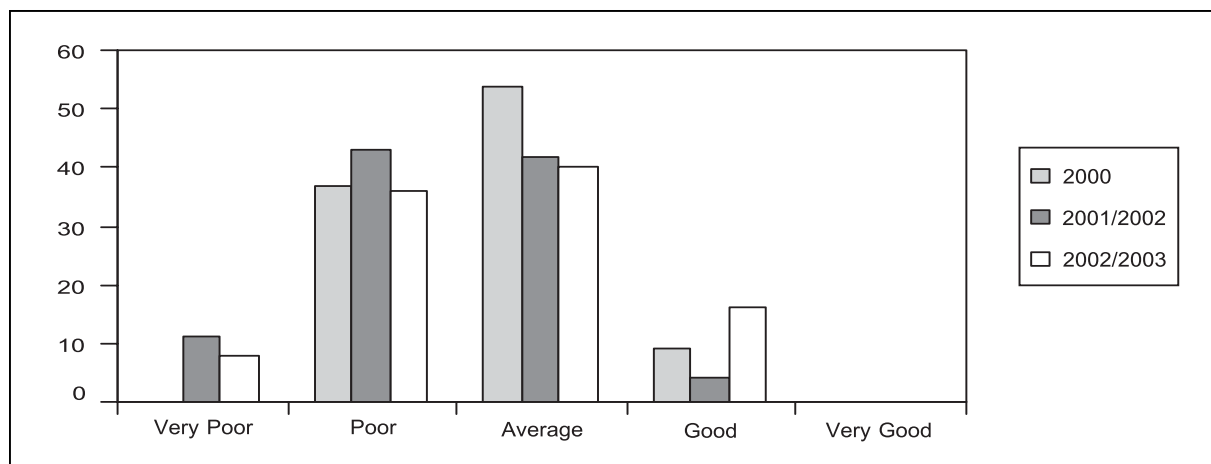


Figure 4. Pulau Pasoso benthic cover 2000 to 2003 (<3% difference over time period)



3.4 Pulau Pasoso Coral Condition 2000 to 2003

The two diagrams above show that the overall condition seem to be improving, possibly as a result of changes in the attitude of the resident family, although further monitoring is needed to confirm that this is a true trend and not a seasonal fluctuation or the result of observer bias, or bias from incomplete coverage in 2000 and 2002/2003.

On both of these surveys, the most exposed northern area which was in the worst condition in 2001/2002 was not accessible due to wave action. A noticeable feature was the shifting of sand between all visits, both above and below water.

Table 7a. ReefCheck substrate summary – Tawaeli

	Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
2001/02	Kadongo	3 m	15.6	0.0	13.1	6.3	0.0	15.0	40.0	5.0	4.4	0.6
	Kadongo	10 m	6.9	6.3	6.3	15.6	2.5	5.6	25.0	23.1	8.1	0.6
	Talise	3 m	52.5	1.9	1.9	2.5	1.3	7.5	9.4	8.8	6.3	8.1
	Talise	10 m	13.1	1.3	1.9	1.3	0.0	4.4	17.5	35.0	16.3	9.4
	Average Tawaeli		22.0	2.3	5.8	6.4	0.9	8.1	23.0	18.0	8.8	4.7
2002/03	Kadongo	3 m	4.4	0.0	11.9	1.3	4.4	6.3	62.5	1.9	0.0	7.5
	Kadongo	10 m	7.5	8.1	12.5	20.0	0.6	6.3	36.9	6.3	1.9	0.0
	Talise	3 m	55.0	1.9	0.0	3.1	11.9	9.4	17.5	0.0	1.3	0.0
	Talise	10 m	5.6	1.9	0.0	0.0	9.4	60.0	23.1	0.0	0.0	0.0
	Average Tawaeli		18.1	3.0	6.1	6.1	6.6	20.5	35.0	2.0	0.8	1.9
	Difference		-3.9	0.7	0.3	-0.3	5.7	12.4	12.0	-16.0	-8.0	-2.8

Table 7b. ReefCheck substrate summary – Pasoso

	Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
2001/02	Pasoso 1	3 m	20.6	2.5	0.0	0.6	0.0	27.5	34.4	3.8	10.6	0.0
	Pasoso 1	10 m	26.3	0.6	2.5	1.9	0.6	23.1	36.9	0.0	8.1	0.0
	Pasoso 2	3 m	47.5	3.1	0.6	0.6	2.5	11.9	28.8	1.9	0.0	3.1
	Pasoso 2	10 m	42.5	0.0	1.3	5.6	2.5	13.1	29.4	2.5	2.5	0.6
	Pasoso 3	3 m	27.5	13.1	3.1	5.0	0.6	18.8	26.9	4.4	0.0	0.6
	Pasoso 3	10 m	26.3	9.4	3.8	8.8	2.5	18.1	22.5	8.8	0.0	0.0
	Pasoso 4	3 m	36.9	25.0	0.6	0.6	1.9	13.1	20.0	1.9	0.0	0.0
	Pasoso 4	10 m	36.3	28.8	1.9	5.6	5.6	13.8	5.6	2.5	0.0	0.0
	Average Pasoso		33.0	10.3	1.7	3.6	2.0	17.4	25.5	3.2	2.7	0.5
2002/03	Pasoso 1	3 m	36.9	3.1	0.6	0.6	8.8	45.0	1.9	3.1	0.0	0.0
	Pasoso 1	10 m	26.3	1.3	1.3	1.3	10.6	53.1	0.6	5.6	0.0	0.0
	Pasoso 2	3 m	48.8	1.9	1.9	1.9	21.3	17.5	6.9	0.0	0.0	0.0
	Pasoso 2	10 m	35.6	0.6	6.9	0.0	14.4	26.9	15.6	0.0	0.0	0.0
	Pasoso 3	3 m	25.6	15.6	13.1	3.1	21.9	11.3	9.4	0.0	0.0	0.0
	Pasoso 3	10 m	36.3	10.0	24.4	1.3	10.0	7.5	9.4	0.0	1.3	0.0
	Pasoso 4	3 m	44.4	22.5	1.3	0.0	28.1	3.1	0.6	0.0	0.0	0.0
	Pasoso 4	10 m	37.5	35.6	1.3	6.3	14.4	2.5	0.6	0.6	1.3	0.0
	Average Pasoso		36.4	11.3	6.3	1.8	16.2	20.9	5.6	1.2	0.3	0.0
	Difference		3.4	1.0	4.6	-1.8	14.2	3.5	-19.9	-2.0	-2.4	-0.5

Table 7c. ReefCheck substrate summary – Labuana

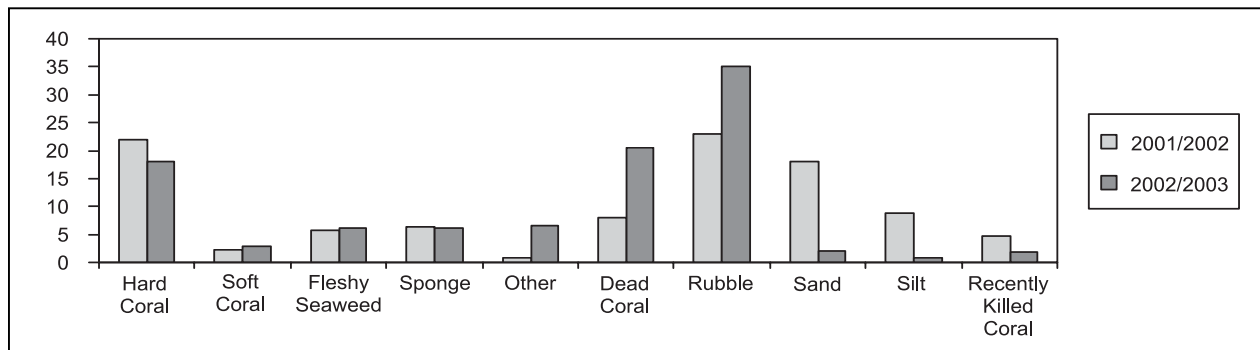
	Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
2001/02	Labuana 1	3 m	63.1	5.0	3.8	3.8	2.5	12.5	3.8	3.1	0.0	2.5
	Labuana 1	10 m	17.5	0.0	17.5	6.9	3.1	5.6	33.1	13.1	0.6	2.5
	Labuana 2	3 m	44.4	1.3	6.9	5.6	2.5	18.1	7.5	11.3	0.6	1.9
	Labuana 2	10 m	28.1	0.0	4.4	1.3	0.6	6.3	25.6	31.3	1.9	0.6
	Labuana 3	3 m	46.3	4.4	6.9	3.8	0.6	26.3	7.5	1.3	3.1	0.0
	Labuana 3	10 m	27.5	1.3	2.5	6.9	0.6	10.6	18.1	26.9	5.0	0.6
	Average Labuana		37.8	2.0	7.0	4.7	1.7	13.2	15.9	14.5	1.9	1.4
2002/03	Labuana 1	3 m	72.5	5.0	3.8	1.9	7.5	0.6	8.8	0.0	0.0	0.0
	Labuana 1	10 m	21.9	0.0	14.4	6.3	21.9	15.6	15.6	1.3	3.1	0.0
	Labuana 2	3 m	45.6	1.3	26.3	2.5	9.4	6.3	6.3	0.0	2.5	0.0
	Labuana 2	10 m	26.3	0.0	5.6	3.1	8.1	20.6	33.1	3.1	0.0	0.0
	Labuana 3	3 m	44.4	5.6	5.6	1.9	24.4	11.3	6.9	0.0	0.0	0.0
	Labuana 3	10 m	21.9	0.6	9.4	8.1	3.8	13.1	43.1	0.0	0.0	0.0
	Average Labuana		38.8	2.1	10.8	4.0	12.5	11.3	19.0	0.7	0.9	0.0
	Difference		1.0	0.1	3.8	-0.7	10.8	-2.0	3.1	-13.8	-1.0	-1.4

Table 7d. ReefCheck substrate summary – Tanjung Api

	Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
2001/02	T Api 1	3 m*	46.9	0.0	0.0	1.9	0.0	18.8	16.9	15.6	0.0	0.0
	T Api 1	10 m**	43.8	0.0	0.6	1.3	0.0	38.1	5.0	10.6	0.0	0.6
	T Api 2	3 m	21.3	0.0	6.3	0.0	0.0	68.8	3.8	0.0	0.0	0.0
	T Api 2	10 m	20.0	0.0	1.3	3.8	0.0	63.8	6.3	2.5	2.5	0.0
	T Api 3	3 m	18.1	0.0	2.5	1.3	1.3	41.9	35.0	0.0	0.0	0.0
	T Api 3	10 m	13.8	0.0	3.8	0.0	0.6	24.4	56.3	0.0	0.0	1.3
	T Api 4	3 m	25.0	0.0	0.0	1.3	0.6	43.8	27.5	1.9	0.0	0.0
	T Api 4	10 m	33.8	0.0	1.3	0.0	5.0	30.6	26.9	2.5	0.0	0.0
	Average T. Api		27.8	0.0	2.0	1.2	0.9	41.3	22.2	4.1	0.3	0.2
2002/03	T Api 1	3 m*	33.1	0.0	0.0	1.3	0.0	43.1	13.1	9.4	0.0	0.0
	T Api 1	10 m**	35.6	0.0	1.3	2.5	4.4	48.8	1.9	5.5	0.0	0.0
	T Api 2	3 m	56.3	0.0	0.0	1.3	1.3	24.4	15.0	1.1	0.0	0.6
	T Api 2	10 m	28.1	0.0	0.0	7.5	0.6	3.1	9.4	0.0	0.0	1.3
	T Api 3	3 m	33.8	1.3	1.9	5.0	11.3	27.5	19.4	0.0	0.0	0.0
	T Api 3	10 m	15.6	0.0	0.0	2.5	0.0	18.8	62.5	0.0	0.0	0.6
	T Api 4	3 m	48.8	0.0	0.0	0.0	11.8	23.8	15.6	0.0	0.0	0.0
	T Api 4	10 m	38.1	0.6	0.0	0.0	1.3	30.0	28.8	1.2	0.0	0.0
	Average T. Api		38.6	0.3	0.4	2.7	4.1	29.3	22.1	2.3	0.0	0.3
	Difference		10.8	0.3	-1.6	1.5	3.2	-12.1	-0.1	-1.8	-0.3	0.1

Based on the above tables, although the picture is not totally negative, with some increases in coral cover, overall the condition of the regions coral reefs would seem to be at best stable and possibly declining further. There is evidence of seasonal variations that need further study. The data above is summarised in graphic format in the following figures, with brief remarks below each figure.

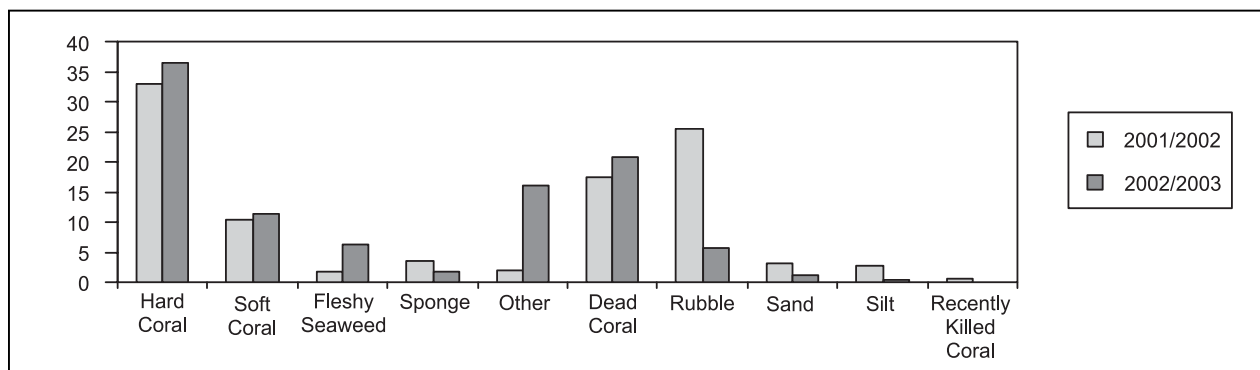
Figure 5a. ReefCheck – Changes in benthic cover for Tawaeli



From this diagram it can be seen that the overall condition is declining. The increase in dead coral is largely composed of fragments over the 15 cm ReefCheck rubble category size, but still quite capable of being moved by waves and currents. It is this broken dead coral of all sizes which is largely responsible for the reduction in sand and silt cover, both of which are still there underneath.

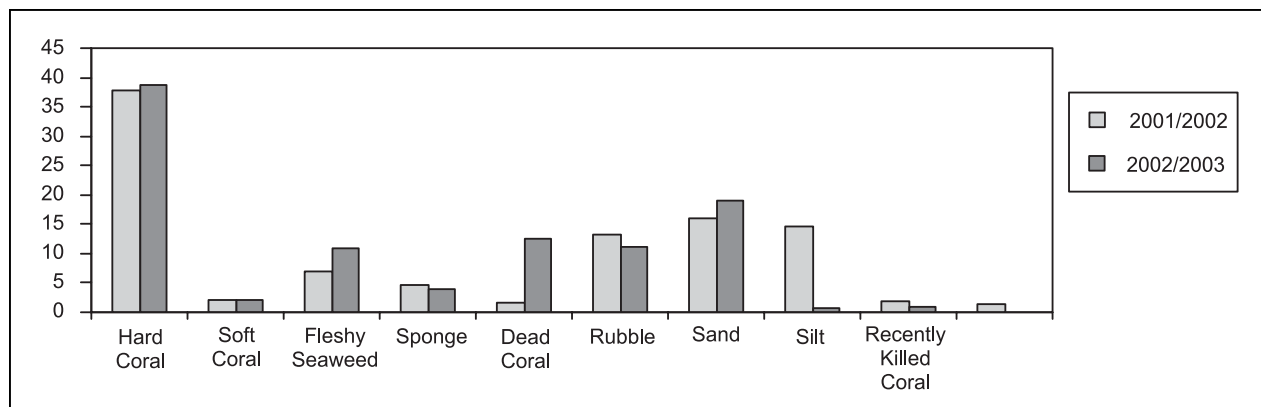
Another cause of silt (not sand) level reduction is seasonal, as this survey was carried out after a 5 month drought, with virtually no flow or sediment load from local rivers, whereas the previous survey was at the end of the rainy season when much sediment had been deposited over several months. Some sand was covered with seagrass and/or a filmy non macro algae which account for most of the increase in “other” category. Some of the rubble increase also can most likely be attributed to uncovering, as sand and silt shifted.

Figure 5b. ReefCheck – Changes in benthic cover for Pasoso

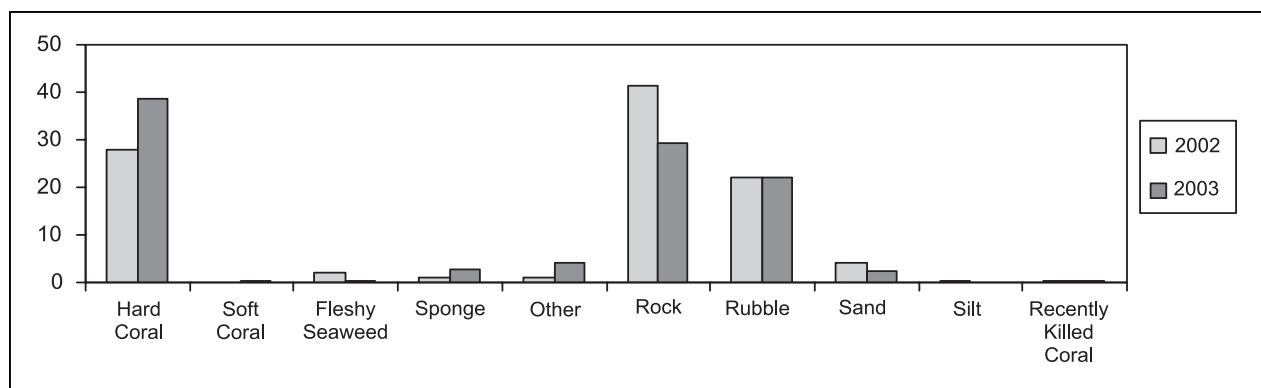


This diagram shows very clearly an increase in fast-growing benthic cover and a decrease in exposed rubble, which indicates little recent damage and recovery is underway, but could be seasonal variation. The increase in fleshy and filmy (“other”) seaweed needs watching, in case it is the result of nutrification. Seagrass also increased, which is a normal occurrence along this coast in the calm/dry season.

There was a small increase in both hard coral and dead coral, but not statistically significant, and the small amount of recently killed coral dropped to zero within the transect areas, though there were still some recently damaged areas clearly visible nearby and a low level of COTs predation was noted outside the transect areas. The reduction in sand and silt seems to be the result of seasonal shifts in location of the mobile sand/silt between reef and beach rather than a true reduction in overall sand.

Figure 5c. ReefCheck – Changes in benthic cover for Labuana


The overall benthic cover shows little change, and that which has occurred appears to be mainly the result of seasonal fluctuation, as the previous survey was at the end of the rainy season and the monitoring survey at the end of a five-month drought period. Both hard and soft coral cover did not change much. The reduction in silt and increase in dead coral seems to be due to a shifting of the previous season's sediment load away from the reef during the dry season. The increase in fleshy seaweed is also felt to be seasonal. Other variations are not statistically significant. Further monitoring will no doubt give clearer indications.

Figure 5d. ReefCheck – Changes in benthic cover for Tanjung Api


This graph gives a misleading perception that the coral cover for Tanjung Api has actually increased. In reality, several of the "permanent" transect markers were destroyed by bomb blasts, along with the surrounding coral, so that only scattered shards were recovered. The video data gives a clearer picture of real changes, and the visually very noticeable deterioration in overall condition is reflected in the decline in indicator fish and invertebrate species recorded.

The lines in these areas were replaced by the team member carrying out the line-laying task in an inappropriate fashion, i.e. he later admitted to deliberately seeking to cover the best available surrounding areas rather than continuing in as straight a line as possible from the remaining existing markers. There were high numbers of juvenile corals growing on these patches – as indeed is the case on many suitable substrate areas at this site. Therefore, this data does not give a true picture of the changes at "permanent" transect sites, but does bear witness to the remaining capacity for regeneration.

3.5 ReefCheck Indicator Species Data

Codex: I = increase; D = decrease; N = no change; S = shift in depth/location

Table 8a. Fish and rare animal summary - Tawaali

Location	2001/2002												2002/2003												Difference %				Overall Change				
	Kadongo				Talise				Average				Kadongo				Talise				Average				Kadongo					Talise			
	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m					
Depth Species/Attribute																																	
Fish:																																	
Butterfly fish	22	8	67	62	44.5	35	39.8	65	9	71	52	68	30.5	49.3	43	1	4	-10	1	4	-10	1	4	-10	1	4	-10	1	4	-10			
Sweetlips	6	2	2	4	4	3	3.5	3	0	12	10	7.5	5	6.5	-3	-2	10	6	0	10	6	0	10	6	0	10	6	0	10				
Snapper	3	0	5	10	4	5	4.5	24	0	21	4	22.5	2	12.3	21	0	16	-6	1	16	-6	1	16	-6	1	16	-6	1	16				
Barramundi Cod	0	0	0	1	0	0.5	0.3	0	0	0	0	0	0	0	0	0	0	-1	N	0	-1	N	0	-1	N	0	-1	N					
Grouper >30 cm	14	0	0	1	7	0.5	3.8	3	1	0	0	1.5	0.5	1	-11	1	0	-1	D?	1	0	-1	D?	1	0	-1	D?						
Humphead Wrasse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0	0	0	0	0	N							
Bumphead Parrotfish	2	0	3	2	2.5	1	1.8	2	0	6	5	4	2.5	3.3	0	0	3	3	N	0	3	3	0	3	3	N							
Other Parrotfish	11	3	3	1	7	2	4.5	10	0	7	8	8.5	4	6.3	-1	-3	4	7	D	1	4	7	D	1	4	7	D						
Moray eel	0	0	0	1	0	0.5	0.3	0	0	1	0	0.5	0	0.3	0	0	1	-1	N	0	1	-1	N	0	1	-1	N						
Rare Species:																																	
Turtle					0	0	0				0	0	0						N								N						
Dugong	1				<1	0	<1	1			<1	0	<1	0					N								N						
Shark					0	0	0				0	0	0						N								N						

Table 8b. Fish belt and rare species transect data – Pasoso

[illegible]

Table 8c. Fish belt and rare species transect data - Labuana

Location	3 m	10 m	Labuana 1	3 m	Labuana 2	10 m	Labuana 2	3 m	Labuana 3	10 m	Labuana 3	3 m	Average	10 m	Average	Overall	2001/2002						2002/2003						Difference						Overall Change	
Depth Species/Attribute	3 m	10 m	Labuana 1	3 m	Labuana 2	10 m	Labuana 2	3 m	Labuana 3	10 m	Labuana 3	3 m	Average	10 m	Average	Overall	2001/2002						2002/2003						Difference						10 m	3 m
Fish:	3 m	10 m	Labuana 1	3 m	Labuana 2	10 m	Labuana 2	3 m	Labuana 3	10 m	Labuana 3	3 m	Average	10 m	Average	Overall	2001/2002						2002/2003						Difference						10 m	3 m
Butterfly fish	46	41	47	30	36	52	43	41	42	97	43	26	36	28	27	50	35	43	51	2	-21	6	-8	-25	S?											
Sweetlips	3	9	1	34	0	1	1.3	15	8	3	1	6	5	0	1	3	2.3	2.7	0	-8	5	-29	0	0	D											
Snapper	16	8	10	17	7	29	11	18	15	94	37	3	30	3	2	33	23	28	78	29	-7	13	-4	-27	I											
Barramundi Cod	0	0	1	1	0	0	0.3	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	D?											
Grouper >30 cm	5	0	8	2	2	0	5	0.7	2.8	7	4	0	2	2	0	3	2	2.5	2	4	-8	0	0	0	D?											
Humphead Wrasse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N												
Bumphead Parrotfish	0	2	0	0	0	0	0	0.7	0.3	0	0	1	0	1	6	0.7	2	1.3	0	-2	1	0	1	6	S?											
Other Parrotfish	0	14	0	13	13	20	4.3	16	10	8	3	0	3	4	1	4	2.3	3.2	8	-11	0	-10	-9	-19	D											
Moray eel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N												
Other/rare species:																	2001/2002						2002/2003						Difference							
Turtle								0	0	0						0	0	0						N												
Dugong								0	0	0					1		<1	0	<1				+1	I?												
Shark								0	0	0						0	0	0						N												

Table 8d. Fish belt and rare species transect data – Tanjung Api

Location	2001/2002												2002/2003												Overall Change																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	T Apl 1	T Apl 1	T Apl 2	T Apl 2	T Apl 3	T Apl 3	T Apl 4	T Apl 4	Average	Average	Average	3 m	10 m	Overall	3 m	10 m	T Apl 1	T Apl 1	T Apl 2	T Apl 2	T Apl 3	T Apl 3	3 m	10 m	Average	3 m	10 m	Average	Overall	3 m	10 m	T Apl 1	T Apl 1	T Apl 2	T Apl 2	T Apl 3	T Apl 3	3 m	10 m	Average	3 m	10 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4	T Apl 4	10 m	3 m	T Apl 4

Table 9a. Invertebrate and coral damage summary – Tawaell

Location	2001/2002										2002/2003										Difference				Overall Change	
	Kadongo					Tallise					Kadongo					Tallise					3 m		10 m		10 m	Tallise
	3 m	10 m	3 m	10 m	Tallise	3 m	10 m	3 m	10 m	Tallise	3 m	10 m	3 m	10 m	Tallise	3 m	10 m	3 m	10 m	Tallise	Average		Average		Overall	Average
Indicator Invertebrates																										
Banded Coral Shrimp	3	0	0	0	0	1.5	0	0.75	0	0	0	1	0	0.5	0	0.25	0	0	0	0	0	0	0	0	0	0
Diadema Urchins	17	0	9	6	3	13	3	8	11	0	1	2	6	1	3.5	6	0	0	0	0	0	0	0	0	0	0
Pencil Urchins	7	0	0	0	0	3.5	0	1.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea cucumber edible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COT Acanthaster planci	2	0	0	0	1	0	0.5	2	0	0	0	0	1	0	0.5	0	0	0	0	0	0	0	0	0	0	0
Giant Clam (Tridacnae)	0	0	4	1	2	0.5	1.25	0	0	0	4	1	2	0.5	1.25	0	0	0	0	0	0	0	0	0	0	0
Triton	0	0	0	0	0	0	0	0	2	0	1	0	1.5	0	0.75	2	0	1	0	1	0	1	0	1	0	1
Lobster	0	0	1	0	0.5	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Damage etc: (scale 0-3)																										
Recent Coral damage	2	2	2	2	2	2	2	2	2	1	0	2	1	1.5	1.25	0	-1	-2	0	0	0	0	0	0	0	0
Trash	0	1	2	2	1	1.5	1.25	2	1	0	0	1	0.5	0.75	2	0	-2	-2	0	0	0	0	0	0	0	0
Bleaching	1	0	0	0	0.5	0	0.25	1	0	1	0	1	0	0.5	0	0	1	0	1	0	1	0	1	0	1	0

Table 9b. Invertebrate and coral damage summary – Pasoso

Transect number	Pasoso 1	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Average	Overall	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Average	Overall	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Average	Overall	10 m	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 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m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso 1	10 m	Pasoso 1	3 m	Pasoso
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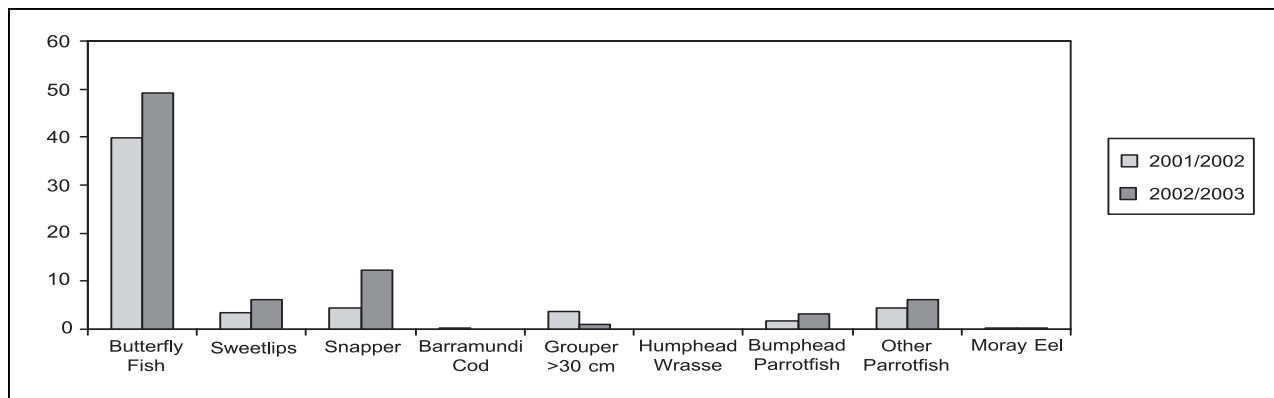
Table 9c. Invertebrate and coral damage summary – Labuana

Location	2001/2002										2002/2003										Difference					Overall Change
	Labuana 1	Labuana 1	3 m	Labuana 2	3 m	Labuana 3	10 m	Average	Overall	Labuana 1	3 m	Labuana 2	3 m	Labuana 3	10 m	Average	Overall	Labuana 1	3 m	Labuana 2	3 m	Labuana 3	10 m	Average		
Depth Species/Attribute																										
Indicator Invertebrates																										
Banded Coral Shrimp	3	1	2	0	0	0	0	1.67	0.33	1	13	4	0	0	0	0	4.33	1.33	2.63	10	3	-2	0	0	0	1
Diadema Urchins	3	0	5	2	3	1	3.67	1	2.33	18	5	9	0	4	2	10.3	2.33	6.33	15	5	4	-2	1	1	1	
Pencil Urchins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	
Sea cucumber edible	0	1	0	0	0	0	0	0	0.33	0.17	0	0	0	0	2	0	0.67	0.33	0	-1	0	0	0	2	5	
COT	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0.67	0	0.33	2	0	0	0	0	0	17	
Giant Clam	16	3	5	4	1	0	8	2.33	5.17	18	1	4	1	2	1	8	1	4.5	0	-2	-1	3	1	1	D	
Triton	0	0	0	1	0	0	0	0	0.33	0.17	0	0	0	2	0	0.67	0	0.33	0	0	0	-1	2	0	S	
Loteler	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0.33	1	0.67	0	2	0	0	1	1	1	
Damage etc: (scale 0-3)																										
Recent Coral damage	1	2	2	1	1	2	1.33	1.67	1.5	1	2	2	1	0	1	1	1.33	1.17	0	0	0	0	-1	-1	D	
Trash	1	1	1	1	1	1	1	1	1	1	2	1	1	0	1	0.67	1.33	1	0	1	0	0	-1	0	S	
Bleaching	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0*	0.67	0	0.33	1	0	1	0	0	0	1	

Table 9d. Invertebrate and coral damage summary – Tanjung Api

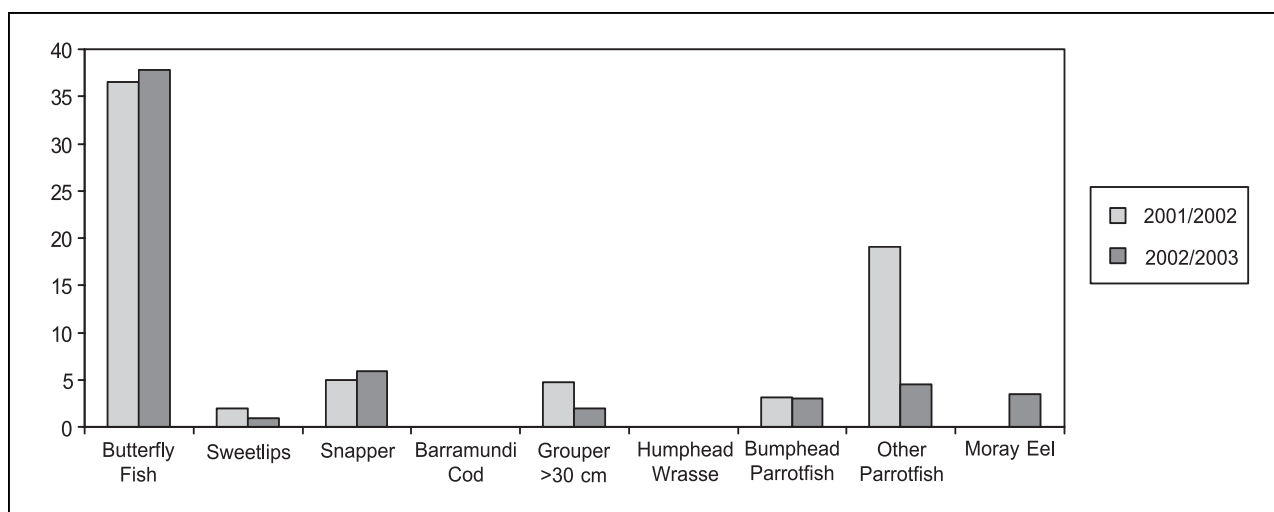
Location	2001/2002										2002/2003										Difference				Overall Change								
	3 m	10 m	T Apl 1	3 m	10 m	T Apl 2	3 m	10 m	T Apl 3	3 m	10 m	T Apl 4	Average	3 m	10 m	T Apl 1	3 m	10 m	T Apl 2	3 m	10 m	T Apl 3	3 m	10 m		T Apl 4	10 m						
Depth Species/Attribute	3 m	10 m	T Apl 1	3 m	10 m	T Apl 4	3 m	10 m	T Apl 4	10 m	Average	Overall	Average	3 m	10 m	Average	Overall	Average	3 m	10 m	Average	3 m	10 m	T Apl 3	3 m	10 m	T Apl 4	3 m	10 m	T Apl 4	10 m		
Indicator Invertebrates																																	
Banded Coral Shrimp	3	2	0	0	0	0	0	0	0	1	0.5	0.8	0	0	0	0	0	0	0	0	0.3	0.3	0.3	-3	-2	0	0	0	0	0	1	D	
Diadema Urchins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.3	0	0	0	0	0	0	0	2	0	I	
Pencil Urchins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	
Sea cucumber (edible)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.3	0	0	0	0	0	0	0	0	2	1	I
COT Acanthaster planci	0	0	0	0	0	0	0	0	0	1	0.3	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	D?	
Giant Clam (Tridacnae)	8	4	6	9	0	0	25	1	98	3.5	6.6	4	5	4	5	0	0	4	4	3	3.5	3.3	-4	1	-2	4	0	0	0	-21	3	D	D
Triton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	
Lobster	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	
Damage etc: (scale 0-3)																																	
Coral damage	3	3	2	3	3	2	2	2	2	2	2	2	2	3	3	3	3	3	2	3	2	2	2	2	2	2	2	2	2	2	1	0	I
Trash	0	0	0	0	0	0	1	0	0	3	0	0.1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	I
Bleaching	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	I

Figure 6a. Indicator fish changes – Tawaeli

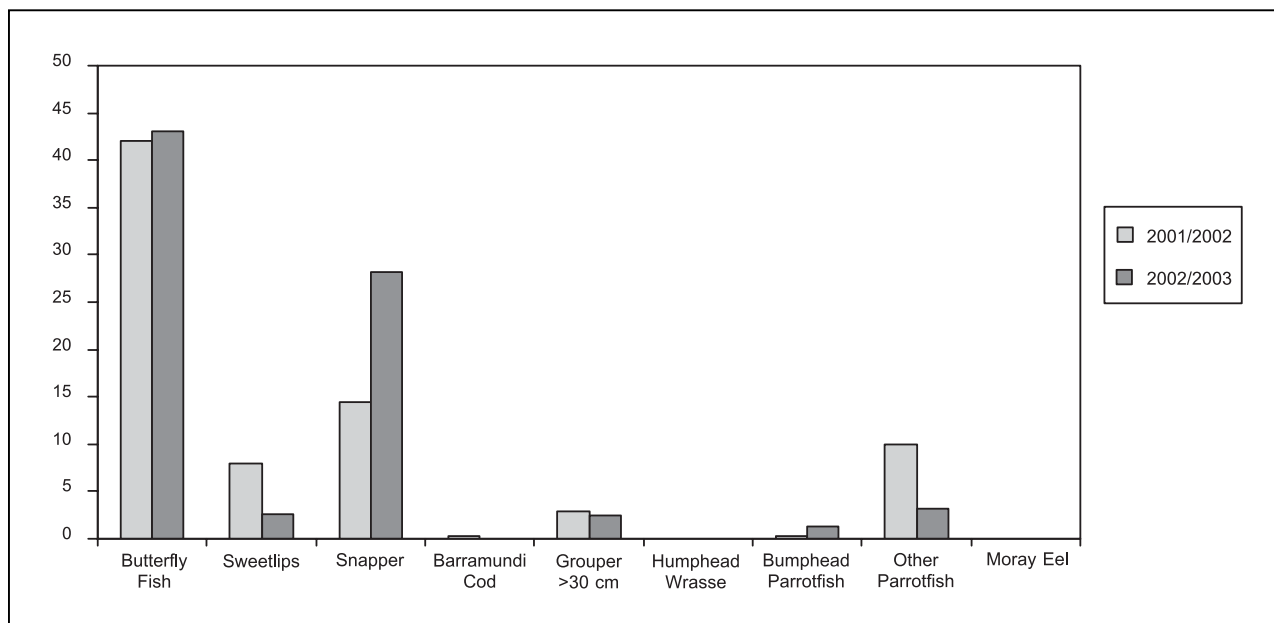


This summary shows that overall fish stocks at Tawaeli appear to be increasing, which could be due to the fact that on the occasion of the first survey, there had been a major decline due to unusual intensive gill-netting by non-local fishermen a few days before the survey. There is a decline in grouper that could be related to habitat decline shown in the Line Transect data.

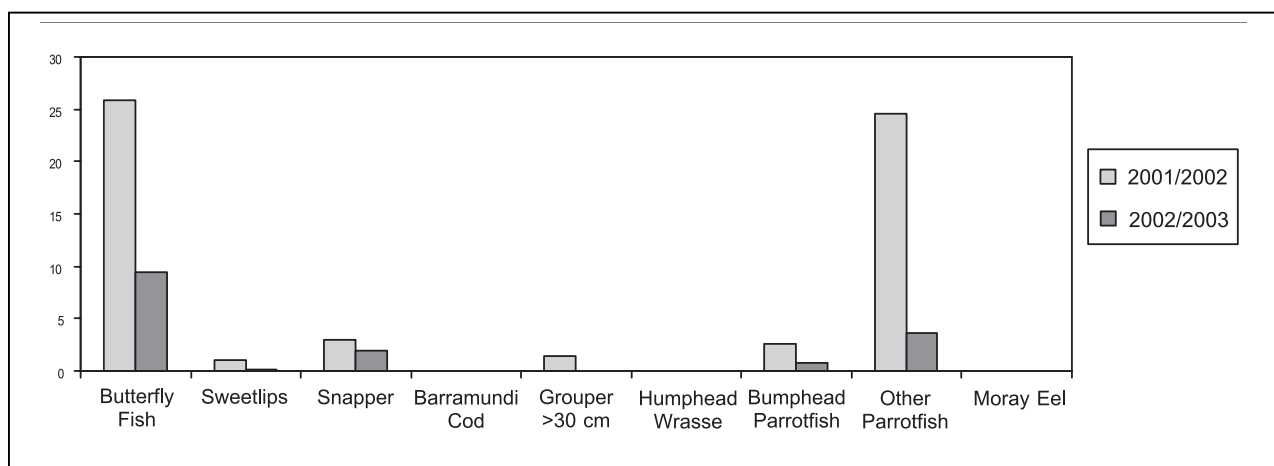
Figure 6b. Indicator fish changes – Pasoso



This summary shows a decline in grouper and especially parrotfish with a possible decline in sweetlips. Snapper and butterfly fish are stable or increasing, and there was a recruitment of moray eels to the transect areas. The reason for declines could be fishing, but could be seasonal or due to survey time/weather and needs further monitoring. More information about activities at the site is being sought.

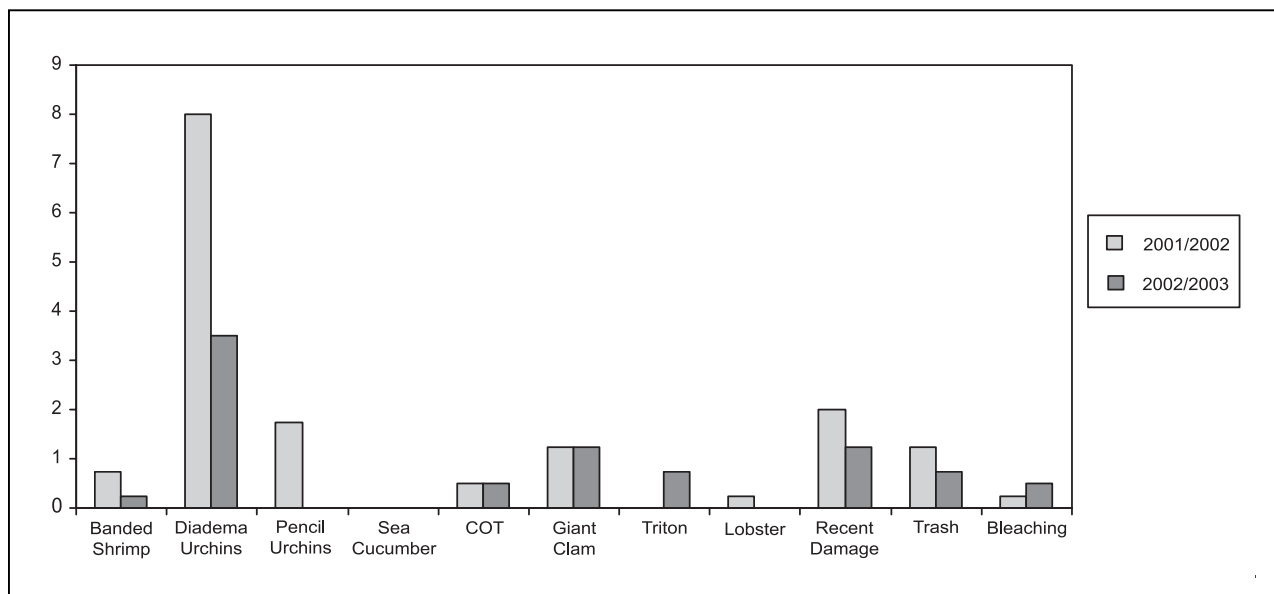
Figure 6c. Indicator fish changes – Labuana


This summary shows a decrease in sweetlips and parrotfish, and an increase in snapper, while other variations are not significant. The trend is similar to Pasoso, and could indicate an overall seasonal difference for the West Coast area. Further monitoring should indicate what is due to seasonal variation and what is true change.

Figure 6d. Indicator fish changes – Tanjung Api


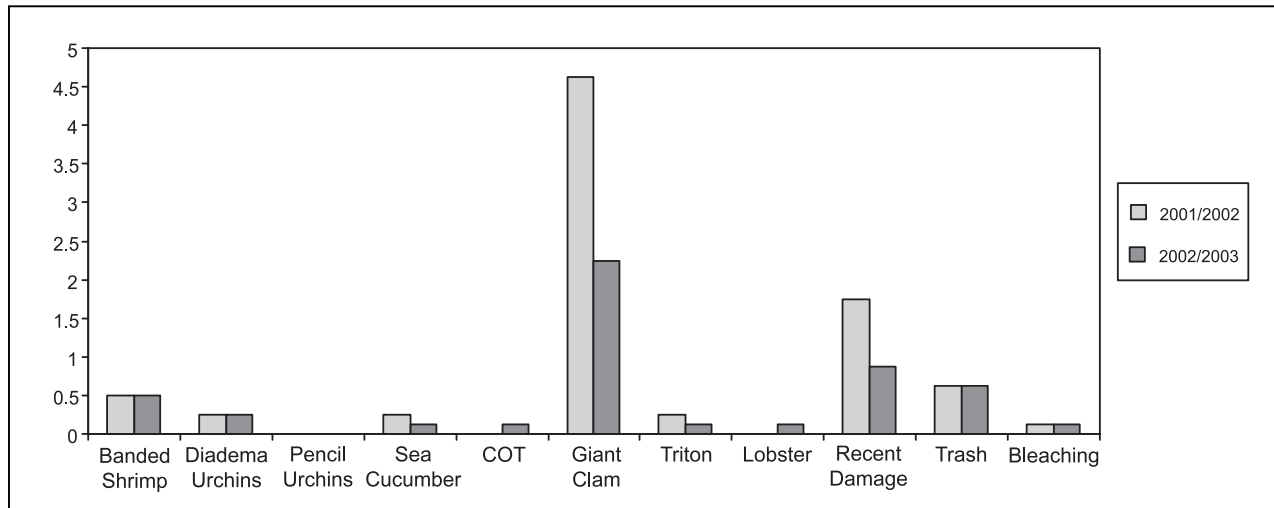
This summary clearly shows the reduction in indicator and commercial fish stocks that was observed by the survey team and reported by local fishermen, both those using traditional methods and those involved in destructive fishing practices. Destructive practices either seen or reported include bomb fishing, the use of poisons for fishing, mainly in the form of cyanided bait broadcast on shallow area, and use of steel bars or similar, to prise clams and other invertebrates from the remaining coral areas, mainly but not solely on the reef flat.

Figure 7a. Indicator invertebrate and impact changes – Tawaeli

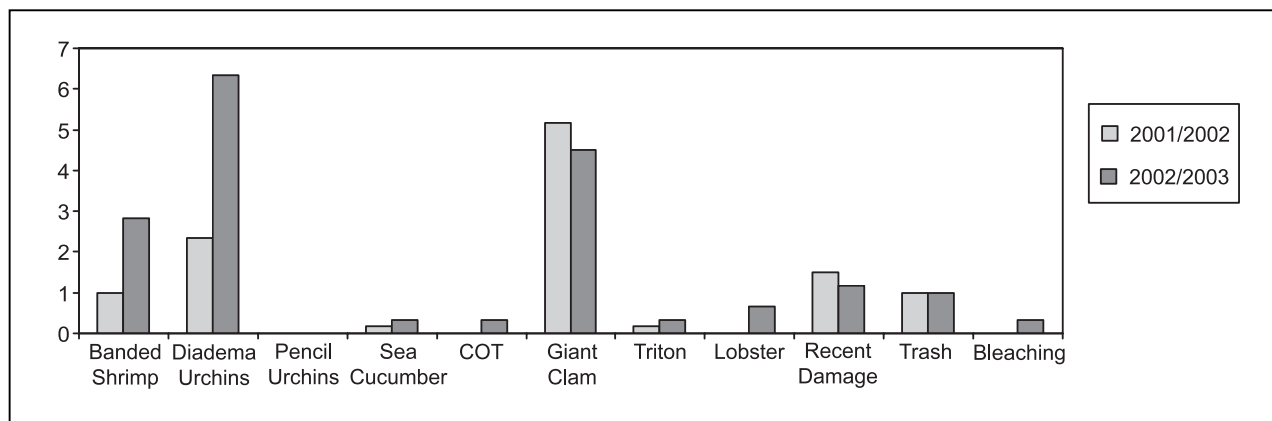


The above table indicates that there has been a reduction in the *Diadema*, pencil urchin and possibly banded shrimp populations, and a possible increase or shift in triton population. The level of recent mechanical damage has dropped, as has trash, while bleaching has increased.

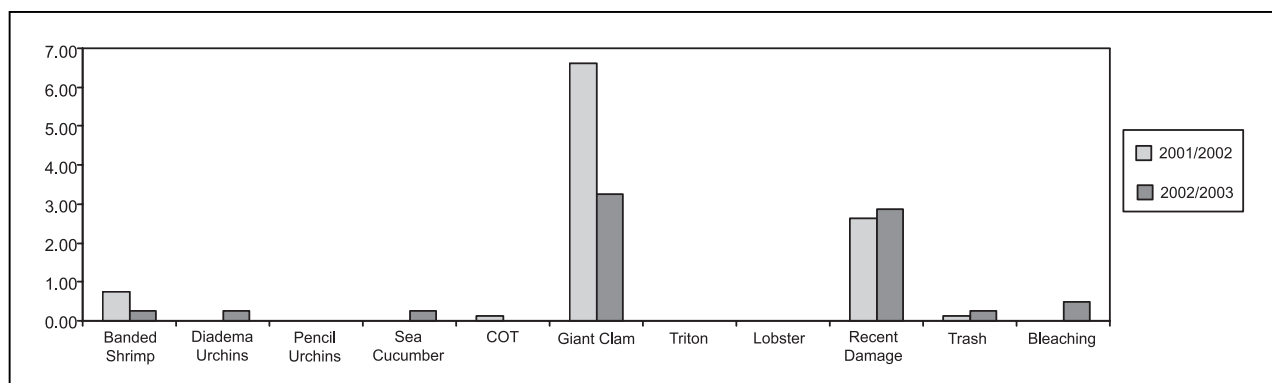
Figure 7b. Indicator invertebrate and impact changes – Pasoso



The diagram shows noticeable declines in the *Tridachna* population, due to the turtle hatchling feeding episode. Other changes are not statistically significant, although the presence of a lobster is positive, and finding a COT reinforces the need for monitoring. Reduction in recent damage is likely due to some protection by the island family after explanations from YACL. There was no observed change in trash and bleaching.

Figure 7c. Indicator Invertebrate and impact changes – Labuana

The above graph shows marked increase in banded shrimp and *Diadema* populations. The appearance of lobster and COT in small numbers, as at Pasoso, maybe a seasonal variation, and further monitoring is needed. Other changes are not significant. There is a small reduction in recent coral damage, and the appearance of a small amount of bleaching that does not appear to be related to cyanide fishing. From the appearance, coral disease and low-level COT predation are suspected.

Figure 7d. Indicator invertebrate and impact changes – Tanjung Api

The above graph shows that the number of invertebrates, especially *Tridacna* clams, has been reduced, and this is even more telling in view of the partial line re-laying to encompass “best possible” areas. The 2003 data may actually be an over-estimate as at least one team member later admitted to exceeding the 5 metre width in an effort to find anything to record at all. No COTs or COTs damage were seen on the 2003 survey transects. The appearance of bleached areas, often partially bleached or with gradations of bleaching, which seemed likely from their position and shape to be cyanide-related rather than due to increased temperature or other sources, and the increase in recent mechanical damage, mainly from explosives but also from use of crow-bars or similar for removing invertebrates (especially *Tridacna* spp.), were very clear visually, both while recording ReefCheck data and on the Manta Tow survey. The small increase in bottom trash was reflected by an increase in the surface or floating trash observed during the Manta Tow.

3.6 Threats Summary

A summary of the threats observed by or reported to the team during monitoring is given in the table below. This table is adapted from the ReefCheck site description data and additional observations/information.

Table 10. Summary of threats and destructive practices

Threat/Practice	Tawaeli	Pasoso	Labuana	Tanjung Api
Bomb Fishing	Some evidence of low-level recent damage	Seems to be reduced but still some recent signs	Denied but some signs, known to be high nearby outside the bay, at risk	Frequent, many new sites seen & documented, move to use of remote detonated "superbombs"
Poison Fishing	Some evidence of low-level recent damage	Evidence of recent damage	No evidence of recent damage	Frequent, both "professional" (compressors) and broadcast "recreational" signs & reports
Anchoring	Regular. Small often stone anchors, on regular basis (moon cycle) at specific depths	Recent signs, includes quite large fishing vessels a tourist boat and frequent grounding	High, small often stone anchors, on regular basis (moon cycle) at specific depths	Medium, as not so many boats anchor. Mostly near Labuan (Transect 1), a sheltered anchorage
Coral "mining"	No recent signs on site but some nearby	Not a threat here	None on site, some nearby (neighbouring village has severe coral mining problem)	Mainly near Labuan, lime kiln, (now mainly burns fossil coral), also for other construction at times
Over Fishing (main types)	Yes (high) (hook & line, spear, nets, traps, gleaning)	Yes (medium) (hook & line, compressor)	Yes (medium) (hook & line, compressor, gleaning)	Yes (high) (hook & line, compressor, free diving)
Collection of invertebrates	Low to Medium For eating (Clams, other mollusca, mantis shrimps, lobster etc)	High increasing Clams used to feed turtle hatchlings, crustaceans & mollusca for consumption (many types) Commercial lobster, teripang & mollusc fishing	High. Both destructive gleaning at low tide (many molluscs and crustaceans), and commercial (compressors) (trochus & other mollusca, teripang, maybe lobster)	High. Anything of value is collected, sometimes with compressors (<i>Tridacna</i> clams, teripang, trochus & other mollusca, lobster & maybe other crustaceans)
COT outbreaks	Now over, but no sign of recovery as yet on badly affected stands	No	No	No
Sedimentation	High from rivers (upland degraded) and from aggregate plant	Relatively low, much shifting of sand	Little observed, possible loads in rainy periods, could increase if land-use changes	High in Labuan area (TR1) in front of clear felled area of Nature reserve. Low elsewhere
Pollution & Eutrophication	Local sewage and effluent from Palu city and Pantaloan Port, much plastic rubbish, some fertiliser	Rubbish from PELNI and other marine traffic plus coastal settlements, much plastic	Local sewage and other domestic rubbish	Domestic rubbish from Ampana, surrounding villages and boats (mainly plastic)
Other		Turtle egg collection and unprofessional "head start" programme		

It can be seen that each location has specific threats, and there has been little change in these since the 2001/2002 survey at Labuana and Tawaeli.

At Pulau Pasoso, the green turtle egg collection has been partly replaced by a potentially damaging "head starting" programme, raising young turtles in barrels and feeding them on clams, and this activity has increased over the period. However a member of the Environment Department accompanied the 2003 LIT survey to Pulau Pasoso and is attempting to close down this activity unless substantial improvements are made.

There has been some positive change in attitudes of people, especially the resident family at Pulau Pasoso and to a lesser extent the communities at Labuana and Tawaeli survey sites. Planned activities at these locations should build on these and other positive developments. The data collected has been the basis for a number of initiatives, including major advances in the process of making Pulau Pasoso an MPA in more than name. Visual data has proven particularly potent in gaining the interest of decision-makers and general public alike, while the figures and resulting graphics give the necessary academic credibility.

At Tanjung Api the situation is constantly becoming more critical and complex, and requires major integrated intervention if any impact is to be hoped for. In view of the level of damage, unless there are positive steps taken to change the situation before the next scheduled monitoring in 2004, the team as a whole felt that there was little point in continuing to monitor an inevitable decline.

It is very disappointing that the large number of "environmental" NGOs based on the doorstep of this Reserve have done so little in spite of the information provided to them in 2000 and 2002 regarding the marine side, and the very visible nature of the land-based degradation. The scale of the problem, aggravated by the additional costs for a location at such a distance from our base, is currently beyond YACL internal capacities, so that possible approaches and partnerships are being explored.

The ReefCheck monitoring results, especially at Tanjung Api, also raised some procedural questions and will result in further clarification of protocols, both internally and through the discussion mechanism initiated as a result of participation in the recent ReefCheck workshop held in Cebu following ITMEMS 2.

4. NEW SURVEY REPORT

Data were collected at a number of new survey sites, and new data were collected at existing sites, most of it in connection with the Togean MPA assessment and the Central Sulawesi MPA. Maps of the survey areas and sites were produced, but not included in this report. These are available from UNEP. Table 11 below gives an outline of the activities.

Table 11. New survey activities in 2002/2003

Location	ReefCheck	Manta Tow	LIT	Life Form	(U/W) Video	Other	Associate/ Remarks
1. Donggala Regency & Palu City							
Tonggolobibi (W Coast)		X		X	X	X	MCRMP
Panggalaseang (W Coast)		X		X	X	X	MCRMP
Sioyong (W Coast)		X		X	X	X	MCRMP
Rerang (W Coast)		X		X	X	X	MCRMP
Labean (W Coast)		X		X	X	X	MCRMP
Lombonga (W Coast)		X		X	X	X	MCRMP
Pulau Pasoso (W Coast)			X		X	X	IPB/DPK
Labuana (W Coast)			X		X		
Tawaeli (Palu Bay)		(X)	X		X		
Kakafu, Donggala, in Palu Bay	X	(X)			X		Markers placed
Palu Bay Manta Tow		X					Community group
2. Poso Regency							
Taningkola (Togean)		X	X	X	X	X	MCRMP
Tumbulawa (Togean)		X	X	X	X	X	MCRMP
Malenge (Togean)		X	X	X	X	X	MCRMP
Kabalutan (Togean)		X	X	X	X	X	MCRMP
Kadidiri (Togean)			X	X		X	IPB/DPK
Teluk Kilat (Togean)			X	X		X	IPB/DPK
Bambu (Togean)			X	X		X	IPB/DPK
Lebiti (Togean)				X		X	IPB/DPK
Tanjung Api (Ampana)			X		X		
Ampana Tete	X	X	X		X		No markers placed

Most of the data collected were submitted in raw data format as part of the mid-term report. Both these and more recent data are summarised as follows: Manta Tow data in Tables 12 to 15 and Figures 8 to 13; ReefCheck data in Tables 16 to 20 and Figures 14 to 17; and LIT data in Tables 21 to 23 and Figures 18 to 19.

“Life-form” data was collected specifically for the MCRMP Project, using purpose-made forms based on ReefCheck and LIT categories, and is not included. Note that in presenting most data, percentages have been rounded to nearest whole numbers, as the accuracy of the survey and analysis methods used makes the use of decimals inappropriate. Any amount under 1% has been rounded up to 1%.

Other data collected include socio-economic data, rare species data, water quality data, general environmental data/information and other data necessary for the use of the associated programmes, and were included in the relevant reporting documents.

Table 12a. Manta Tow Palu Bay (including Tawaeli) – Benthic cover

(Percentage)

Location	HC	SC	OT	RC	RB	S
Labuan	25	13	10	20	12	20
Tawaeli	24	10	9	13	23	21
Tondo	18	16	9	16	25	16
Rilanta	23	14	7	21	18	17
Kakafu	27	8	8	21	24	12
Donggala South	24	8	9	28	20	11
Donggala Town	20	12	9	18	27	14
Tanjung Karang	18	10	12	21	31	8
Overall Palu Bay	22.6	11.2	8.9	19.1	22.7	15.4

Table 12b. Coral condition

Location	No of Tows	Length (+ 0.5 km)	Hard Coral Cover (Condition) Category %				
			1 Very Poor	2 Poor	3 Average	4 Good	5 Very Good
Labuan	13	4	15	27	50	8	0
Tawaeli	44	6	32	22	27	9	0
Tondo	20	5	65	25	10	0.0	0
Rilanta	35	8	21	43	27	9	0
Kakafu	26	7	21	31	36	10	2
Donggala South	20	3.5	8	40	20	32	0
Donggala Town	20	3	22	25	30	23	0
Tanjung Karang	22	3	36	45	14	5	0
Overall Palu Bay	200	39.5	28	32	26	13	1

Table 13a. Manta Tow Donggala Regency – West Coast – Benthic cover
(Percentage)

Location	LC	DC	HC	SC	OT	RC	RB	S
Tonggolobibi	40	60	19	9	12	18	10	32
Panggalaseang	38	62	18	11	10	19	23	20
Rerang	50	50	25	12	13	12	17	21
Sioyong	59	41	27	21	12	12	14	15
Labean	40	60	17	11	12	24	13	22
Lombonga	46	54	24	12	9	21	18	16
West Coast	45	55	22	12	11	18	16	21
Category	3	4	2	2	2	2	2	2

Table 13b. Coral condition
(Percentage)

Location	Very Poor	Poor	Average	Good	Very Good	% HC	Average Category
Tonggolobibi	36	29	14	21	0	19	2
Panggalaseang	10	36	36	19	0	18	2
Rerang	21	33	21	25	0	25	2
Sioyong	13	13	50	25	0	27	2
Labean	33	54	13	0	0	17	2
Lombonga	10	45	40	0	5	24	2
West Coast	20	35	29	15	1	22	2

Table 14a. Manta Tow Poso Regency – Benthic cover – Togean Islands
(Percentage)

Manta Tow	No of Tows	HC	SC	OT	RC	RB	S
Malenge	10	17	9	13	25	16	20
Kalabutan	12	16	10	9	26	24	15
Taningkola	10	20	9	13	22	19	17
Tumbulawa	10	14	10	10	29	26	11
Siatu	10	13	12	13	23	19	20
Togean Overall	52	16	10	12	25	21	16
Tete B	13	27	2	6	26	32	7

Table 14b. Benthic cover mainland

Location	No of Tows	Length (0.5 km)	Approximate Percentage Benthic Cover						HC Category
			HC	SC	OT	DC	RB	S	
Tete B	13	2	27	2	6	26	32	7	2
Pal 1 to 2002 Tow	27	4	17	6	9	26	34	8	2
End 2002 to Point	20	2.5	25	3	6	23	33	10	2
Point to Fire	21	2.5	24	5	8	23	35	5	2
Fire to TR4 & TR3	18	3	26	5	10	30	26	3	2
TR3 to TR2	20	2.5	17	2	5	24	45	7	2
TR2 to Labuan Pal 71	20	3.5	23	1	8	21	32	15	2
Overall CA 2002	99	14	23	3	8	24	34	8	2
Overall New from 2002	40	6	21	4	8	26	33	8	2
Overall	139	20	22	4	8	25	33	8	2
Overall CA	126	18	22	4	8	25	33	8	2

Notes: Pal is the name for the official boundary markers, numbered from 1 on the beach at Tete B to 71 which is actually in the sea on an outcrop of reef off Labuan, at the point where Manta Tow surveys started each year. Point refers to the tip of Tanjung Api peninsular. Due to confusion of the location of Pal 1 which in 2002 was missing, having been destroyed, a portion of the Reserve was not surveyed in 2002. The areas surveyed in 2002 are in bold text.

Table 14c. Coral condition at Togean Islands

Category	Very Poor	Poor	Average	Good	Very Good	% HC	Average Category
Malenge	45	35	20	0	0	17	2
Kalabutan	50	42	8	0	0	16	2
Taningkola	25	55	10	10	0	19	2
Tumbulawa	55	45	0	0	0	14	2
Siatu	55	30	15	0	0	13	2
Togean Average	46	41	11	2	0	16	2
Tete B	4	39	38	19	0	27	2

Table 14d. Coral condition mainland

Location	No of Tows	Percentage					Direction	Area
		1	2	3	4	5		
Tete B Outside CA	13	4	38	39	19	0	S-N	SE
Pal 1 to 2002 Tow	27	30	55	15	0	0	S-N	SE
End 2002 to Point	20	3	42	45	10	0	SE-NW	NE
Point to Fire	21	7	60	33	0	0	E-W	N
Fire to TR4 & TR3	18	0	29	65	6	0	NE-SW	NW
TR3 to TR2	20	18	62	20	0	0	S-N	SW
TR2 to Labuan Pal 71	20	3	60	25	12	0	E-W	S
Overall CA 2002	99	6	51	38	6	0		
Overall New	40	17	47	27	10	0		
Overall 2003	139	9	49	35	7	0		
Overall CA Tj Api	126	10	51	34	5	0		

The tables above show that the overall coral condition for all new areas surveyed by the Manta Tow method is 2 – Poor. This corresponds with the visual observation that fringing reefs in general within Central Sulawesi at almost all locations visited by team members, whether on survey or in the course of other activities, are in poor condition.

Though the causes of this poor condition and the outlook vary between locations, in nearly all cases, this appears to be the result of relatively recent human activities (under 100 years, most under 20 years ago) rather than a long-standing “natural” phenomenon. As can be seen, the reefs of the much-vaunted Togean Islands are no exception, and indeed in spite of the exceptionally good coral growth conditions afforded by the climatic and geological conditions, some of the lowest coral cover figures were recorded from this area. The tourist operators in the area are much worried by the rate of degradation, and a spokesman said that he felt unless the situation changed, at current rates of destruction, in 5 years there would be nothing left for snorkelling and diving tourists to come and see. Our team agreed with this assessment.

Although Tete B forms the neighbouring portion of the coast to Tanjung Api, as it is a new site in Poso Regency, also a fringing reef in the Bay of Tomini, the monitoring data for adjacent Tanjung Api has also been included for comparison purposes. The overall cover at Tete B does approach “average” overall, and the percentage in the “good” category is noticeably higher than for the Togean fringing reefs, contrary to popular perception which is that Tete B is completely bombed and Togean Islands has beautiful coral. The condition at Tete B is also somewhat better than for most of Tanjung Api Reserve, with the second best area in terms of remaining “good” coral cover being those nearest to Labuan, in spite of the increase in sedimentation and other damage seen. This reflects a general trend noticed throughout the Province, which is that areas in direct line of sight from villages are generally less frequently bombed than areas nearby, but out of sight.

There is a note of caution in applying these samples to valuation of larger areas, such as whole villages. The figures for the Tanningkola Manta Tow show 10% good coral condition, the best of the fringing reefs surveyed in the Togean Islands. However, at another fringing reef in the village waters where LIT was carried out, the lowest coral cover of any site surveyed to date in any area was found – just 4%.

Figure 8a. Palu Bay Manta Tow survey data – Approximate benthic cover per location in Palu Bay

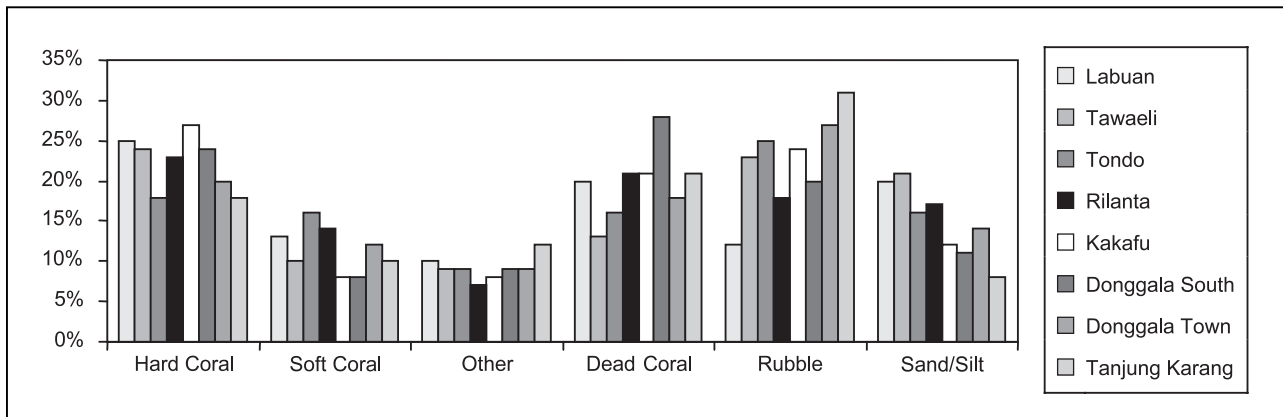


Figure 8b. Approximate overall benthic cover for Palu Bay

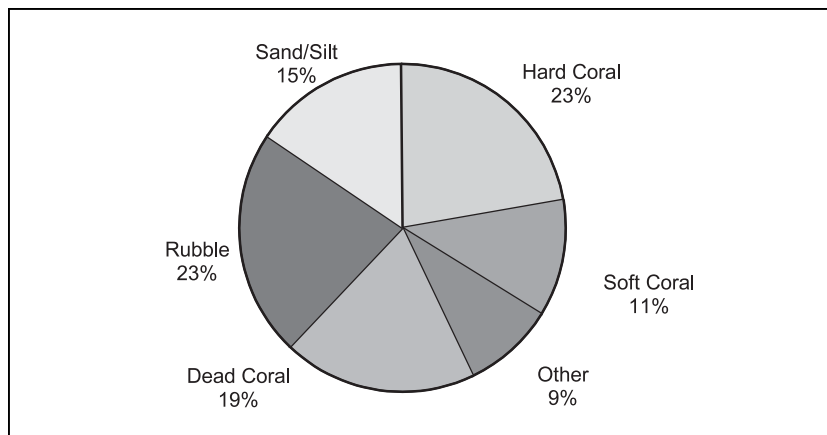


Figure 8c. Coral condition Palu Bay, by location

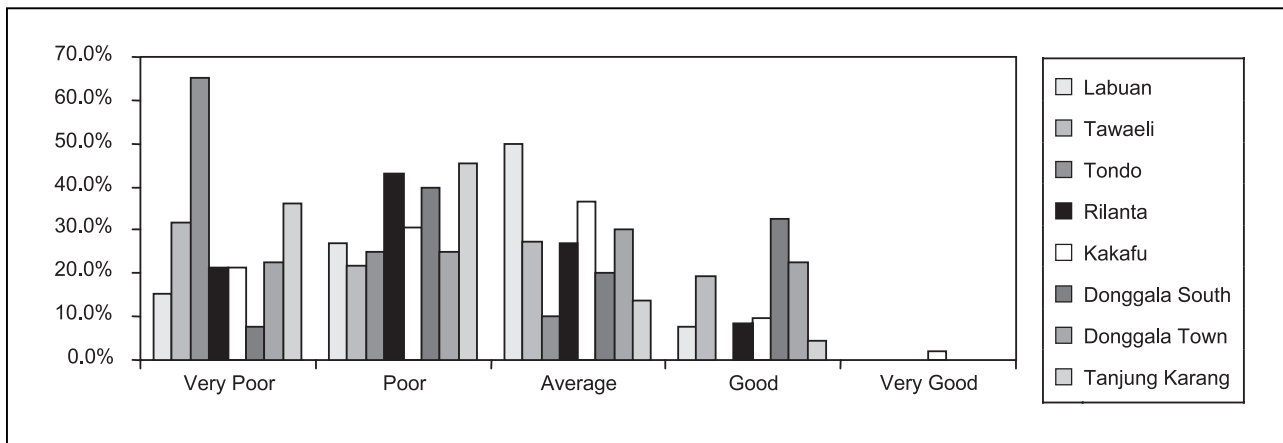
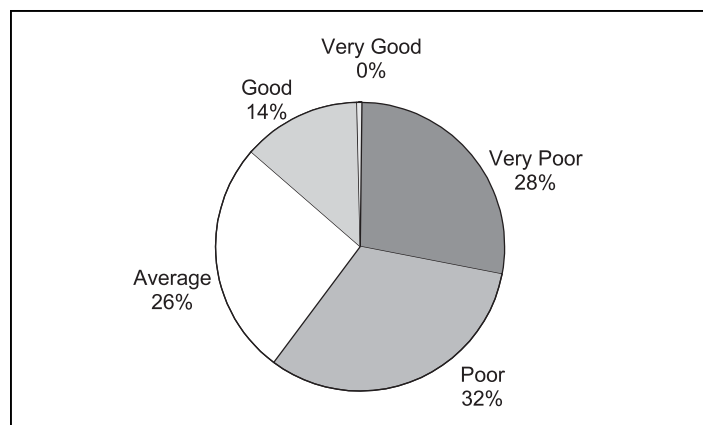


Figure 8d. Overall coral condition in Palu Bay



The 4 graphs above show that the condition of the coral reefs in Palu Bay is highly variable, but that there are still some good reefs in the area. It should be noted that data was not recorded over areas where the substrate was seen to be over around 90% abiotic or where the visibility was less than 3 m. As a result, the coverage is not 100% of the Bay area. The northern most point on the East Coast was chosen, as this is the accepted limit of the Bay in the perception of most users. Beyond this point the coast is referred to as the “Pantai Barat” or West Coast, an area that has been treated separately in this report.

Surprisingly, the condition around the resort of Tanjung Karang was far from the best in terms of hard coral cover and overall condition. This is partly because the area was previously heavily mined for the construction industry, including for rock and lime production, and parts of the headland were heavily bombed by fishermen. Although these activities have now largely ceased, the headland continues to erode both above and below water as a result of wave action due to the loss of much of that portion of the reef that previously afforded most protection.

In addition, there is a new source of damage from the widening of the narrow access road between Labuan Bajo and the resort area. This road is being hewn into the chalk cliff-face and most of the tailings have been deliberately dumped into the sea below, in contravention of the local government instructions, and in some cases there have been accidental landslides triggered by this activity. As far as can be ascertained, there has been no prosecution or penalisation of the construction company in respect of this breach of contract.

Figure 9a. West Coast Manta Tow survey data summary – Approximate benthic cover West Coast, by location

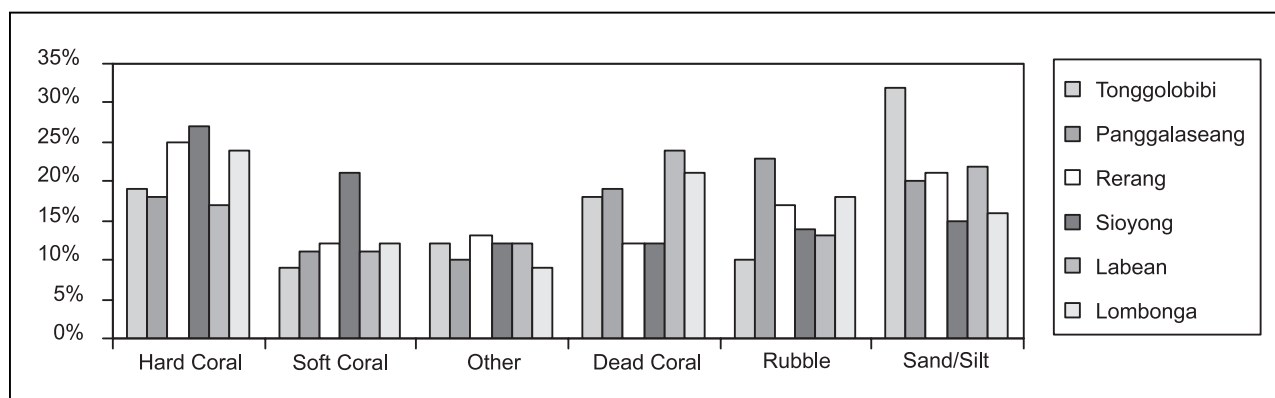


Figure 9b. Approximate overall benthic cover for the West Coast

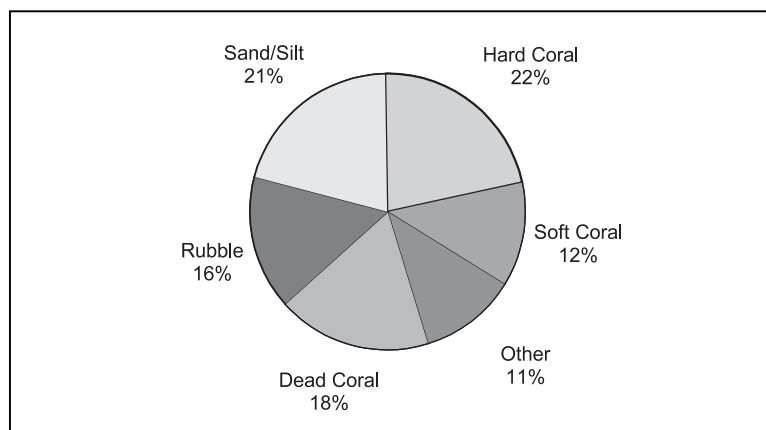


Figure 9c. Coral condition West Coast, by location

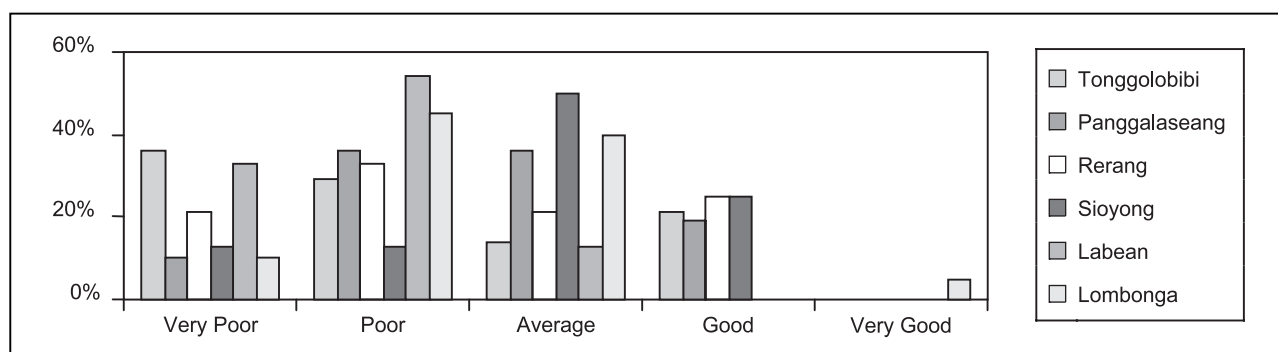
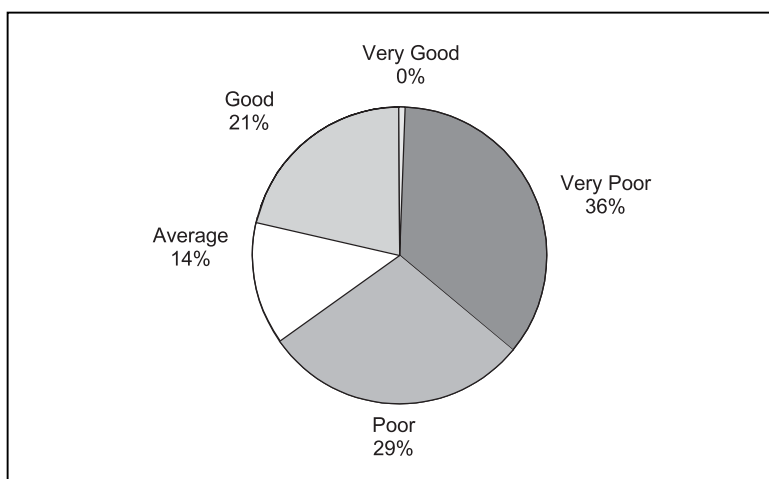
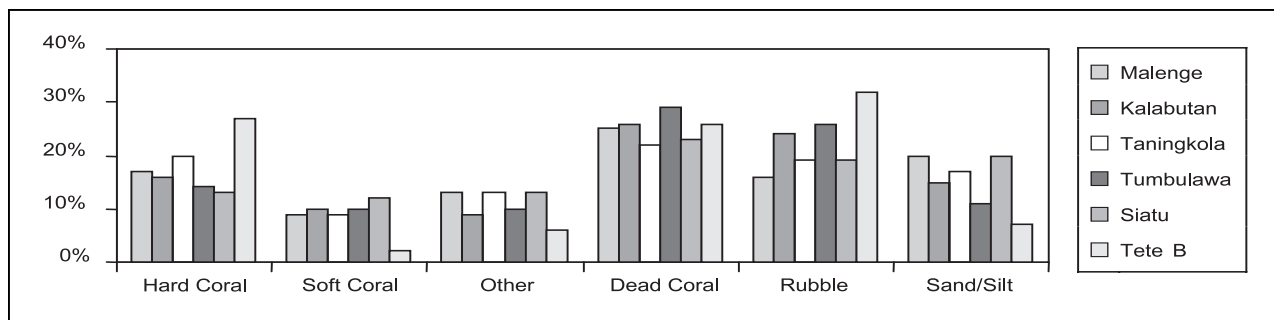


Figure 9d. Overall coral condition for the West Coast

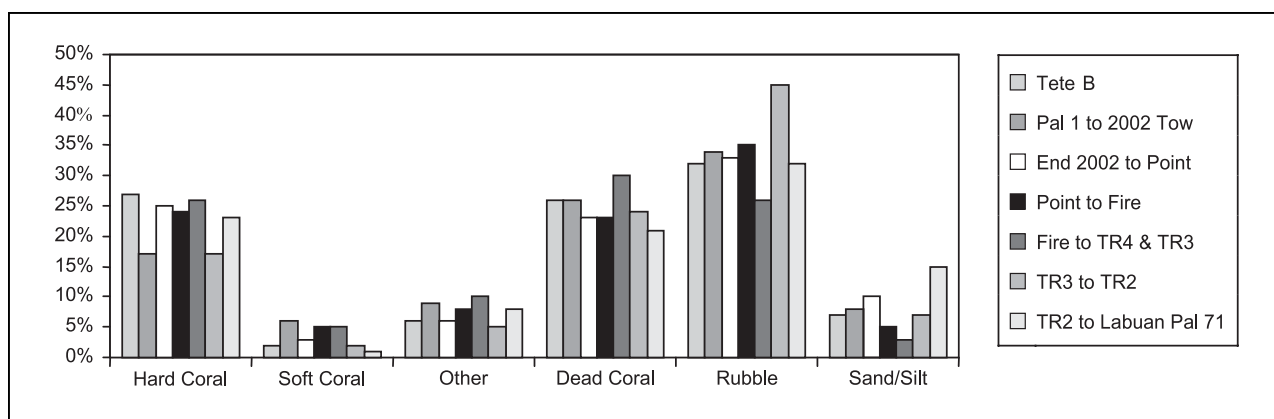


From the above 4 graphs it can be seen that the overall condition for the West Coast is poor, but that there are still areas in good condition. Some areas are suffering badly from sedimentation, destructive fishing and coral mining, while in areas where these activities (especially coral mining) have been stopped, some evidence of recovery was seen. Some evidence of nutrification was seen at certain locations also, and accounts for a proportion of the "Other" category.

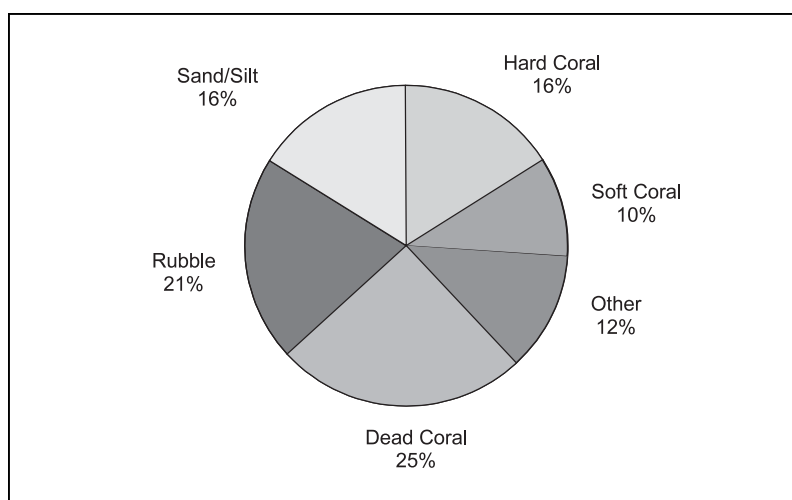
Figure 10. Manta Tow data summary. Benthic cover by location for (a) Tomini Bay, and (b) Tete B and neighbouring Tanjung Api Reserve for comparison and, (c) overall benthic cover for Poso Regency – Togeian Islands (Fringing Reef) and (d) overall benthic cover for Tete B



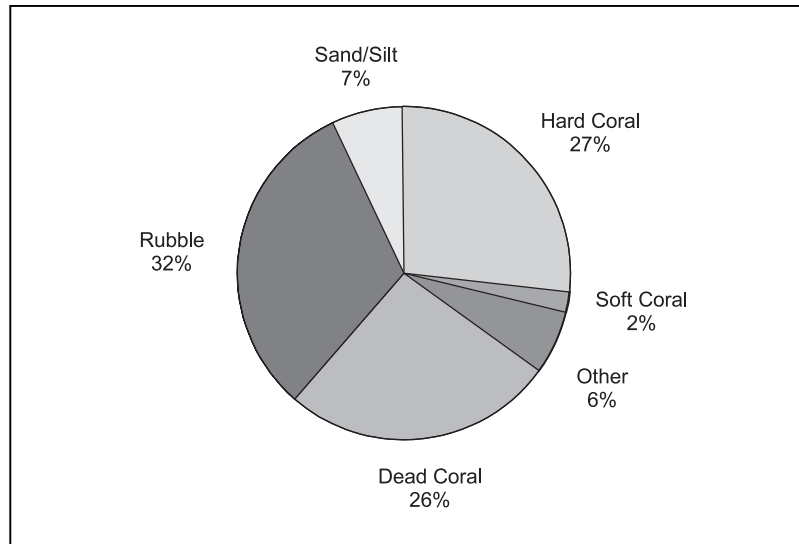
Tomini Bay



Tete B and neighbouring Tanjung Api Reserve



Benthic cover for Togeian Island Fringing Reefs



Benthic cover for Tete B

Figure 11a. Coral condition for Tomini Bay, by location, and (b) coral condition for Tete B and neighbouring Tanjung Api Reserve for comparison

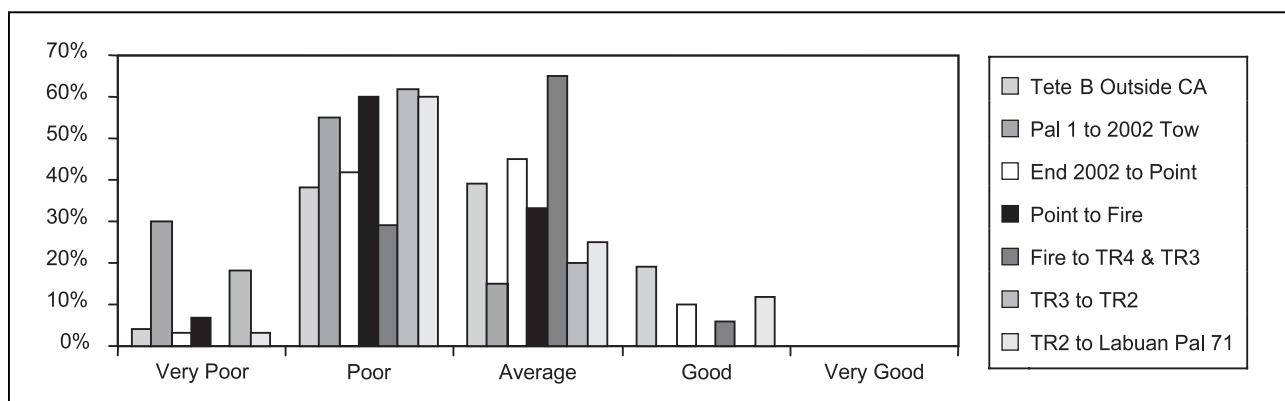
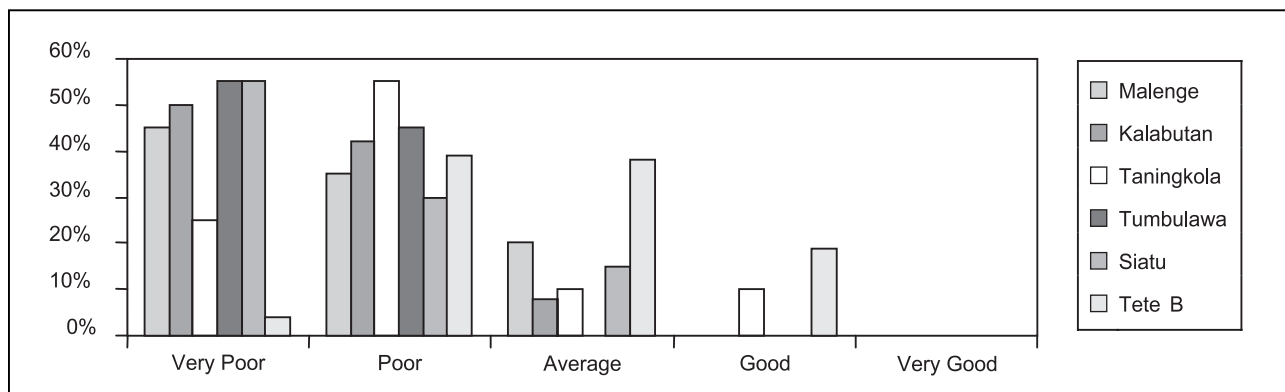
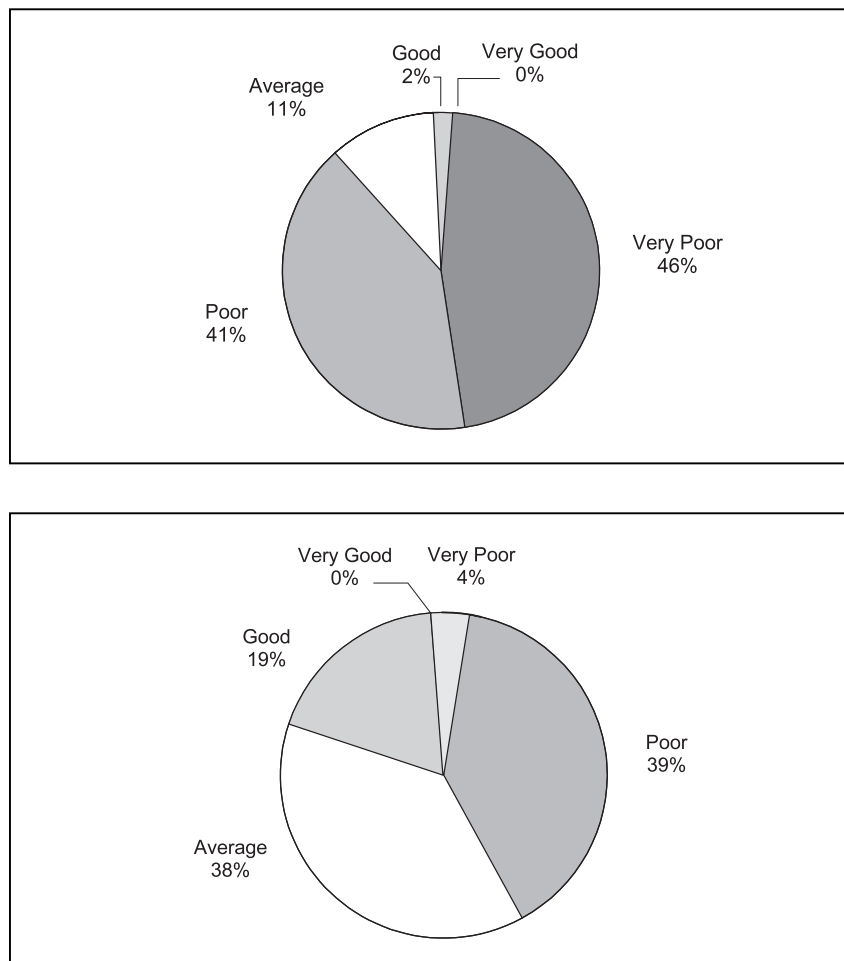


Figure 12a. Overall coral condition for Togean Islands Fringing Reefs, and (b) Tete B



These graphs highlight the poor condition of Togean Island Fringing Reefs. The area of Tete B surveyed is adjacent to Tanjung Api Nature Reserve, and is in sight of the village itself. The condition contrasts favourably not only with the Togeans but also with the Nature Reserve itself. It is noticeable that the nearest areas out of direct site of the villages on each side of the headland are the areas in worst conditions.

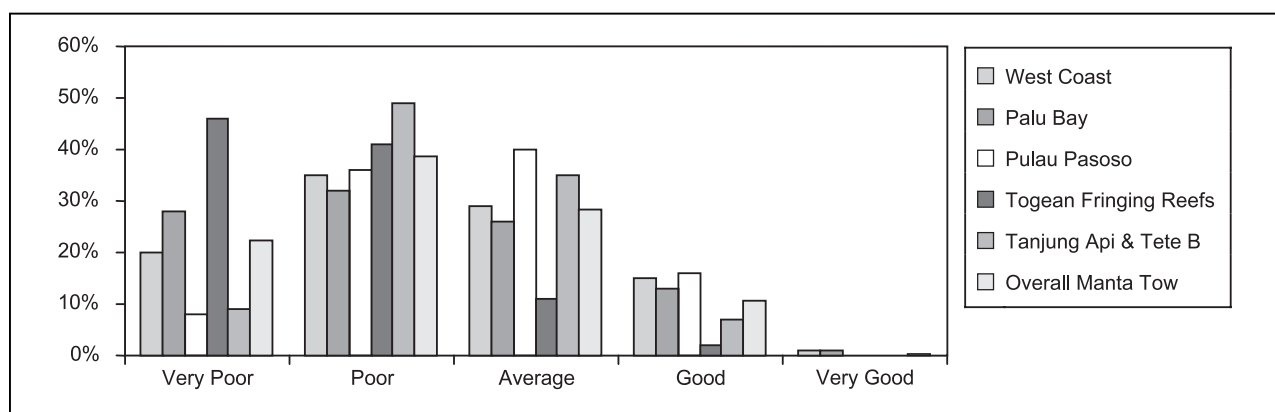
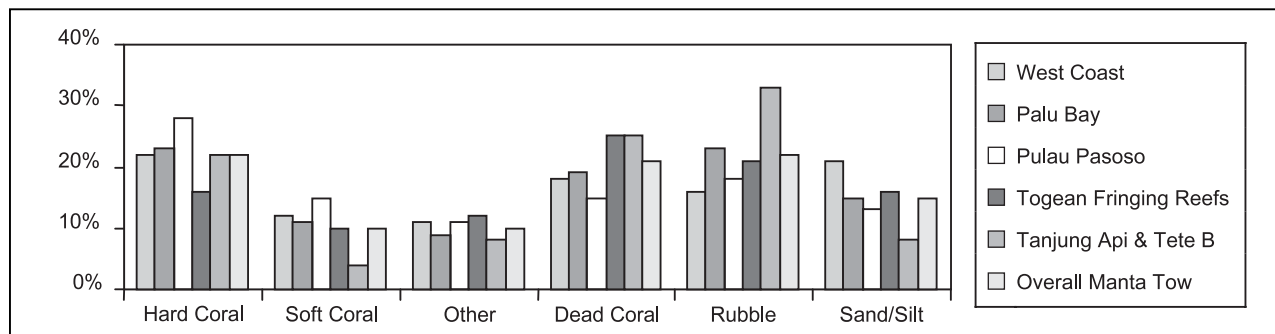
Table 15. Summary of all 2002/2003 Manta tow data. (a) Summary of hard coral condition and (b) approximate benthic cover

(Percentage)

Location	Very Poor	Poor	Average	Good	Very Good
West Coast	20	35	29	15	1
Palu Bay	28.0	32.0	26.0	13.0	1.0
Pulau Pasoso	8	36	40	16	0
Togean Fringing Reefs	46	41	11	2	0
Tanjung Api & Tete B	9	49	35	7	0
Overall Manta Tow	22	39	28	11	0

(Percentage)

Location	HC	SC	OT	RC	RB	S
West Coast	22	12	11	18	16	21
Palu Bay	23	11	9	19	23	15
Pulau Pasoso	28	15	11	15	18	13
Togean Fringing Reefs	16	10	12	25	21	16
Tanjung Api & Tete B	22	4	8	25	33	8
Overall Manta Tow	22.0	10.0	10.0	21.0	22.0	15.0

Figure 13a. Summary of all 2002/2003 Manta Tow data. Hard coral condition**Figure 13b. Summary of all 2002/2003 Manta Tow data. Approximate benthic cover summary**

The tables and figures above show very clearly the overall differences between the various areas surveyed, and are consistent with visual impressions. For example, hard and soft coral cover was highest at Pulau Pasoso; soft coral was very low at Tanjung Api; other was highest in the Togeans, dead coral rock was highest in the Bay of Tomini generally; rubble was worst at Tanjung Api; sand and silt cover was highest on the West Coast and lowest at Tanjung Api.

5. REEFCHECK DATA

New ReefCheck transects were surveyed at two locations. The first was Kakafu, in the Bay of Palu, just outside the boundary of Palu City, in Donggala Province, on the southwest side of the Bay. At this location, permanent transect markers were laid, and it is hoped that this will complement the monitoring data from Talise and Kadongo on the northeast side of Palu Bay, within Palu City boundaries. The shoreline behind the transect at Kakafu is bordered by the main road from Palu to Donggala Town, and backed by largely vegetated steep cliffs.

The second location was at Tete B, on the Eastern side of Tanjung Api headland, outside the Nature Reserve. At this location, permanent markers were not laid, and monitoring will depend very largely on whether it is practical to do anything to change the situation at this site. With the recent development of heavy usage of remote-detonated high explosive bombs in the area, unless there is some kind of effective protection put in place, monitoring here will only record the inevitable destruction of the remaining potential of the marine side of the Reserve and all adjacent coastline.

The coral in the neighbouring bay of Uebone has already been virtually destroyed mainly by similar activities between January 2002, and January 2003, on which occasions it was surveyed non-quantitatively using snorkel equipment. On the first occasion, Uebone had been considered as a potential new survey/monitoring and eco-tourism site, but on the second visit there was very little live coral and almost no fish remaining. The signs are clear that Tanjung Api area is now the current target of mainly (allegedly – according to local “traditional” fishers) the same group of people.

The land portion of the Reserve is also under dire threat of losing its function as a Nature Reserve from the illegal clearance continuing apace, especially on the Labuan side. However, the land behind the new survey site is mainly occupied by old (up to 100 years) coconut groves, and there are attractive sandy beaches along most of the area. Some mangroves remain, although many are senile with few young seedlings.

Part of the seafront coconut grove area nearest to the village is scheduled to become the site for a polka dot grouper (*Cromileptes altivelis*) hatchery run by the Regency Fisheries Department, although so far only red ones have been drawn on the coconut trees within the proposed area. This development was to have been built at Uebone, and there is evidence of political intrigue and internecine jealousy between these two villages. Fresh water wells up out of the sand or shingle at many points along this coast, roughly from half-way along the headland to over 20 miles east, including at several points within the tow area, one of these below the tide-line, where a small wall has been built to prevent seawater mixing at high tide.

Table 16a. ReefCheck substrate data at Kakafu

(Percentage)

Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Kakafu	3 m	55	0	14	1	1	12	9	8	0	0
Kakafu	10 m	32	1	8	9	0	9	24	17	0	0
Average Kakafu		43	1	11	5	1	11	16	12	0	0

Table 16b. Comparison of Kakafu with other Palu Bay sites

(Percentage)

Location	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Kakafu	43	1	11	5	1	11	16	12	0	0
Talise	30	2	0	2	11	34	20	0	1	0
Kadongo	6	4	12	10	3	6	50	4	1	4
Palu Bay	26	2	8	6	5	17	29	5	1	1

Table 17a. Tete B substrate data

(Percentage)

Location	Depth	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tete B	3 m	46	0	1	6	1	35	7	3	0	1
Tete B	10 m	36	0	0	2	4	39	18	1	0	0
Average Tete B		41	0	1	4	3	37	12	1	0	1

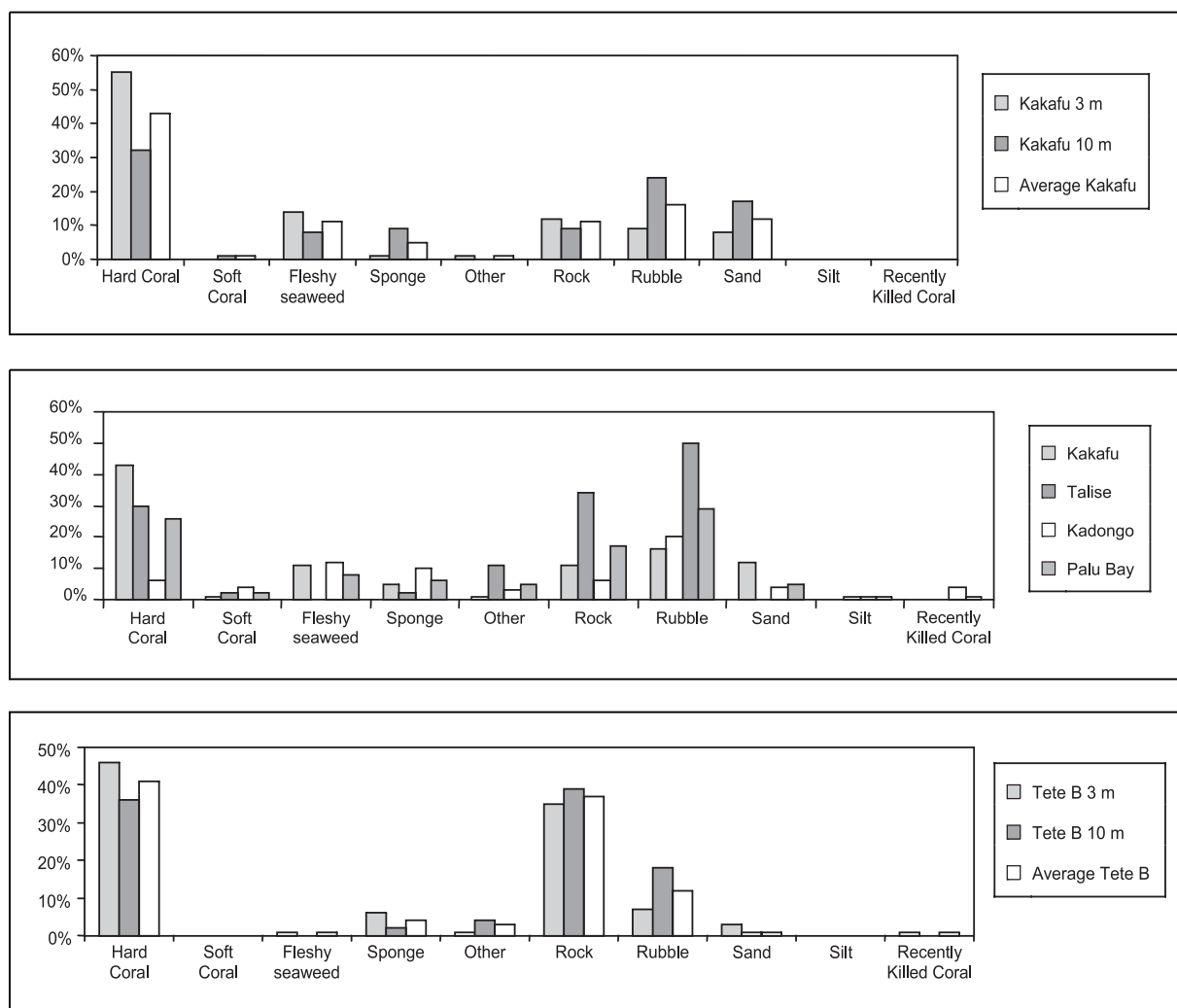
Table 17b. Comparison of Tete B with Tanjung Api sites

(Percentage)

Location	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tete B	41.0	0.0	1.0	4.0	3.0	37.0	12.0	1.0	0.0	1.0
Tj Api 1	34.0	0.0	1.0	2.0	2.0	46.0	8.0	7.0	0.0	0.0
Tj Api 2	56.0	0.0	0.0	6.0	1.0	18.0	16.0	1.0	0.0	2.0
Tj Api 3	24.0	1.0	1.0	4.0	5.0	23.0	41.0	0.0	0.0	1.0
Tj Api 4	43.0	1.0	0.0	0.0	6.0	27.0	22.0	1.0	0.0	0.0
Overall	39.0	1.0	1.0	3.0	3.0	30.0	20.0	2.0	0.0	1.0

The tables above show Kakafu to have a higher hard coral cover than the other Palu Bay sites, which confirms the Manta Tow results. The coral cover at Tete B was superior to that observed at nearly all locations within the Tanjung Api Reserve. The unexpectedly high hard coral cover at Tanjung Api transects 2, 3 and 4 compared to previous ReefCheck and this year's Manta Tow data is thought to be due to the relaying of destroyed markers in the best possible coral cover directions.

Figure 14. ReefCheck Line Transect benthic cover data at (a) Kakafu, Palu Bay, (b) Palu Bay for comparison, (c) Tete B just outside Tanjung Api Reserve, and (d) Tanjung Api Area for comparison



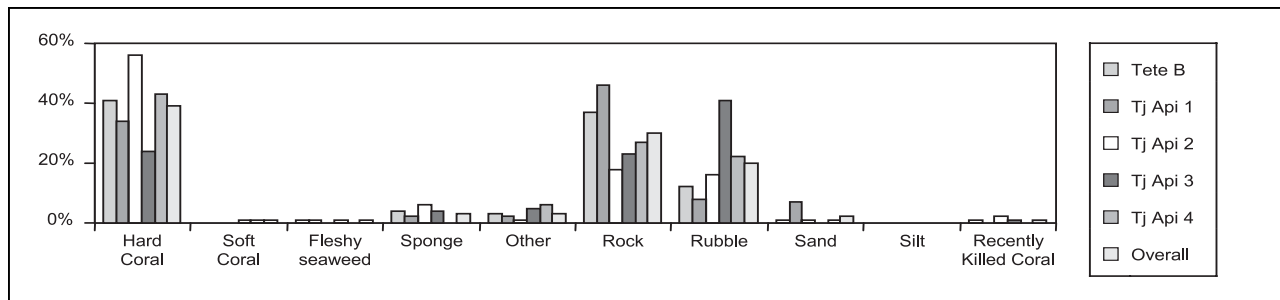


Table 18a. ReefCheck indicator species data – new transect indicator for fish data

Location	Kakafu	Kakafu	Kakafu	–	Tete B	Tete B	Tete B
Depth	3 m	10 m	Overall	–	3 m	10 m	Overall
Fish:							
Butterfly fish	199	130	164.5		18	58	38
Sweetlips	0	1	0.5		0	0	0
Snapper	36	48	42		7	38	22.5
Barramundi Cod	0	1	0.5		0	0	0
Grouper >30 cm	10	2	6		1	0	0.5
Humphead Wrasse	0	0	0		0	0	0
Bumphead Parrotfish	0	1	0.5		4	0	2
Other Parrotfish	33	17	25		2	14	8
Moray eel	0	0	0		0	0	0
Rare Species:							
Turtle	0	0	0		0	0	0
Dugong	0	0	0		0	0	0
Shark	0	0	0		0	0	0

Table 18b. Fish data at Kakafu and Other Palu Bay Sites for comparison

Location	Kakafu	Kadongo	Talise	Palu Bay
Fish:				
Butterfly fish	164.5	37	61.5	87.7
Sweetlips	0.5	1.5	11	4.3
Snapper	42	12	12.5	22.2
Barramundi Cod	0.5	0	0	0.2
Grouper >30 cm	6	2	0	2.7
Humphead Wrasse	0	0	0	0.0
Bumphead Parrotfish	0.5	1	5.5	2.3
Other Parrotfish	25	5	7.5	12.5
Moray eel	0	0	0.5	0.2
Rare Species:				
Turtle	0	0	0	0.0
Dugong	0	<1	0	<1
Shark	0	0	0	0.0

Table 18c. Tete B and Tanjung Api Reserve sites – Comparison

Location	Tete B	T Api 1	T Api 2	T Api 3	T Api 4	Overall
Fish:						
Butterfly fish	38	11.5	19.5	6.5	13	17.7
Sweetlips	0	0.5	0.5	0.0	0.25	0.3
Snapper	22.5	1	6	0.0	3	6.5
Barramundi Cod	0	0	0	0.0	0	0.0
Grouper >30 cm	0.5	0.5	0	0.0	0	0.2
Humphead Wrasse	0	0	0	0.0	0	0.0
Bumphead Parrotfish	2	2	0	2.5	1.25	1.6
Other Parrotfish	8	1.5	1.5	8.5	5	4.9
Moray eel	0	0	0	0.0	0	0.0
Rare Species:						
Turtle	0	0	0	0	0	0
Dugong	0	0	0	0	0	0
Shark	0	0	0	0	0	0

The above data show that both new sites have higher indicator fish densities than previous monitoring sites. Good fish population might have been expected from the relatively good coral condition of these transects and their immediate surrounding areas.

In the case of Kakafu it is suspected that this is due not only to the good coral condition but also to the relatively low fishing effort known to take place at this location, as it is not one of the most accessible parts of the Palu Bay coastline from any of the main fishing villages.

In the case of Tete B, this larger number of fish is suspected to be due to the much lower frequency of bomb and poison fishing so near to the village. There are also indications that fishing immediately in front of the coconut grove owned by a particular influential member of the local community is discouraged, especially destructive fishing. The difference with the Reserve is very marked.

Figure 15a. ReefCheck survey data – indicator fish species at Kakafu

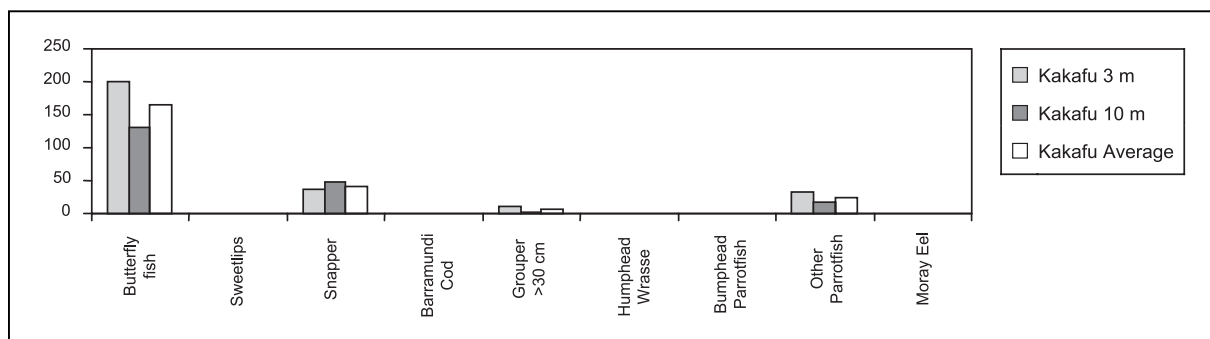


Figure 15b. ReefCheck survey data indicator fish species Kakafu and other Palu Bay sites – comparison

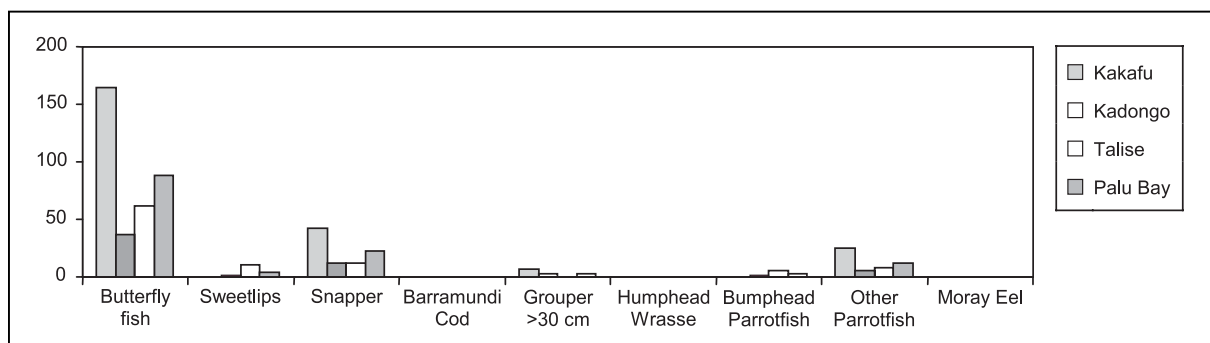


Figure 15c. ReefCheck survey data indicator fish species Tete B

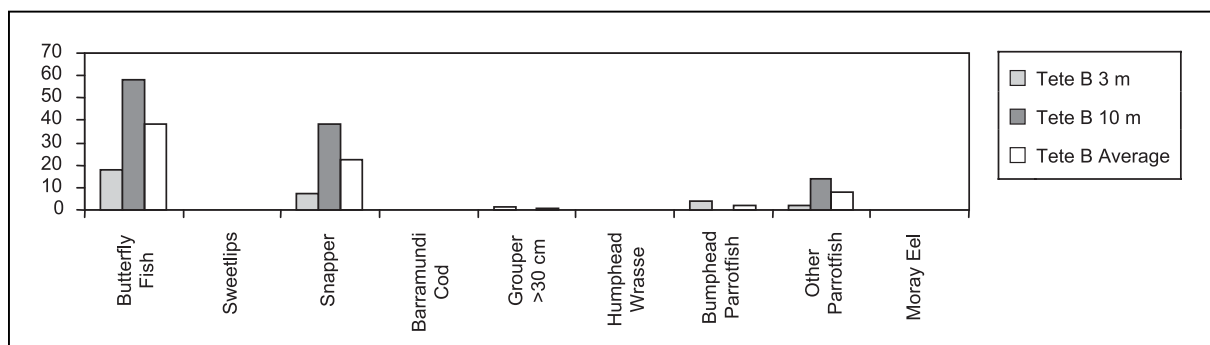


Figure 15d. ReefCheck survey data indicator fish species Tete B and Tanjung Api sites – comparison

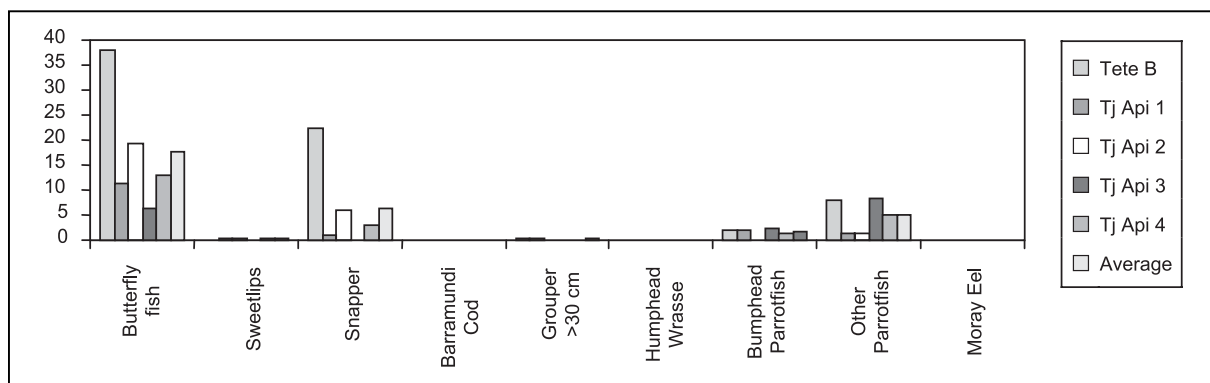


Table 19a. New site indicator invertebrate species data and damage at Kakafu and Tete B

Location	Kakafu	Kakafu	Kakafu	–	Tete B	Tete B	Tete B
Depth	3 m	10 m	Overall	–	3 m	10 m	Overall
Indicator Invertebrate Species							
Banded Coral Shrimp	2	16	9		0	2	1
<i>Diadema</i> Urchins	7	8	7.5		2	0	1
Pencil Urchins	0	0	0		0	0	0
Sea cucumber edible	2	1	1.5		0	0	0
COT <i>Acanthaster plancii</i>	0	0	0		0	0	0
Giant Clam (<i>Tridacnae</i>)	0	1	0.5		12	6	9
Triton	0	0	0		1	0	0.5
Lobster	0	0	0			2	1
Damage etc: (scale 0-3)							
Recent Coral damage	3	2	2		2	2	2
Trash	1	0	1		0	0	0
Bleaching	0	1	1		1	1	1

Table 19b. Kakafu invertebrate data, damage, & comparison with other Palu Bay sites

Location	Kakafu	Kadongo	Talise	Palu Bay
Indicator Invertebrate Species*				
Banded Coral Shrimp	9	0	<1	3
<i>Diadema</i> Urchins	8	5	2	5
Pencil Urchins	0	0	0	0
Sea cucumber edible	2	0	0	<1
COT <i>Acanthaster plancii</i>	0	1	0	<1
Giant Clam (<i>Tridacnae</i>)	<1	0	2	1
Triton	0	1	<1	<1
Lobster	0	0	0	0
Damage etc: (scale 0-3)				
Recent Coral damage	2	2	1	2
Trash	1	2	0	1
Bleaching	1	1	1	1

* Rounded to nearest integer.

Table 19c. Tete B invertebrate data, damage, and comparison with Tanjung Api sites

Location	Tete B	Tj Api 1	Tj Api 2	Tj Api 3	Tj Api 4	Overall
Indicator Invertebrate Species*						
Banded Coral Shrimp	1	0	0	0	1	<1
<i>Diadema</i> Urchins	1	0	0	0	1	<1
Pencil Urchins	0	0	0	0	0	0
Sea cucumber edible	0	0	0	0	1	0
COT <i>Acanthaster planci</i>	0	0	0	0	0	0
Giant Clam (<i>Tridacnae</i>)	9	4	4	0	4	4
Triton	<1	0	0	0	0	<1
Lobster	1	0	0	0	0	<1
Damage etc: (scale 0-3)						
Coral damage	2	3	3	3	2	3
Trash	0	0	0	0	1	1
Bleaching	1	1	1	0	1	1

* Rounded to nearest integer.

Figure 16a. ReefCheck survey data. Indicator invertebrate species at Kakafu

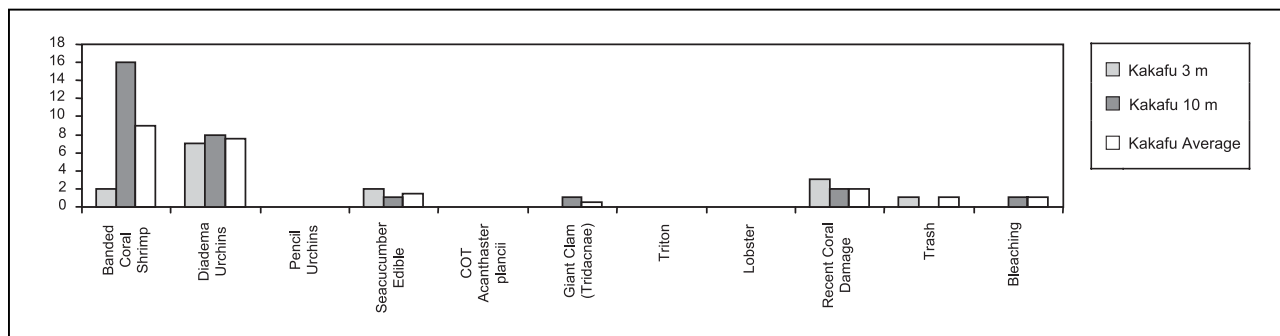


Figure 16b. Comparison between Kakafu and Other Palu Bay Sites

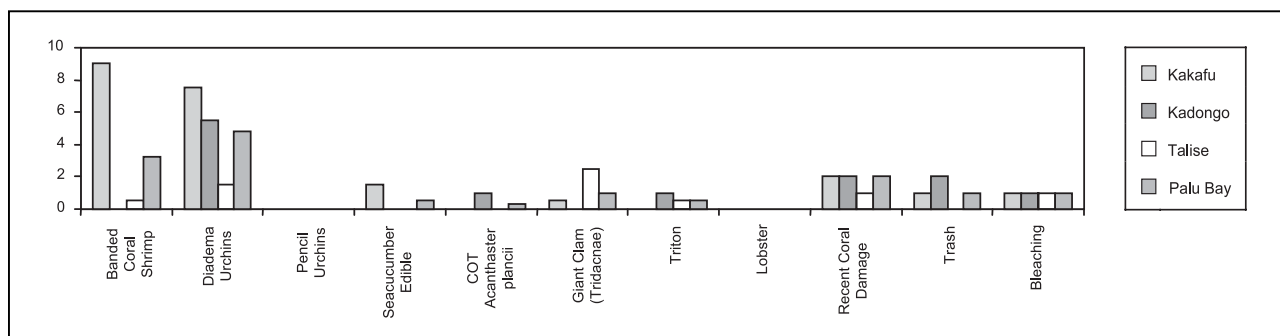


Figure 16c. Tete B indicator invertebrate species data

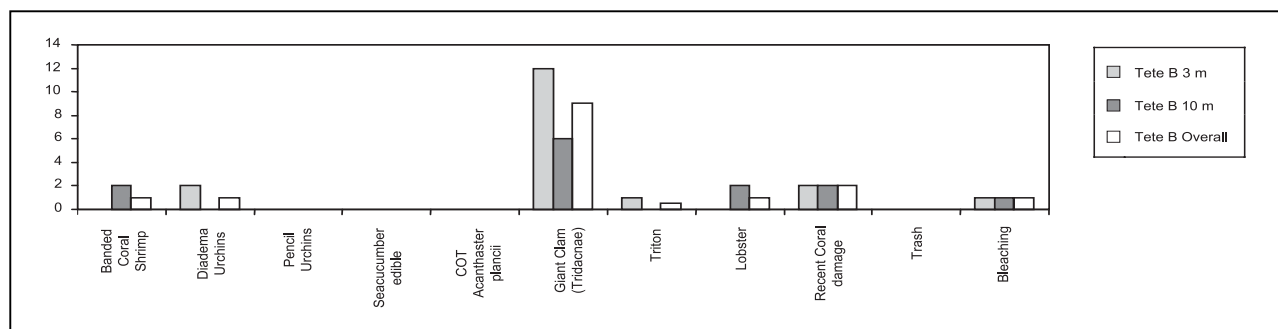
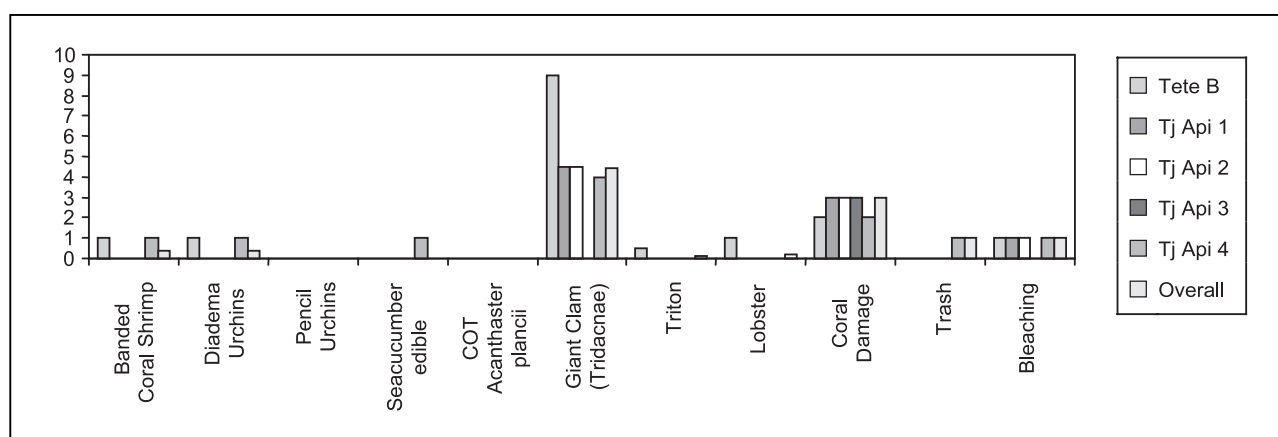


Figure 16d. Tete B and Tanjung Api Sites comparison



From the above data, it is clear that Kakfu has a high population of banded shrimp (*Stenopus hispidus*), while Tete B is relatively rich in *Tridacna* spp., a general feature noted on all visits to this site and to the Togeian Islands offshore. Overall, all the sites in the Palu Bay and Tanjung Api area have relatively low numbers of commercially valuable invertebrates. It known that invertebrate collection is very high in the Tanjung Api area, and high in the Palu Bay area. It is therefore thought that some at least of these low numbers are due to over collection.

At Kakafu, off-transect, several juvenile lobster were seen. However, it is known that there is currently an increase in lobster fishing effort in both these (and other) areas, due to the SARS-related decline in the live reef fish trade and other economic incentives. The only on-transect (adult) lobster in these areas was seen at Tete B, and a few more (small individuals) were seen off-transect.

The *Tridacna* seen at Tete B were nearly all small, a sign that larger and medium-sized individuals have probably been taken, as in Tanjung Api Reserve. The largest are mainly valued as food and the medium-sized clams are sold to the growing market in high-grade chalk for mixing with betel nut to produce a product chewed by a number of the traditional tribes living in the mountains behind Ampa.

It is worth noting that no COTs were found on the transects, although a very small number was seen nearby at both Kakafu and Tete B, and during the Manta Tow at Tete B. Moderate recent coral damage was noted at both sites and gives cause for concern. Bleaching at both sites seems to be mainly poison-fishing related, with much of the damage occurring at the 10 m depth and rarely in a tip or top-down gradation as would be expected for temperature-related bleaching, but rather graded from a central white or dead patch, in all directions or predominantly to one side.

Table 20a. Summary per area of 2002/2003 ReefCheck data. Benthic cover summary – ReefCheck*

(Percentage)

Location	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tanjung Api & Tete B	39	1	1	3	3	30	20	2	0	1
Palu Bay	26	2	8	6	5	17	29	5	1	1
Labuana	39	2	11	4	12	11	19	1	1	0
Pulau Pasoso	36	11	6	2	16	21	6	1	1	0
Overall	35	4	6	4	9	20	18	2	1	1

* Rounded to nearest integer.

Table 20b. Indicator fish summary

Fish & Rare Species*	TJ Api & Tete B	Palu Bay	Labuana	Pasoso	Overall
Butterfly fish	18	88	43	38	47
Sweetlips	<1	4	3	1	2
Snapper	7	22	28	6	16
Barramundi Cod	0	<1	0	0	<1
Grouper >30 cm	<1	3	3	2	2
Humphead Wrasse	0	0	0	0	0
Bumphead Parrotfish	2	2	1	3	2
Other Parrotfish	5	12	3	5	6
Moray eel	0	<1	0	0	<1
Turtle	0	0	0	<1	<1
Dugong	0	1	<1	0	<1
Shark	0	0	0	0	0

* Rounded to nearest integer.

Table 20c. Invertebrate summary

Location	TJ Api & Tete B	Palu Bay	Labuana	Pasoso	Overall
Indicator Invertebrates*					
Banded Coral Shrimp	<1	3	3	<1	2
<i>Diadema</i> Urchins	<1	5	6	<1	3
Pencil Urchins	0	0	0	0	0
Sea cucumber edible	0	<1	<1	<1	0
COT <i>Acanthaster planci</i>	0	<1	<1	<1	0
Giant Clam (<i>Tridacnae</i>)	4	1	5	2	3
Triton	<1	<1	<1	<1	0
Lobster	<1	0	<1	<1	0
Damage etc: (scale 0-3)					
Recent Coral damage	3	2	1	1	2
Trash	1	1	1	1	1
Bleaching	1	1	1	1	1

* Rounded to nearest integer.

Figure 17a. Area summary of 2002/2003 ReefCheck data for benthic cover

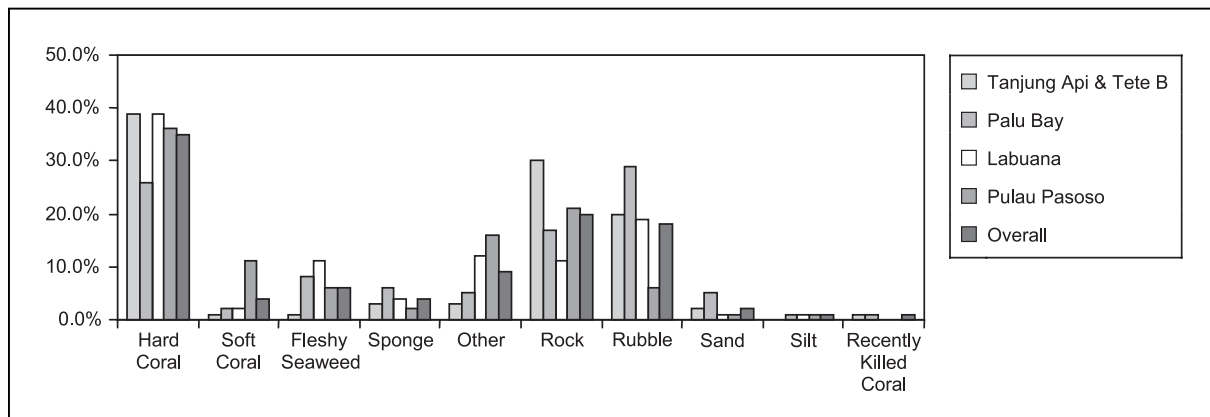


Figure 17b. Indicator fish summary

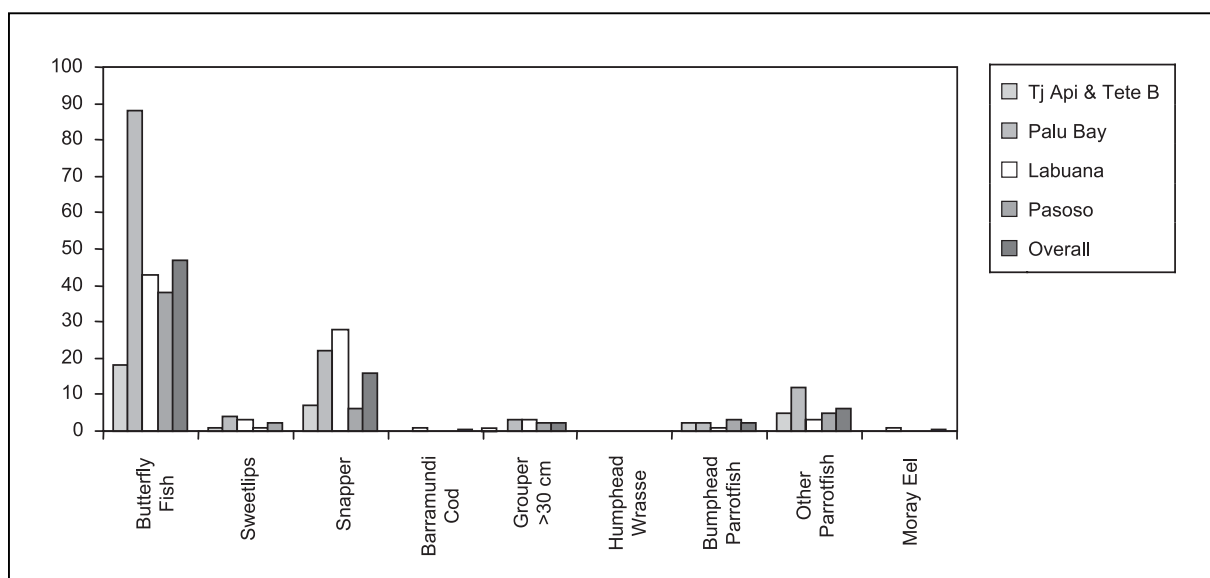


Figure 17c. Invertebrate summary

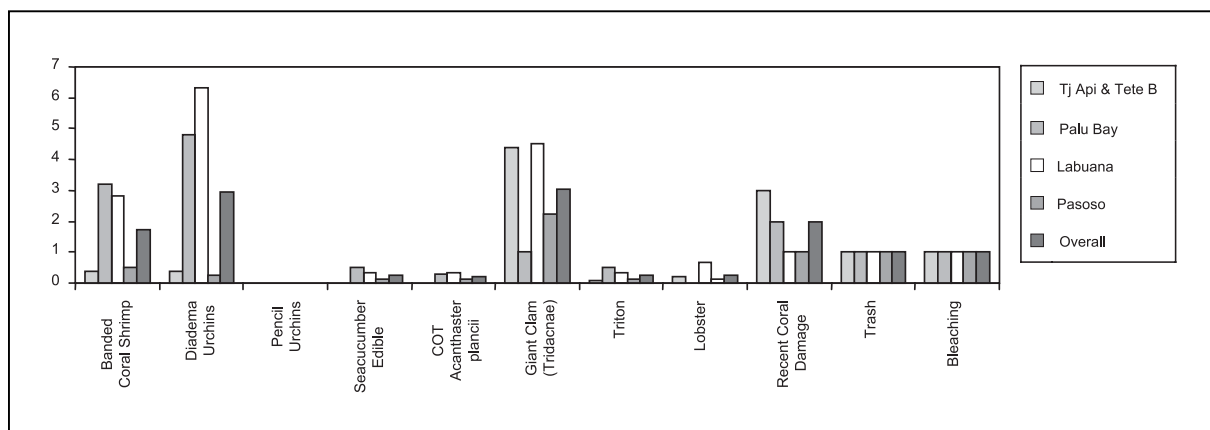


Table 21a. LIT summary per transect for each area. Togean Islands

(Percentage)

Life Form	Bambu	Siatu	Taningkola 1	Taningkola 2	Kadidiri 1	Kadidiri 2	Teluk Kilat	Malenge	Kabalutan	Togean islands
ACB	2.5	0.0	0.0	0.6	8.0	2.0	2.0	3.2	7.0	2.8
ACT	14.5	0.0	0.0	0.0	1.5	9.5	22.7	4.5	6.7	6.6
ACD ACE ACS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acropora	17.0	0.0	0.0	0.6	9.5	11.5	24.7	7.7	13.7	9.4
CB	1.5	20.0	1.5	7.3	10.9	6.4	8.5	8.8	16.6	9.1
CD	0.0	0.0	0.0	12.0	3.3	2.4	9.6	0.0	9.8	4.1
CF	1.0	0.0	0.5	0.0	0.9	0.0	0.0	0.0	0.0	0.3
CS	0.0	0.0	0.0	0.7	3.6	3.0	1.3	0.0	3.6	1.4
CM	8.3	3.0	1.2	16.1	1.7	8.4	4.3	6.2	10.3	6.6
CE	7.2	1.5	0.7	2.2	0.3	3.9	3.5	3.4	2.5	2.8
CMR	0.0	1.0	0.0	1.5	1.0	0.0	0.0	0.5	0.8	0.5
CME	0.0	1.2	0.0	0.0	17.0	0.0	0.0	9.0	3.0	3.4
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non Acropora	18.0	26.7	3.9	39.8	38.7	24.1	27.2	27.9	46.6	28.1
SC	0.0	1.0	3.0	1.5	4.6	1.5	0.0	3.1	1.5	1.8
SP	13.4	4.3	6.3	6.7	3.3	7.0	7.8	7.2	2.5	6.5
ZO	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0.3
OT	2.0	2.6	3.7	3.8	10.6	14.3	10.0	6.1	2.9	6.2
Non-Alga	15.4	7.9	13.0	12.0	18.5	22.8	19.3	17.4	6.9	14.8
CA	4.0	4.7	5.0	1.1	6.0	1.2	1.5	2.0	2.8	3.1
HA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TA	0.5	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.2
MA	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.3	0.1
AA	2.8	1.0	6.4	1.0	1.5	2.5	1.0	3.5	1.4	2.3
Alga	7.3	5.7	12.4	2.1	7.5	3.7	3.5	6.0	4.5	5.9
DC	2.0	1.5	0.0	2.1	4.4	0.7	2.0	4.6	4.6	2.4
DCA	7.1	23.6	34.5	19.6	5.7	13.7	12.8	16.1	10.3	15.9
RB	27.7	31.7	17.2	17.8	15.7	18.5	4.5	20.3	12.9	18.5
Dead coral	36.8	56.8	51.7	39.5	25.8	32.9	19.3	41.0	27.8	36.8
SA	5.5	2.9	19.0	6.0	0.0	5.0	6.0	0.0	0.5	5.0
SL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total abiotic	42.3	59.7	70.7	45.5	25.8	37.9	25.3	41.0	28.3	41.8
Hard Coral	35.0	26.7	3.9	40.4	47.9	35.6	51.9	35.6	60.3	37.5
Live Cover	57.7	40.3	29.3	54.5	74.3	62.8	74.7	59.0	71.7	58.3
# Lifeforms	15	12	13	16	18	16	17	17	19	16
# HC forms	6	5	4	7	10	7	7	7	9	7
% Recorded HC forms	60	50	40	70	100	70	70	70	90	70
% Total HC forms	43	36	29	50	71	50	50	50	64	49

Table 21b. ReefCheck sites

(Percentage)

Life Form	Kakafu	Kakafu	Kakafu	Talise	Talise	Talise	Kadongo	Kadongo	Kadongo	Palu Bay
Depth	3 m	10 m	Overall	3 m	10 m	Overall	3 m	10 m	Overall	Overall
Length m	25	10	35	20	10	30	20	15	35	100
ACB	1.1	3.0	1.5	0.0	0.5	0.2	0.4	0.0	0.2	0.6
ACT	0.0	5.2	1.2	4.9	0.0	3.2	0.0	0.0	0.0	1.5
AC Other	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0
Acropora	1.1	8.2	2.7	4.9	0.9	3.5	0.4	0.0	0.2	2.1
CB	13.7	2.7	11.2	8.3	2.8	6.5	0.3	0.2	0.3	6.0
CD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CF	0.4	0.6	0.4	6.8	1.5	5.0	0.0	0.0	0.0	1.8
CS	17.8	0.5	14.0	5.1	0.0	3.4	1.5	0.0	0.9	6.1
CM	14.1	10.3	13.3	10.0	3.9	7.9	1.0	0.3	0.7	7.3
CE	4.6	6.9	5.1	7.4	12.9	9.2	0.5	0.0	0.3	4.9
CMR	4.2	0.0	3.3	6.8	1.0	4.8	2.6	0.4	1.7	3.3
CME	0.1	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.2	0.4
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HC Non-Acropora	54.9	21.0	47.4	44.2	22.1	36.8	8.0	0.9	4.9	29.7
SC	1.0	0.4	0.9	0.0	0.0	0.0	0.3	7.7	3.5	1.5
SP	1.1	16.1	4.4	10.8	5.3	9.0	7.9	9.3	8.5	7.3
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	2.5	3.6	2.7	2.8	2.7	2.7	2.6	0.6	1.7	2.4
Other non-alga	4.6	20.1	8.0	13.6	8.0	11.7	10.8	17.6	13.7	11.1
CA	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HA	0.2	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.1
TA	0.1	0.0	0.0	0.0	0.3	0.1	0.0	2.4	1.0	0.4
MA	0.0	0.0	0.0	0.8	0.0	0.5	0.4	0.0	0.2	0.2
AA	2.1	0.5	1.7	7.2	6.8	7.0	43.0	19.0	32.7	13.8
Alga	2.4	1.1	2.1	8.0	7.1	7.7	43.5	21.4	34.0	14.6
DC	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2
DCA	15.3	15.8	15.4	6.2	9.0	7.1	16.5	2.5	10.5	11.0
RB	9.7	24.6	13.0	4.4	18.0	8.9	7.0	0.3	4.1	8.7
Dead coral	25.6	41.1	29.0	10.5	27.0	16.0	23.4	2.8	14.6	19.9
SA	11.5	8.2	10.7	2.9	34.9	13.5	13.3	41.2	25.3	16.5
SL	0.0	0.3	0.1	16.1	0.0	10.7	0.7	16.1	7.3	6.0
Total abiotic	37.1	49.6	39.8	29.5	61.9	40.3	37.4	60.1	47.1	42.4
Hard Coral	56.0	29.2	50.0	49.1	23.0	40.4	8.4	0.9	5.2	31.9
Live Cover	62.9	50.4	60.2	70.6	38.1	59.7	62.6	39.9	52.9	57.6
# Lifeforms	18	17	19	15	14	18	17	12	17	18
# HC forms	8	7	8	7	7	9	7	3	7	9
% HC forms recorded Palu Bay	89	78	89	78	78	100	78	33	78	100
% Total HC forms	54	50	57	50	50	64	36	21	31	64

Table 21c.

(Percentage)

Life Form	Labuana 1	Labuana 1	Labuana 1	Labuana 2	Labuana 2	Labuana 2	Labuana 3	Labuana 3	Labuana 3	Labuana
Depth	3 m	10 m	Overall	3 m	10 m	Overall	3 m	10 m	Overall	Overall
Length m	20	10	30	20	10	30	20	10	30	90
ACB	7.2	0.6	5.0	4.8	12.1	7.2	1.3	10.1	4.3	5.5
ACT	2.3	3.9	2.9	0.0	0.0	0.0	2.1	13.1	5.7	2.9
AC Other	4.9	0.0	3.3	4.8	0.0	3.2	3.0	0.0	2.0	2.8
Acropora	14.4	4.5	11.2	9.6	12.1	10.4	6.4	23.2	12.0	11.2
CB	6.5	3.7	5.6	11.9	1.4	8.4	7.8	1.8	5.8	6.6
CD	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.9	0.3
CF	0.0	32.8	10.9	3.5	0.0	2.3	0.0	0.0	0.0	4.4
CS	6.8	0.0	4.5	10.7	1.7	7.7	6.1	2.2	4.8	5.7
CM	24.6	2.8	17.4	3.9	21.2	9.7	8.6	1.4	6.2	11.1
CE	4.4	0.0	2.9	1.3	4.3	2.3	3.3	4.7	3.8	3.0
CMR	0.9	3.7	1.8	1.5	3.8	2.3	1.8	0.4	1.3	1.8
CME	1.7	3.6	2.3	0.0	7.0	2.3	0.0	0.0	0.0	1.6
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	44.9	46.6	45.4	32.8	39.4	35.0	28.9	10.5	22.8	34.5
SC	0.2	0.0	0.1	0.0	0.0	0.0	3.6	1.3	2.8	1.0
SP	1.4	5.4	2.8	3.8	5.6	4.4	4.5	7.3	5.4	4.2
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.7	2.5	1.3	1.8	2.3	2.0	1.7	0.6	1.3	1.5
Other non-alga	2.3	7.9	4.2	5.6	7.9	6.4	9.8	9.2	9.5	6.7
CA	6.4	1.2	4.7	5.2	1.9	4.1	0.8	0.5	0.7	3.1
HA	0.8	0.0	0.6	2.4	0.3	1.7	0.5	0.0	0.3	0.8
TA	1.1	0.0	0.7	0.3	0.0	0.2	2.1	0.0	1.4	0.8
MA	0.5	3.5	1.5	1.2	1.9	1.5	0.0	0.5	0.2	1.0
AA	6.4	9.2	7.3	10.9	3.6	8.4	7.7	0.5	5.3	7.0
Alga	15.2	13.9	14.8	20.0	7.7	15.9	11.1	1.5	7.9	12.7
DC	0.0	3.7	1.2	0.2	0.2	0.2	0.0	1.3	0.5	0.6
DCA	18.0	4.8	13.6	16.1	8.8	13.7	15.3	7.9	12.8	13.4
RB	2.3	18.6	7.7	8.7	14.0	10.5	17.2	18.3	17.6	11.9
Dead coral	20.3	27.1	22.5	25.0	23.0	24.4	32.5	27.5	30.9	25.9
SA	0.9	0.0	0.6	4.7	7.5	5.6	11.4	28.1	16.9	7.8
SL	2.0	0.0	1.3	2.3	2.4	2.3	0.0	0.0	0.0	1.2
Dead Cover	23.2	27.1	24.4	32.0	32.9	32.3	43.8	55.6	47.8	34.9
Hard Coral	59.4	51.1	56.6	42.5	51.5	45.5	35.0	33.7	34.5	45.5
Live Cover	76.8	72.9	75.6	68.0	67.1	67.7	56.2	44.4	52.2	65.1
# Lifeforms	19	15	22	20	18	21	22	17	23	23
# HC forms	9	7	10	8	7	9	11	7	11	13
% HC forms recorded	69.2	53.8	76.9	61.5	53.8	69.2	84.6	53.8	84.6	100
% Total HC forms	64.3	50.0	71.4	57.1	50.0	64.3	78.6	50.0	78.6	93

Table 21d.

(Percentage)

Life Form	Pasoso 1	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	Pasoso 4	Pasoso
Depth	3 m	10 m	Over-all	3 m	10 m	Over-all	3 m	10 m	Over-all	3 m	10 m	Over-all	Over-all
Length m	20	10	30	20	10	30	20	10	30	20	10	30	120
ACB	3.6	3.0	3.4	6.1	0.0	4.1	13.1	2.7	9.6	0.0	0.0	0.0	4.3
ACT	0.0	0.0	0.0	4.3	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7
AC Other	0.0	0.0	0.0	1.4	0.0	0.9	1.5	0.0	1.0	0.0	0.0	0.0	0.5
Acropora	3.6	3.0	3.4	11.7	0.0	7.8	14.6	2.7	10.6	0.0	0.0	0.0	5.4
CB	9.9	14.5	11.4	7.8	22.4	12.6	9.3	6.6	8.4	9.6	2.2	7.1	9.9
CD	0.9	0.0	0.6	0.5	0.0	0.3	0.0	0.4	0.1	0.0	0.0	0.0	0.3
CF	0.0	0.7	0.2	5.6	2.3	4.5	0.0	1.5	0.5	0.0	1.9	0.6	1.5
CS	3.5	10.0	5.6	4.3	10.0	6.2	2.5	2.3	2.4	1.9	1.3	1.7	4.0
CM	7.1	1.0	5.1	6.8	0.0	4.5	5.5	15.2	8.7	6.7	12.0	8.5	6.7
CE	7.2	10.2	8.2	1.2	5.6	2.7	2.2	9.4	4.6	1.3	21.4	8.0	5.9
CMR	0.1	3.1	1.1	0.2	0.7	0.3	1.1	3.8	2.0	0.0	4.8	1.6	1.3
CME	0.5	0.4	0.5	0.9	0.0	0.6	0.0	0.3	0.1	0.0	0.4	0.1	0.3
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	29.1	39.9	32.7	27.2	41.0	31.8	20.6	39.5	26.9	19.5	44.0	27.7	29.8
SC	4.0	0.3	2.7	0.0	6.0	2.0	2.2	14.3	6.2	1.2	24.9	9.1	5.0
SP	1.0	4.8	2.2	0.3	3.7	1.4	1.0	9.3	3.7	14.3	7.2	11.9	4.8
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.1	9.1	3.1	1.7	1.8	1.7	0.6	6.7	2.6	0.0	3.7	1.2	2.2
Other non-alga	5.0	14.2	8.1	1.9	11.5	5.1	3.8	30.3	12.6	15.5	35.8	22.3	12.0
CA	0.0	1.7	0.6	0.0	1.4	0.5	0.1	1.5	0.5	0.0	2.4	0.8	0.6
HA	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.2	0.0	0.1	0.1
TA	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MA	0.0	0.6	0.2	1.8	0.0	1.2	0.2	1.1	0.5	0.0	0.7	0.2	0.5
AA	1.0	3.2	1.7	0.9	0.9	0.9	5.0	0.4	3.4	0.7	0.6	0.7	1.7
Alga	1.0	6.0	2.7	2.7	2.3	2.6	5.6	3.0	4.7	0.9	3.7	1.8	2.9
DC	0.0	3.9	1.3	0.3	0.9	0.5	0.0	1.3	0.4	0.0	2.3	0.8	0.7
DCA	8.2	9.8	8.7	20.5	4.7	15.2	40.5	11.7	30.9	15.7	8.3	13.2	17.0
RB	47.6	23.2	39.5	34.1	33.1	33.7	13.8	10.1	12.5	42.0	5.7	29.9	28.9
Dead coral	55.8	36.9	49.5	54.8	38.7	49.4	54.3	23.1	43.9	57.7	16.3	43.9	46.7
SA	5.7	0.0	3.8	1.8	6.5	3.4	1.3	0.9	1.2	6.4	0.2	4.3	3.2
SL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0
Total abiotic	61.4	36.9	53.2	56.6	45.2	52.8	55.6	24.5	45.2	64.1	16.5	48.2	49.9
Hard Coral	32.6	42.9	36.0	38.9	41.0	39.6	35.2	42.2	37.5	19.5	44.0	27.7	35.2
Live Cover	38.6	63.1	46.8	43.5	54.8	47.2	44.5	75.5	54.8	35.9	83.5	51.8	50.1
# Lifeforms	13	18	14.667	16	14	15	12.5	21	15.333	11	17	13	22
# HC forms	6.5	8	7	11	5	8	4.5	9	6	4	7	5	11
% HC forms/ HC forms recorded	59	73	64	100.0	45.5	72.7	41	82	55	36	64	45	100
% Total HC forms	46	57	50	67.9	35.7	57.1	32	64	43	29	50	36	79

Table 21e.

(Percentage)

Life Form	Tete B	Tete B	Tete B	T Api 1	T Api 1	T Api 1	T Api 2	T Api 2	T Api 2	T Api 3	T Api 3	T Api 3	T Api 4	T Api 4	T Api 4	T Api	Overall
Depth	3 m	10 m	Over-	3 m	10 m	Over-	3 m	10 m	Over-	3 m	10 m	Over-	3 m	10 m	Over-	Over-	
Length m	20	10	30	20	10	30	20	10	30	20	10	30	20	10	30	120	150
ACB	00	30	10	00	00	00	19	00	10	01	00	01	06	00	04	04	05
ACT	00	115	38	00	00	00	00	16	08	00	00	00	42	00	28	09	15
AC Other	00	40	14	00	00	00	91	41	66	00	00	00	14	22	17	21	19
Acropora	00	185	62	00	00	00	110	57	84	01	00	01	62	22	49	34	39
CB	40	55	45	194	122	170	05	35	20	70	34	58	88	177	117	91	82
CD	14	00	09	01	109	37	26	00	13	00	00	00	11	00	07	14	13
CF	00	00	00	00	18	06	00	00	00	26	00	17	29	00	20	11	09
CS	24	25	24	00	07	02	19	15	17	11	04	08	91	61	81	27	26
CM	175	141	163	18	45	26	189	128	157	00	00	00	38	51	43	57	78
CE	12	267	97	15	00	10	00	122	61	06	13	08	73	108	84	41	52
CMR	04	24	10	03	23	10	00	17	09	13	09	12	41	10	31	15	14
CME	16	31	21	00	00	00	00	00	00	00	29	10	04	00	02	03	07
CHL	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Non-Acropora	285	543	369	231	324	261	239	317	277	126	89	113	375	407	385	259	281
SC	02	00	01	00	00	00	04	00	02	08	00	06	00	00	00	02	02
SP	66	43	59	18	44	27	00	95	48	12	08	11	44	14	34	30	36
ZO	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
OT	08	05	07	03	11	06	53	47	50	02	03	03	58	07	41	25	21
Other non-alga	76	48	67	21	55	33	57	142	100	22	11	20	102	21	75	57	59
CA	15	22	17	02	00	01	29	19	24	04	02	03	08	29	15	11	12
HA	09	00	06	00	04	03	02	00	01	12	00	08	00	00	00	03	04
TA	00	08	03	00	17	05	00	00	00	00	00	00	00	00	00	01	02
MA	02	00	01	03	61	22	00	00	00	00	00	00	00	00	00	05	04
AA	43	42	43	13	19	15	46	46	46	16	14	15	45	12	34	27	31
Alga	69	72	70	18	101	46	77	65	71	32	16	26	53	41	49	47	53
DC	10	00	07	00	00	00	10	00	05	00	00	00	00	00	00	01	02
DCA	426	116	323	217	420	284	303	250	276	55	00	36	167	86	140	185	212
RB	101	18	74	440	72	317	194	161	178	764	884	804	241	423	302	400	335
Dead coral	537	134	404	657	492	601	507	411	459	819	884	840	408	509	442	586	549
SA	09	00	06	30	28	30	10	08	09	00	00	00	00	00	00	10	09
SL	24	18	22	43	00	29	00	00	00	00	00	00	00	00	00	07	10
Total abiotic	570	152	432	730	520	660	517	419	468	819	884	840	408	509	442	603	568
Hard Coral	285	728	431	231	324	261	349	374	361	127	89	114	437	429	434	293	320
Live Cover	430	848	568	270	480	340	483	581	532	181	116	160	592	491	558	397	432
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
# Life forms	19	11	23	14	15	17	15	14	19	14	10	15	17	12	17	26	26
# HC forms	7	9	10	5	6	7	6	7	9	6	5	7	11	6	11	13	13
% HC forms recorded	54	69	77	38	46	54	46	54	69	43	50	64	85	46	85	100	100
% Total HC forms	50	64	71	36	43	50	43	50	64	43	36	50	79	43	79	930	930

**Table 22a. LIT results simplified to basic (Manta Tow) codes.
Summary for the Togean Islands**

(Percentage)

Location	LC	DC	HC	SC	OT	RC	RB	S
Teluk Kilat	74	26	51	0	23	15	5	6
Kadidiri 1	74	26	48	5	21	10	16	0
Kadidiri 2	62	38	35	2	25	15	18	5
Tanangkola 1	29	71	4	3	22	35	17	19
Tanangkola 2	54	46	40	2	12	22	18	6
Siatu	40	60	26	1	13	25	32	3
Bambu	57	43	35	0	22	9	28	6
Malenge	59	41	36	3	20	21	20	0
Kabalutan	72	28	60	2	10	14	13	1
Togean Islands	58	42	37	2	19	18	19	5

Table 22b. LIT summary for Tamjung Api & Tete B

(Percentage)

Location	HC	SC	OT	RC	RB	S	Total	LC	DC
Tete B	43	1	13	33	7	3	100	57	43
Tj Api 1	26	0	8	28	32	6	100	34	66
Tj Api 2	36	1	17	28	17	1	100	54	46
Tj Api 3	11	1	4	4	80	0	100	16	84
Tj Api 4	43	0	13	14	30	0	100	56	44
Tj Api & Tete B	32	1	11	21	33	2	100	44	56
Tj Api	29	1	10	18	40	2	100	40	60

Table 22c. LIT summary for Palu Bay

(Percentage)

Site	HC	SC	OT	RC	RB	S	Total	LC	DC
Kakafu	50	1	9	16	13	11	100	60	40
Talise	41	0	19	7	9	24	100	60	40
Kadongo	5	4	44	11	4	32	100	53	47
Palu Bay	32	2	24	11	9	22	100	58	42

Table 22d. LIT summary for Labuana

(Percentage)

Location	HC	SC	OT	RC	RB	S	Total	LC	DC
Labuana 1	56	1	18	15	8	2	100	75	25
Labuana 2	45	0	22	14	11	8	100	67	33
Labuana 3	35	3	14	13	18	17	100	52	48
Labuana	46	1	18	14	12	9	100	65	35

Table 22e. LIT summary for Pasoso

(Percentage)

Location	HC	SC	OT	RC	RB	S	Total	LC	DC
Pasoso 1	36	3	8	10	40	3	100	47	53
Pasoso 2	39	2	6	16	34	3	100	47	53
Pasoso 3	38	6	11	31	13	1	100	55	45
Pasoso 4	28	9	15	14	30	4	100	52	48
Pasoso	35	5	10	18	29	3	100	50	50

Table 23. Hard coral condition per area for LIT sites

(Percentage)

Category	Very Poor	Poor	Average	Good	Very Good	% HC	Average Category
Togean Islands	11	11	56	22	0	42	3
Tj Api & Tete B	10	30	50	10	0	32	3
Palu Bay	33	33	17	17	0	32	3
Labuana	0	0	50	50	0	46	3
Pasoso	0	13	87	0	0	35	3

Figure 18a. ReefCheck site's LIT data per transect for each area – Palu Bay

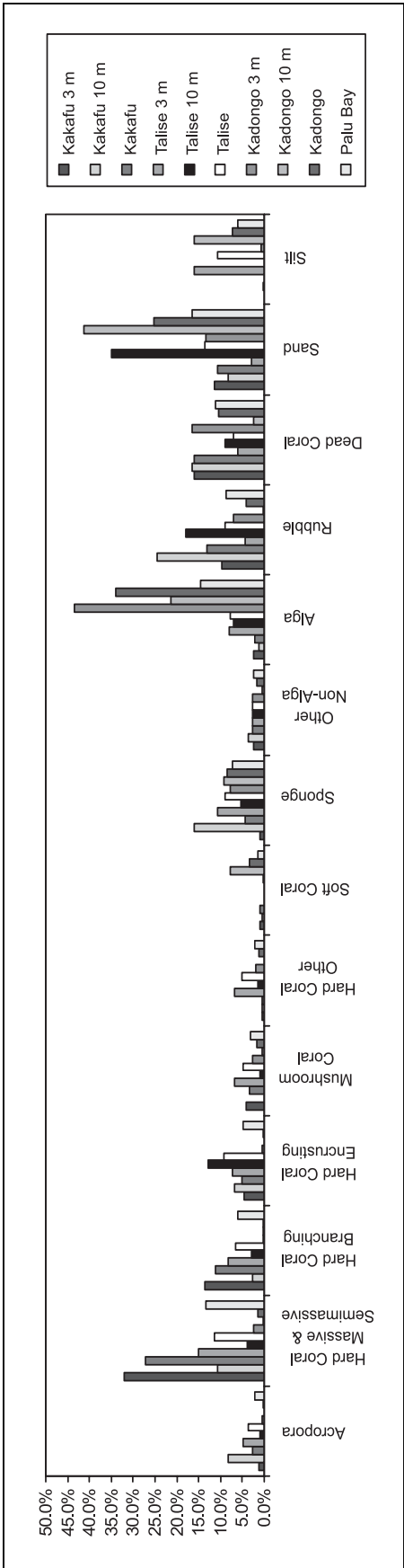


Figure 18b. ReefCheck site's LIT data per transect for each area – Labuana

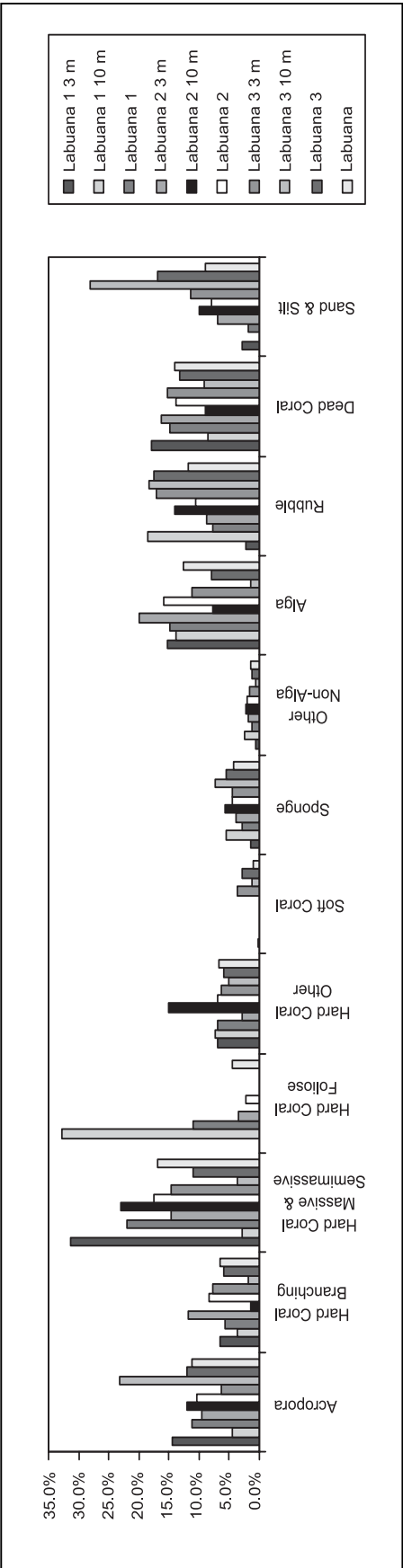


Figure 18c. ReefCheck site's LIT data per transect for each area – Pulau Pasoso MPA

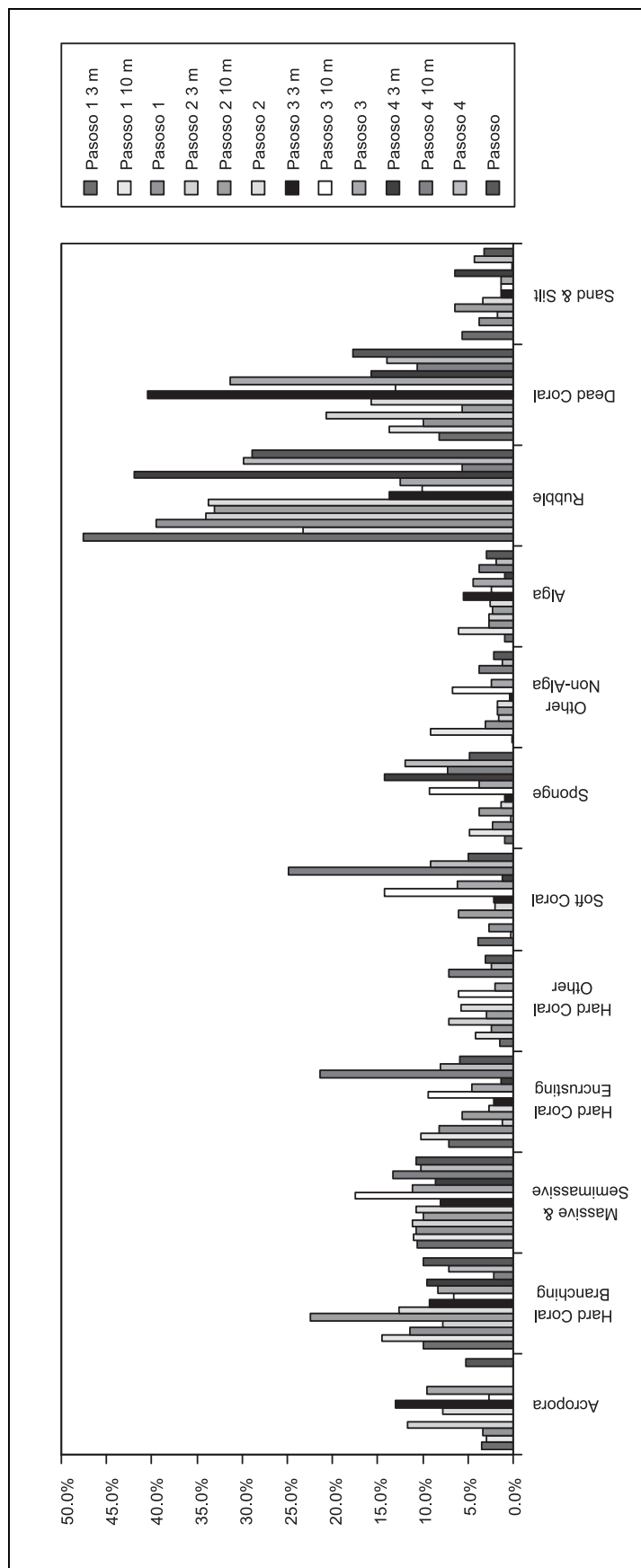


Figure 18d. ReefCheck site's LIT data per transect for each area – Tanjung Api MPA and Tete B

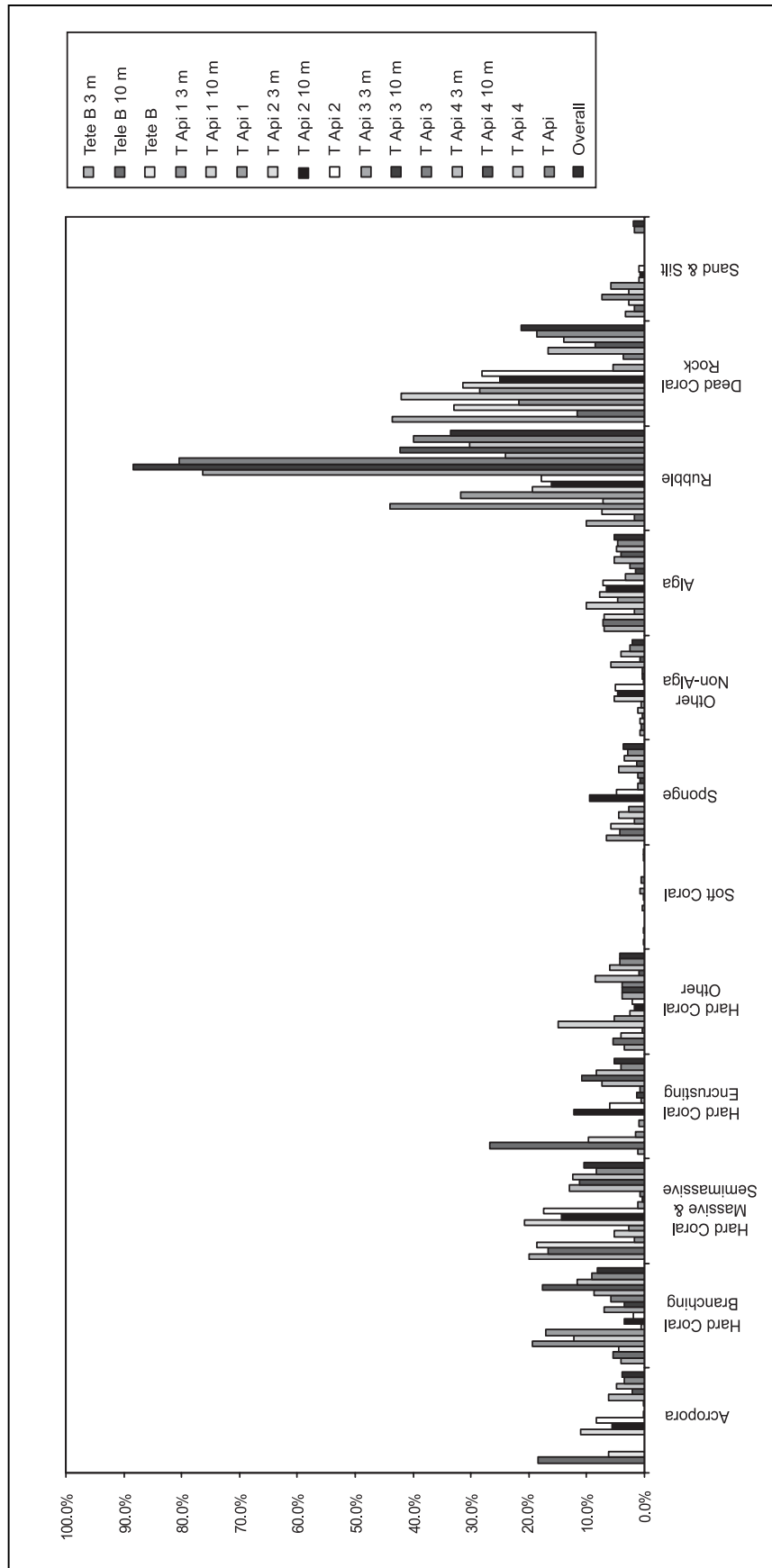


Figure 19. LIT coral condition data summary

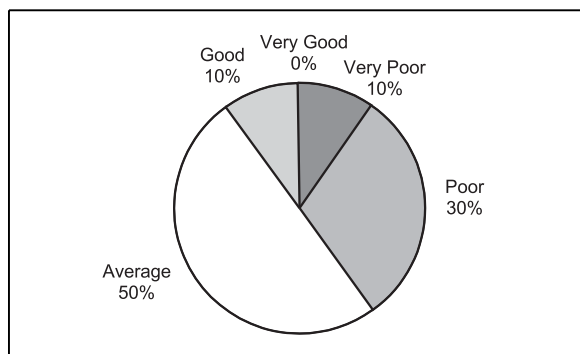


Figure 19a. Togeian Islands

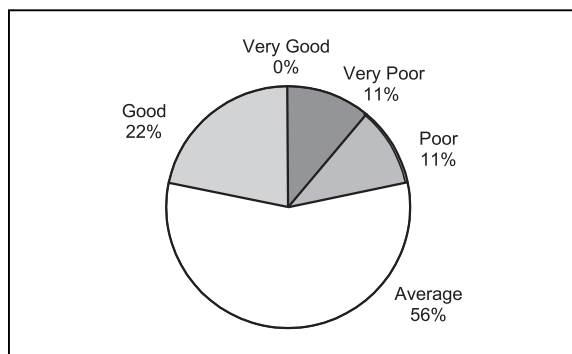


Figure 19b. Tanjung Api & Tete B

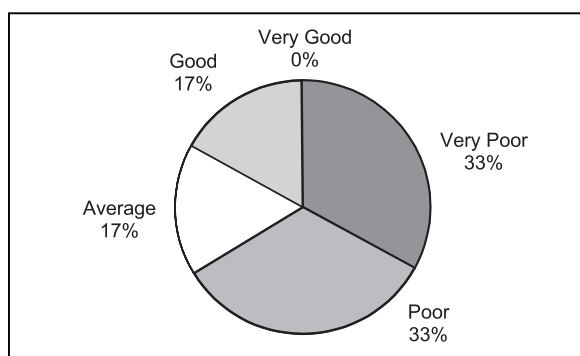


Figure 19c. Palu Bay

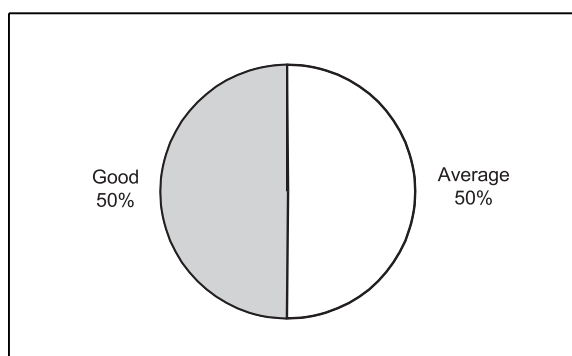


Figure 19d. Labuana

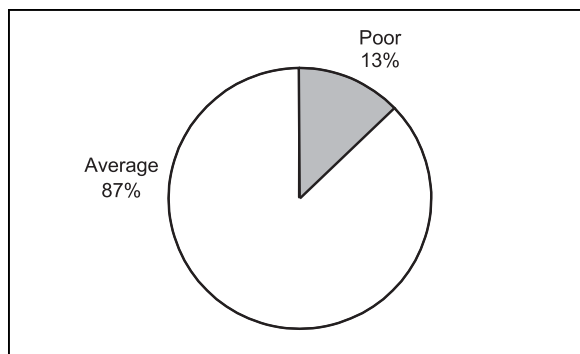


Figure 19e. Pasoso

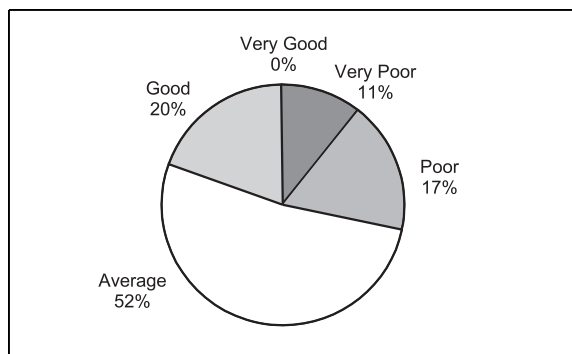


Figure 19f. Overall LIT Survey Coral Condition

At non-ReefCheck sites, the transects were specifically chosen to be as representative as possible of the general conditions, whereas at ReefCheck sites the transects were sub-samples of the ReefCheck transects themselves.

The figures and tables above show how diverse the coral reef benthic cover and condition is both between and within areas. There are indications of specific trends related to area and depth that will be confirmed or refuted by ongoing monitoring at as many of these locations as possible.

There is a majority of “average” condition except in Palu Bay, where the Kadongo transect weights heavily with its still relatively recent major COTs outbreak, resulting in very low coral cover.

6. SUMMARY OF DATA COLLECTED TO DATE

In the tables and figure below, all the data collected by the three methods used (ReefCheck, Manta Tow and LIT) has been summarised with benthic cover reduced to Manta Tow categories.

Table 24a gives the code conversions used to combine Manta tow, ReefCheck and LIT data. The summary results are given in Table 24b and Figure 20.

Table 24a. Conversion between Manta Tow, ReefCheck and LIT Codes

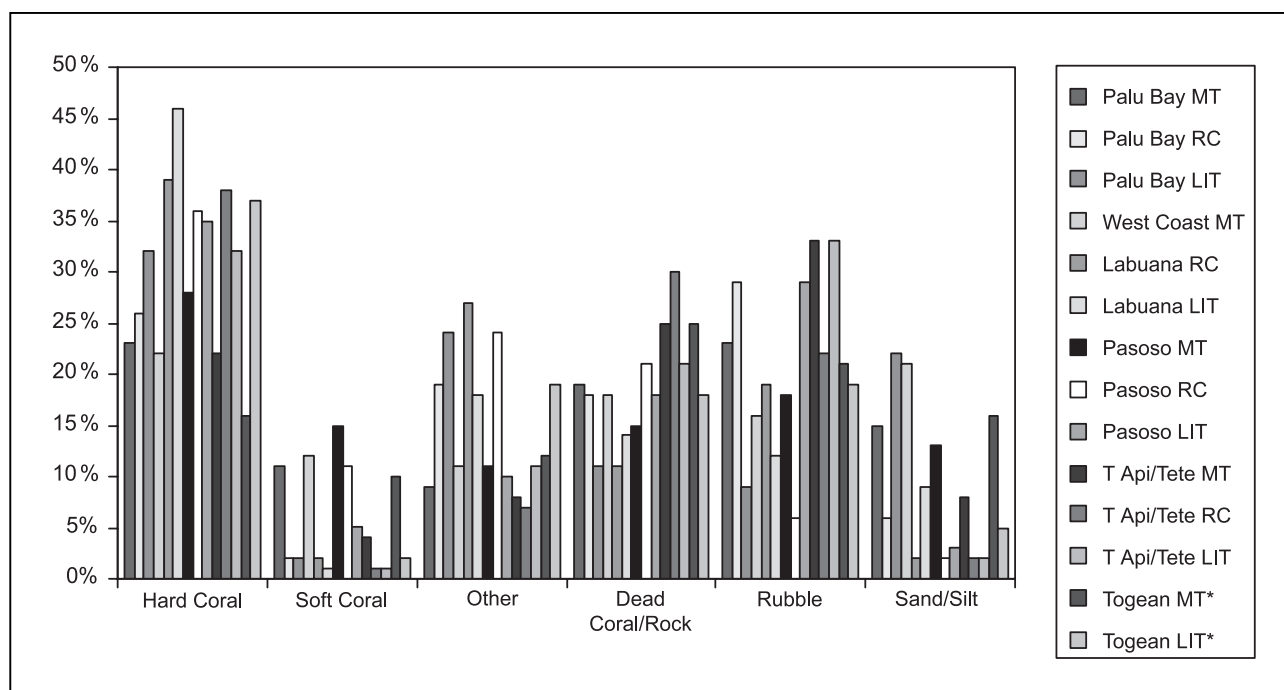
LIT Code	LIT Description	RC Code	MT Code	LIT Code	LIT Description	RC Code	MT Code
Acropora:				Other Biotic			
ACB	Branching	HC	HC	SC	Soft Coral	SC	SC
ACD	Digitate	HC	HC	SP	Sponge	SP	OT
ACS	Submassive	HC	HC	ZO	Zooanthid	OT	OT
ACE	Encrusting	HC	HC	OT	Other	OT	OT
ACT	Table	HC	HC	Algae			
Other Hard Corals				HA	Halimeda	OT	OT
CE	Encrusting	HC	HC	TA	Turf Algae	OT	OT
CS	Submassive	HC	HC	MA	Macro Algae	FS	OT
CM	Massive	HC	HC	CA	Coraline Algae	OT	OT
CB	Branching	HC	HC	AA	Algal Assemblage	FS	OT
CF	Foliose	HC	HC	Abiotic			
CHL	Blue Coral (<i>Heliopora</i>)	HC	HC	WA	Water (>1m)	N/A	
CME	Fire Coral (<i>Millepora</i>)	HC	HC	S	Sand	SA	S
CMR	Mushroom	HC	HC	SL	Silt	SI	S
Dead Coral				RCK	Rock (non coral origin)	RC	OT
DC	Dead Coral (white)	RKC	DC				
DCA	Dead Coral with Algae	RC	DC				
R	Rubble	RB	RB				

Table 24b. Survey & Monitoring Data Summary

(Percentage)

Benthic Cover	HC	SC	OT	DC	RB	S
Palu Bay MT	23	11	9	19	23	15
Palu Bay RC	26	2	19	18	29	6
Palu Bay LIT	32	2	24	11	9	22
West Coast MT	22	12	11	18	16	21
Labuana RC	39	2	27	11	19	2
Labuana LIT	46	1	18	14	12	9
Pasoso MT	28	15	11	15	18	13
Pasoso RC	36	11	24	21	6	2
Pasoso LIT	35	5	10	18	29	3
T Api/Tete MT	22	4	8	25	33	8
T Api/Tete RC	38	1	7	30	22	2
T Api/Tete LIT	32	1	11	21	33	2
Togean MT*	16	10	12	25	21	16
Togean LIT*	37	2	19	18	19	5

* Not same locations.

Figure 20. Survey & Monitoring Data summary


7. DATA REPORTING

The data and/or suitable reports have been or will very shortly (at latest in May 2003) be submitted in appropriate formats to: ReefCheck Foundation and ReefCheck Indonesian databases (at WWF Bali); ReefBase; WCMC; WRI R@R project; BKSDA Sulteng; MCRMP co-ordinating bodies including the Marine & Fisheries Department and the Small Islands Dirigent; Pasoso and Togean MPA work teams; COREMAP; LIPI; all funding agencies, and metadata submitted to the Southeast Asia START Regional Centre (SEA START RC). Tanjung Api reports and data have been shared with our 2001/2002 partner organisation for Tanjung Api, YPH.

Material will be made available during 2003 via the bilingual website which YACL is building in partnership with Webinspired Ltd UK, and to the FIPA Indonesian Protected Areas Network site.

8. ASSESSMENT AND FORWARD PLANNING

In accordance with the MOU, an assessment has been made of work to date, and how closely it relates to the workplan submitted at the beginning of the programme. This is summarised in table 25. Table 26 shows which items in the MOU were achieved.

Table 25. Completion of MOU tasks

Task	Completed?	Remarks
Yayasan Adi Citra Lestari will carry out training courses in coral reef survey and monitoring, and present the results to relevant managers.	Yes	Courses took place and survey/monitoring results have been and will continue to be presented to relevant managers.
The purpose of carrying out training courses is to increase capacity in surveying and monitoring coral reefs, and to transfer the results to managers.	Yes	Capacity was increased and some action based on the results is already taking place with more in the planning stage.
(i) Capacity Building:		
Increase the survey and monitoring skills of the local community in: (1) Manta Tow	Yes	Tawaeli local community group, Ampana (Tanjung Api) community group and YACL team/volunteers
(2) ReefCheck and Line Intercept Transect methods	Yes	YACL team/volunteers
(3) 5 training sessions	Yes	Some variation from original plan
(4) for 16-20 persons	Yes?	21 trainees but as some took part in more than one training, only 14 people
(ii) Survey and Monitoring:		
Continue monitoring at sites from a previous project funded by UNEP: Tawaeli, Pulau Pasoso, Tanjung Api and Labuana	Yes	ReefCheck and Manta Tow as previously, plus additional LIT data at all 4 sites
Baseline surveys at up to 4 new sites	Yes?	More than 4 sites surveyed but permanent markers at only 1 site
Establish monitoring plans for all surveyed sites	No	Several sites surveyed in conjunction with other projects, YACL will not have the resources to monitor all without additional funding and capacity building.

Table 25. (Continued)

(iii) Data Processing:*		
Data will be submitted to ReefBase, COREMAP, ReefCheck	Yes	In CD form or email. ReefCheck already, others in July/August
Metadata will be submitted to the SEA START RC meta database	?	If promised forms arrive it will be – we are STILL waiting!
Evidence of data submission will be shown via e-mail/reports copied to UNEP	Yes	Some items sent via CD and not email as too large. Cover letters will be copied.
(iv) Resource Management:		
Present results to stakeholders, site managers, media and decision makers in written formats	Yes	On several occasions, including at an exhibition (Fisheries Expo 2003 at Alkhairat University, Palu), through participation in seminars, specific events, on-off or group meetings etc.
In electronic and audio-visual formats	Yes	In video (shown from videocam), slide-show and CD formats. Shortly also via website.
(v) Reporting:		
Submit a progress report to UNEP no later than 31 December 2002	Yes	Already submitted
Submit a final report to UNEP no later than 30 April 2003. – Requested no-cost extension to mid-June which was agreed.	Delayed to Mid-June	This report

* Due to unanticipated visit to USA in connection with Pasoso MPA work, some reporting and data submission to organisations other than UNEP and ReefCheck will be delayed to July/August 2003.

Based on the table above, the YACL team feels that the objectives of the MOU have been achieved, albeit in a slightly longer time frame than had been anticipated. More information on the actual timing of activities undertaken (excluding time spent in preparation, etc.) is shown in Table 26 below.

The codes used are:

X = Items originally scheduled at this period but did not take place (then).

C = Items carried out – whether or not completed – during this period.

P = Items postponed and due to be undertaken using different funding over 2003/2004.

Table 26. YACL proposed and actual workplan 2002/2003

ITEM	MONTH (Month 1 = June 2002)												REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	
Evaluation of 2001/2002 & Detailed Planning for 2002/2003	X	C											Completed
1. Training:													
1.1 TOT Manta Tow		X										P	Completed
1.2 Manta Tow Training		X	C				X					C	Two training sessions completed
1.3 LIT training								P	C	C			Completed
1.4 ReefCheck incl without SCUBA												P	Postponed to 2003/2004 as funds delayed
1.5 Other Training & Preparation of Training Materials	X	X	C	C	C		X	C	C	C	C	P	Most postponed to 2003/2004 now has funding
2. Survey/Monitoring: (**)													
2.1 Monitoring Existing Sites (or LIT)			C	C					C	C	C		Completed
2.2 Manta Tow Monitoring at Pasoso & Tanjung Api			C							C		C	Completed
2.3 Survey New Sites		X		C	C		X			C		C	Completed – but with more sites and fewer permanent markers than original plan
2.4 Manta Tow Survey of the Bay of Palu		C	C	X					C	C			Completed
2.5 Community Manta Tow Surveys			?					?	C				Combined with 2.4
2.6 Networking	C	C	C	C	C	C	C	C	C	C	C	C	Ongoing at all times
3. Data Collection/Analysis & Reporting:													
3.1 Data collection (other than surveys above)		X	X	C	C		C	C	C	C	C	C	Much collected and much planned – ongoing
3.2 Data analysis		C	C	C	C	C	C	C	C	C	C	C	Ongoing task
3.3 Production of ITMEMS presentation	X			X	X	X							No presentation, but did participate
3.4 Production of final report												C	Month 11 = April 2003, final deadline for UNEP reporting
3.5 Production of specific reports			X		C	C	C		C	C	C	C	Reporting to UNEP completed, much reporting locally but still more in preparation
3.6 Establishment of internet site	X	X		C	C	C	C	C	C	C	C	P	Delayed but underway ongoing
3.7 Production of other data and information products, internet site maintenance etc	X	C	C	C	C	C	C	C	C	C	C	C	Ongoing task
3.8 Attending ITMEMS 2						X				C			Completed
4. Other major programme items:													
4.1 Pasoso DPL pilot project:	X	X	X	C	C		C	C	C	C	C	P	Postponed as funds delayed, now seriously underway
4.2 Other Community, DPL/MPA activities	X	X	X	C	C		C	C	C	C	C	C	Ongoing tasks

Overall, YACL feels that the 2002/2003 programme went well. Part of the delay was due to attending ITMEMS 2, and the International Marine Turtle Conference, both of which events have already had positive outcomes with respect to YACL's future programmes and effectiveness. The delay in receiving funding from all agencies also contributed. Indeed, the NOAA funding for 2002/2003 has still not arrived.

The good side to this is that YACL has negotiated increased time-scales, which means there is more time available with secured funding in which to work towards finding sources of funding for the future, i.e. to mid-2004.

As in 2002/2003, the main points of the YACL forward planning for 2003/2004 are: to continue training and general capacity building; to continue surveying, especially monitoring of previous sites; to apply the results of survey work in practical resource management activities; and to seek means of financing these and other related activities.

8.1 Commitment

As regards the likelihood for continuation of activities, YACL and the remaining core team members are fully committed to ongoing training and survey work. Those who were not committed or able to commit the necessary time have dropped out from the core survey team. However they have become associates and ambassadors who share our goals and ideals, and can help us in many ways. Monitoring and other activities will continue at surveyed sites. The core team has been enlarged and a long-term relationship with the committed members of the community group at Tawaeli has been established.

8.2 Financing

Ongoing grant funding for 18 months from The David & Lucille Packard Foundation, at a similar level to 2001/2002 and from NOAA International Coral Reef Conservation Fund for 12 months has been secured. While these two grants do not cover 100% of planned activities, they guarantee a measure of security including the continuation of most anticipated survey/monitoring activities until mid-2004.

Further joint activities with local government programmes are anticipated, and other funding applications have been and will continue to be made for specific purposes, such as our successful proposal to the BP Conservation Fund together with a group of local students for turtle conservation-related data collection at Pulau Pasoso MPA, one of the ongoing monitoring sites.

With now greatly increased capacity in both personnel and equipment, and increasing interest and attention from local government and other stakeholders, we feel YACL has the capacity to keep going and that there is a perceived need for the type of services that YACL can now offer. The third point – funding means – is becoming increasingly obvious as the major potential stumbling block to longevity of the programme. With this in mind, the team intends to focus a part of resources over the coming year into seeking various options to provide greater financial security.

8.3 Local Impact

The local interest is growing to the point where YACL is not able to take up all the offers of work – in some cases expenses at least would be paid, but in other cases YACL would need to find funding or assist in finding funding. The demand for training is also increasing – YACL's next training is already over-subscribed many times. There is scope to use increased team capacity both in terms of skills and numbers, as and when resources (trainer time as well as financial/logistical constraints) allow.

The "hard" science approach using internationally recognised methods is working in achieving professional respect from local and national government organisations and institutes of higher education, while the use of visual media has been extremely successful in getting the attention of local decision-makers. With other community members/stakeholders, the visual approach is definitely the most effective, but still has to be backed by credibility. YACL still needs to continue to work hard in improving outreach.

Greater emphasis will be placed on communicating our results both directly and electronically. In particular, the website is now being considered a priority task, a major seminar is scheduled for July/August focusing on Pulau Pasoso MPA, and a number of live presentations are planned for both communities and specific target groups, such as the local legislative assemblies.

YACL aims to become increasingly involved in practical measures aiming to combat destruction of coastal and marine resources. These are likely to include providing data for specific management purposes (survey/monitoring; EIA, a field in which several members have been professionally trained); poverty alleviation and alternate activities, including working directly with local communities; policy and local regulations, including pilot projects at Pulau Pasoso and Labuana; education and awareness, for decision makers (special presentations, direct communication), coastal communities (working on a variety of approaches) and children (possibly including school visits, curriculum, teacher training or other).

8.4 “Partnership” With (Local) Government

In addition to YACL's own programme, YACL's involvement in the MCRMP in Central Sulawesi, at provincial level and for the Regencies of Donggala and Poso (no third Regency was selected) has had good results from the survey/monitoring viewpoint as can be seen from the data collected to date.

Although the data collection and distribution aspirations seem to be going well, how far YACL will actually be able to influence the direction of coastal resource management is still unclear, especially as regards community involvement and contribution to an improvement in “good governance.” It is likely that YACL will be involved in facilitating the implementation of at least some of the follow-up actions to the recommendations made in the YACL report to MCRMP. However all aspects of the implementation will be put out to tender via competitive bidding, and YACL may or may not be successful in competing for the work.

The contacts made with the Marine and Fisheries Ministry and the Small Islands Dirigent are already proving most valuable. They have been reinforced during the recent conferences in Kuala Lumpur and Manila, and at other events. One outcome was the subsequent joint surveys with IPB and DPK as reported above.

9. ABBREVIATIONS

Abbreviation	Full Name (Details)
BKSDA	Balai Konservasi Sumberdaya Alam (Conservation Department)
COREMAP	Coral Reef Rehabilitation & Management Project
DKP	Dirigen Kelautan dan Perikanan (Marine & Fisheries Department)
GCRMN	Global Coral Reef Monitoring Network
LIPI	Lembaga Ilmu Pengetahuan Indonesia
MCRMP	Marine and Coastal Resources Management Programme
WRI	World Resources Institute
YPH	Yayasan Palu Hijau
ADB	Asian Development Bank

10. REFERENCES

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English S., C. Wilkinson & V. Baker (1997). Survey Manual for Tropical Marine Resources, 2nd Edition, Australian Institute of Marine Sciences, Townsville, Australia.

CRITC (2001). Manual – CRITC, PMO COREMAP, Jakarta, Indonesia.

Siahainenia A.J. (1998). Bahan Acuan Pelatihan Monitoring Terumbu Karang di Desa Tumbak, 24-29 Augustus 1998, Proyek Pesisir, Manado, Indonesia.

CDs:

ReefCheck headquarters, ReefCheck 2001 CD.

GCRMN, C-Nav CD.

11. ACKNOWLEDGEMENTS

YACL wishes to express heartfelt thanks to all who have contributed to the programme to date, in their various ways. In particular:

- To UNEP EAS/RCU for funding this programme and for providing support and advice since 2000.
- To our main overall programme sponsors The David & Lucille Packard Foundation (2001 to 2004) and NOAA International Coral Reef Conservation Program (2003/2004).
- To our co-workers on MCRMP and IPB/DKP related survey work.
- To all who helped and welcomed the YACL team in the field.
- To all who provided materials and advice, including COREMAP (especially Ir Muchsin and Ir Baharuddin), the ReefCheck Foundation, GCRMN, Peter Feedhan of Webinspired UK and others.
- To our survey team members and the Tawaeli community group, and the families of all involved, and all in Palu who provided practical back-up and moral support.

Laporan Kegiatan
Coral Reef Survey & Monitoring for Management in
Central Sulawesi, Indonesia

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1. PENDAHULUAN

Yayasan Adi Citra Lestari (YACL) telah melaksanakan program kelautan yang meliputi pelatihan, survai dan monitoring di Sulawesi Tengah yang pelaksanaannya antara bulan Juni 2002 sampai dengan bulan Mei 2003 yang dibantu oleh UNEP EAS/RCU¹. Tujuan dari program ini yaitu mendukung pengelolaan sumberdaya alam pesisir dan laut yang berkelanjutan terutama ekosistem terumbu karang. Program ini merupakan tindak lanjut dari program kelautan YACL yang dilaksanakan pada awal tahun 2000 dengan dukungan UNEP EAS/RCU serta kerjasama dengan program Reefs at Risk South East Asia (Terumbu Karang yang Terancam di Asia Tenggara) oleh WRI dan ICLARM. Kegiatan program kelautan YACL tahun 2001 hingga awal tahun 2004, selain mendapat dukungan dari UNEP EAS/RCU juga dari beberapa donator lainnya.

Pada tahun 2002 YACL dapat kesempatan melakukan kerjasama dengan Pemerintah Daerah Sulawesi Tengah dengan lokasi di Kabupaten Donggala dan di Kabupaten Poso di tingkat lokal yaitu MCRMP. Program MCRMP adalah sebuah program ICZM (Integrated Coastal Zone Management atau Pengelolaan Wilayah Pesisir secara Terpadu), yang pelaksanaannya untuk jangka waktu 5 tahun dan didanai oleh ADB, Pemerintahan pusat dan daerah (GOI). YACL juga bekerjasama dengan Dinas Perikanan dan Kelautan (DPK) dengan Institut Pertanian Bogor (IPB) dalam program penentuan kawasan konservasi laut khususnya di Suaka Marga Satwa Pulau Pasoso² dan Kepulauan Togean yang mana daerah tersebut dicalonkan sebagai Taman Wisata Laut.

YACL dalam meningkatkan kemampuan (Capacity Building) anggotanya, mengadakan kegiatan pelatihan dalam pengamatan terumbu karang dengan menggunakan metodologi-metodologi yang telah disahkan oleh GCRMN³. Metodologi yang diberikan ada tiga (3) yaitu pelatihan Manta Tow dengan anggota 9 orang baik anggota YACL maupun masyarakat Pesisir di Teluk Palu dan Ampana. Pelatihan ReefCheck anggotanya 6 orang dan pelatihan LIT anggotanya 6 orang. Untuk lebih jelasnya dapat lihat pada Lampiran A, B dan C.

Monitoring dilaksanakan pada 4 lokasi di dalam propinsi yang meliputi 4 lokasi survai ReefCheck (yang telah disertai dengan tanda-tanda transek permanen) dan 2 lokasi survai Manta Tow. Data awal diambil pada 17 Lokasi baru di dalam propinsi Sulawesi Tengah, 2 secara independen dibawah program dengan UNEP sendiri (ReefCheck, LIT dan Manta Tow), 3 Lokasi kerjasama dengan tim DPK/ IPB (LIT dan Manta Tow), serta 10 lokasi dalam rangka MCRMP (Manta Tow dan LIT). Data tambahan menggunakan metodologi LIT diambil pada semua (4) lokasi monitoring. Disamping pengambilan data diatas pada sebagian lokasi juga diambil data sosio-ekonomi (MCRMP) dan data kualitatif berupa indikasi keanekaragaman dengan menggunakan klasifikasi "life-form" serta dokumentasi berupa fotografi dan/atau video.

Hasil survai dan monitoring 2002/2003 mengkonfirmasi bahwa hasil survai-survai sebelumnya (2000 dan 2001/2002) menunjukkan bahwa kondisi terumbu karang pada sebagian besar lokasi survai di Sulawesi Tengah memprihatinkan. Secara umum hal ini perlu mendapat perhatian dan penanganan yang serius terhadap pelestarian sumberdaya alam laut yang berpotensi tersebut. Berdasarkan hasil survai tidak ada lokasi yang masuk dalam kategori "Sangat Baik" dan semua lokasi mengalami tekanan yang beragam oleh aktivitas manusia. Sistem pengelolaan yang selama ini dilakukan tidak mampu menghindari atau mengatasi ancaman-ancaman pengrusakan terumbu karang, malahan cenderung meningkat sehingga degradasi kondisi ekosistem terumbu karang juga bakal meningkat terus.

Berdasarkan penyebab dan tipe kerusakan tiap-tiap lokasi sangat berbeda. Hasil survai terumbu karang yang masih hidup belum kehilangan daya berkembang biak dan dapat pulih kembali secara alami, sehingga pengrusakan terumbu karang masih dapat dihentikan dan dapat dipulihkan kembali dengan langkah-langkah/upaya-upaya yang dilaksanakan secara realistis jika kemauan dan perhatian yang serius. Jumlah juvenil/bibit karang dan biota lain memberikan indikasi bahwa tanpa intervensi

¹ United Nations Environment Programme East Asian Seas Regional Coordinating Unit.

² SK Gubernur GKDH Tk I Sul-Teng No. 188/44/3932/dinhud/89.

³ Global Coral Reef Monitoring Network.

teknis baik individu maupun kelompok sebagian besar terumbu karang di Sulawesi Tengah masih dapat dikembalikan kepada keadaan yang semula (mendekati semula), yaitu mempunyai keanekaragaman yang sangat tinggi dengan ekosistem sangat indah dan mempunyai produktifitas yang tinggi jika ancaman/tekanan dapat diatasi sesegera mungkin. Berdasarkan data yang akurat tentang kondisi setempat, program pelestarian dapat disesuaikan dengan kebutuhan riil di lapangan dan menjadi tepat sasaran. Dengan demikian sumberdaya khusus pelestarian SDA, yang sangat terbatas dieksploitasi sesuai dengan kebutuhan maka akan terpakai secara efisien dan efektif.

Sayangnya semua masyarakat mengira bahwa terumbu karang yang sekarang sudah tinggi tingkat kerusakannya dimana pemulihan alami (tanpa intervensi teknis) tidak dapat dilakukan lagi. Jika tidak ada perubahan besar dalam perilaku dan aktivitas manusia maka berdampak pada terumbu karang dan ekosistem-ekosistem lainnya. Diperkirakan bahwa luas areal terumbu karang yang masuk dalam kategori Rusak, Rusak Berat atau bahkan berubah total menjadi ekosistem lain bakal meningkat terus pada tahun-tahun mendatang.

Dalam situasi ini, tindakan pelestarian sangat dibutuhkan segera mungkin dan juga diharapkan pengertian dan perhatian oleh pihak-pihak pengambil keputusan dan masyarakat luas dalam proses pembangunan baik secara langsung ataupun tidak langsung dapat mempengaruhi ancaman-ancaman yang telah teridentifikasi. Dengan menggunakan pendekatan siens, YACL bertujuan memberikan informasi dan perhatian terhadap pengambil keputusan baik tingkat daerah maupun ditingkat pusat juga mengharap bahwa data kongrit di lapangan dapat dijadikan sebagai acuan dalam rangka pengelolaan sumberdaya alam pesisir dan laut di Propinsi Sulawesi Tengah.

Data yang telah diperoleh digunakan dalam penilaian potensi kawasan konservasi. Penyusunan "Project Pasoso" adalah sebuah program pelestarian penyu hijau serta habitatnya (di SMS Pulau Pasoso dan sekitarnya), yang masuk dalam perencanaan dan penyusunan program lanjutan MCRMP, pembukaan lokasi ekowisata baru dan beberapa inisiatif/program lainnya. YACL juga berpartisipasi dalam acara pameran yang diselenggarakan oleh satu Universitas lokal "Fisheries Expo 2003", hal ini sangat positif dalam rangka sosialisasi terhadap berbagai lapisan dan YACL mempersiapkan peluang-peluang dan metode-metode sosialisasi yang tepat sasaran.

Salah satu isu yang menjadi bahan diskusi pada ITMEMS⁴ adalah penegakan hukum yang kurang efektif (law enforcement). Hukum negara Indonesia, seperti kebanyakan negara lainnya sangat mendukung pelestarian dan pemanfaatan berkelanjutan sumberdaya alam, namun prinsip-prinsip hukum tersebut belum dilaksanakan secara menyeluruh. Pada umumnya masyarakat siap mendukung⁵ aturan-aturan yang bertujuan untuk menjaga ketersediaan SDA yang ada sekarang dan di masa akan datang. Penegakan hukum harus jelas, tepat/efektif, realistis dan diterapkan secara *adil*. Maka dari itu perlu kesadaran baik masyarakat maupun ditingkat pengambil kebijakan harus mempunyai kesadaran dan didukung oleh tindakan nyata.

2. PELATIHAN

Pada awal tahun 2001/2002, program YACL dititikberatkan pada kegiatan pelatihan guna pembentukan keterampilan SDM lokal khususnya dibidang Survei dan monitoring terumbu karang dan di bidang kelautan secara lebih luas. Tim yang telah terlatih pada tahun 2001/2002 merupakan tulang punggung dalam pelaksanaan program survei dan monitoring terumbu karang pada tahun 2002/2003. Meskipun pelatihan tidak menjadi fokus utama dalam program tahun 2002/2003, pelatihan dan pemberdayaan SDM merupakan komponen sangat penting dalam menunjang kegiatan survei dan monitoring. Peningkatan SDM baik internal (di dalam lembaga YACL sendiri) maupun eksternal adalah satu prinsip dasar dalam Visi/Misi YACL. Penyusunan program pelatihan/pendidikan pada tahun 2002/2004 meliputi pelatihan teknis seperti SCUBA, beberapa metodologi Survei, pengelolaan/analisis data, penggunaan sistem GIS serta pelatihan lainnya yang berguna untuk penguatan lembaga seperti bahasa Inggris dan manajemen keuangan. Aktivitas pelatihan yang telah tercapai dalam rangka program tahun 2002/2003 tercantum dalam Tabel 2.1.

⁴ International Tropical Marine Ecosystems Management Symposium, Manilla, 23-27 Maret 2003.

⁵ Berdasarkan hasil survei KAP (Knowledge Attitude & Practice) oleh YACL 2002.

Tabel 2.1 Pelatihan Tahun Juni 2002 s/d Mei 2003

Jenis Pelatihan	Bulan/Tahun	Lokasi	Jumlah Peserta	Hasil
Penyempurnaan ReefCheck	Juli/Ags 2002	Palu	6	Semua peserta siap melaksanakan survai ReefCheck
Manta Tow	Sept/Okt 2002	Teluk Palu Pasoso	6 (internal & masyarakat)	4 siap survai 2 siap mengambil data GPS dan mendampingi pengamat 4 siap mengemudi perahu khusus pendataan
Revisi Manta Tow	Mei 2003	Ampana	3 (masyarakat lokal)	2 siap survai 2 siap mengambil data GPS 1 siap mendampingi pengamat
LIT	Maret 2003	Teluk Palu	6	5 siap survai 1 membutuhkan pelatihan/pengalaman lanjutan

Pada akhir bulan Mei 2003, jumlah tenaga terampil dalam tim YACL serta jumlah anggota masyarakat dampingan yang terlatih tercantum dalam Tabel 2.2. Ada juga beberapa orang yang memiliki keterampilan dalam pengambilan data lebih dari satu yang masuk dalam tabel lain dan instruktur tidak dihitung pada tabel tersebut.

Tabel 2.2 Jumlah Tenaga Terlatih YACL Sampai Dengan 15 Maret 2003

Ketrampilan	Manta Tow	ReefCheck	LIT	SCUBA	GPS
Terlatih dan Aktif	4	6	5	7	3
Aktif tetapi masih dalam tahap pelatihan	4	1	1	0	3
Terlatih tetapi sering tidak sempat mengikuti aktivitas	3	3	0	3	4
Terlatih tetapi tidak lagi aktif (total/sementara)	0	0	0	2	1
Total	11	10	6	14	11

3. MONITORING

(a) Kegiatan dan Lokasi Monitoring

Dalam kegiatan program tahun 2002/2003, YACL melakukan monitoring di 4 lokasi. Untuk lebih jelasnya baik jumlah transek, metodologi-metodologi serta survai/monitoring sebelumnya tercantum Tabel 3.1. Khusus survai ReefCheck, setiap transek meliputi garis-garis transek pada dua kedalaman, yaitu 3 m serta 10 m.

Tabel 3.1 Kegiatan Monitoring

Lokasi & Tanggal	Manta Tow 2001/2002	Manta Tow 2002/2003	Transek ReefCheck	Keterangan
Kadongo, Tawaeli Agustus 2002	Tidak	Ya	1	• Empat tanda permanen hilang (telah terpasang ulang) • Manta Tow dalam rangka Survai Teluk Palu
Talise, Tawaeli Agustus 2002	Tidak	Ya	1	• Dua tanda permanen hilang (telah terpasang ulang) • Manta Tow dalam rangka Survai Teluk Palu
Pulau Pasoso September 2002	Ya	Ya (Tidak 100%)	Ya	• Semua tanda permanen tetap pada posisinya • Survai Manta Tow tahun 2000 • Program efektif DPL telah mulai
Labuana September 2002	Tidak	Tidak	3	• Semua tanda permanen tetap pada posisinya • Program pelestarian berbasis masyarakat dalam tahap perencanaan
Cagar Alam Tanjung Api Mei 2003	Ya	Ya (Tidak 100%)	Ya (Transek 2 hanya 50 m @ 10 m	• Sebagian tanda permanen pecah oleh aktivitas pengeboman • Survai Manta Tow tahun 2000 • Partisipasi masyarakat lokal dalam Manta Tow

Data lengkap dalam bentuk tabulasi, data GPS dalam format Garmin Worldmap, dokumentasi berupa foto-foto dan video serta sebagian materi pelatihan dalam Bahasa Indonesia tersedia di Lampiran berupa CD. Tidak ada hasil fotografi di bawah laut khusus Tanjung Api karena kamera bawah laut telah rusak (kemasukan air) pada saat kegiatan Survai di Kepulauan Togean bersama dengan peneliti dari IPB. Selain laporan yang berbahasa Inggris juga tersedia laporan dalam Bahasa Indonesia telah diterbitkan dan persiapan laporan lain dalam rangka membantu Pemerintah Daerah, Mitra Kerja dan pihak lain yang berkepentingan dengan pengelolaan sumberdaya alam pesisir dan laut. Bentuk laporan tersebut berupa materi cetak serta audiovisual dalam bentuk video ataupun Presentasi dalam program Powerpoint. Selain itu juga menyediakan website YACL⁶ bersama data dan informasi lainnya.

Sejak survai awal pada tahun 2000/2002 jumlah hasil tangkapan nelayan secara umum cenderung menurun. Harga kebutuhan bahan pokok seperti bahan bakar dan konsumsi terus meningkat sedangkan hasil penjualan ikan umumnya stabil ataupun menurun, maka hal seperti itu yang mendorong peningkatan perilaku tidak berwawasan lingkungan baik di darat maupun di laut yang dilakukan oleh masyarakat yang ada di wilayah setempat maupun dari luar wilayah.

Pada tahun 2002 terjadi musim kemarau panjang kurang lebih selama 5 bulan. sebelum kegiatan monitoring di Tawaeli, Pasoso dan Labuana. Akibatnya untuk memenuhi kebutuhan sehari-hari masyarakat pesisir di Pantai Barat yang pada umumnya sebagai petani dan nelayan, aktifitas berkonsentrasi pada penangkapan biota laut dari pada bertani. Akibat musim kering tersebut tingkat sedimentasi semakin berkurang sehingga kecerahan air meningkat baik di Teluk Palu maupun di Pantai Barat karena tidak ada sedimentasi yang masuk ke laut.

Selain itu dampak musim kemarau tersebut sangat mempengaruhi sosial-ekonomi masyarakat di wilayah sekitar Cagar Alam Tanjung Api. Pembukaan lahan dilakukan secara besar-besaran baik di sekitar kawasan Cagar Alam itu sendiri maupun disekitar kawasan hutan sepanjang jalan Poso dengan Ampana. Pembabatan hutan dilakukan oleh masyarakat pendatang atau pengungsi yang tidak memiliki lahan tetapi ada juga masyarakat hanya sebagai pekerja saja untuk membabat hutan sedangkan pemiliknya tidak berada ditempat. Tetapi menurut beberapa informasi yang didapat dari sejumlah tokoh-

⁶ <http://www.yacl-sulawesi.org>.

tokoh masyarakat setempat mengatakan bahwa cerita tentang pengungsi hanya kamufase saja untuk menutupi kepentingan oknum-oknum tertentu yang mengambil kesempatan untuk menguasai lahan dengan cara pembabatan hutan. Menurut informasi masyarakat nelayan dan penduduk pesisir lainnya bahwa aktifitas pengeboman dan pembiusan juga meningkat baik di dalam maupun di luar kawasan Cagar Alam. Hal ini sangat merugikan nelayan tradisional karena hasil tangkapan mereka sangat menurun drastis dan kecenderungan menurun terus. Pada tahun 2002, nelayan yang menggunakan bom memakai jenis bom dengan teknologi lebih tinggi, yang dipasang kemudian diledak dari jarak jauh. Sehingga sulit untuk mendeteksi pelaku bom tersebut dan tingkat kerusakan sangat tinggi dibandingkan dengan menggunakan bom dengan botol yang biasa digunakan. Lebar lubang-lubang (*craters*) yang teramati oleh tim monitoring sampai 10-30 meter, "ukuran rumah", pada sebagian titik telah mengakibatkan tebing karang patah dan terjadi longsor, yang tersisa hanya kerakal dan pasir. Pada satu lokasi tanda permanen pun ikut hancur dan tertimbun akibat pengeboman tersebut.

Pelaksanaan monitoring di kawasan Cagar Alam Tanjung Api dilakukan setelah musim kemarau panjang. Pada saat kegiatan monitoring pembukaan lahan di Cagar Alam sudah semakin luas melebihi areal yang telah dibabat sebelum/pada saat survai tahun 2001/2002, dan masih ada kegiatan pembukaan lahan yang sedang berlangsung. Bunyi Chainsaw masih terdengar serta asap dari pembakaran kelihatan setiap harinya. Kelihatannya pihak pemerintah tidak mampu atau tidak punya "*political will*" untuk menghentikan aktivitas pembabatan hutan secara ilegal tersebut yang dilaksanakan secara terbuka di depan mata umum. Setelah YACL memberikan laporan serta LSM dan pihak-pihak lain yang peduli, memberikan laporan tentang pelanggaran tersebut kepada Pemerintah Daerah dan pihak yang berkait untuk menindak terhadap pelaku pengrusakan hutan. Sampai sekarang tidak ada tindakan untuk menghentikan pembukaan lahan atau pun tindakan hukum terhadap pelaku-pelaku pengrusakan hutan.

Salah satu akibat pembabatan hutan di kawasan Cagar Alam yang sangat menonjol yaitu tingkat erosi yang tinggi, Tanah yang kelihatan subur tahun sebelumnya (2001/2002) telah tipis, tanah dan batu-batuan juga terbawa oleh aliran sungai ke laut. Pada monitoring 2002/2003, kualitas air menurun secara drastis dibanding dengan tahun 2000, dimana pada musim hujan kecerahan masih tinggi dengan jarak penglihatan dibawah air antara sampai 15-30 meter tetapi pada monitoring tahun 2002/2003, jarak penglihatan 5 m dibawah air yang berada di depan lokasi pembabatan hutan dan penuh dengan mikro-organisme yang mengakibatkan penyakit kulit dengan gejala gatal serta benjolan sehingga sebagian tim memerlukan perawatan medis khusus. Pada kawasan perairan Cagar Alam lainnya kecerahan air masih tinggi dan tidak ada kelimpahan organisme penyebab gatal-gatal.

Pada umumnya, di semua wilayah survai, belum ada Penegakan Hukum yang efektif tentang pengelolaan atau pemanfaatan sumberdaya alam, baik laut maupun darat. Hal ini disebabkan oleh kurangnya perhatian personil penegak hukum maupun sarana dan prasarana tetapi juga adanya keterlibatan oknum-oknum yang mempunyai kepentingan serta kekurangan kesadaran dan pengetahuan baik di kalangan masyarakat maupun di pihak pemerintah lokal ataupun aparat penegak hukum.

(b) Data Penutupan Dasar Laut (Substrat)

Data monitoring hasil Manta Tow dan ReefCheck serta perbandingan dengan data Survai sebelumnya memberikan gambaran tentang perkembangan kondisi terumbu karang di Sulawesi Tengah yang sangat mengkhawatirkan. Tabel 3.2 mendefinisikan Kategori-kategori Kondisi yang digunakan dalam rangka survai serta analisa data.

**Tabel 3.2. Kategori-Kategori Kondisi Terumbu Karang.
Kode Kategori**

Koda Kategori	1	2	3	4	5
Persentase Penutupan	<10%	11-30%	31-50%	51-75%	76-100%
Deskripsi	Rusak Berat Very Poor	Rusak Poor	Sedang Average	Baik Good	Sangat Baik Very Good

(i) *Survai/monitoring Manta Tow*

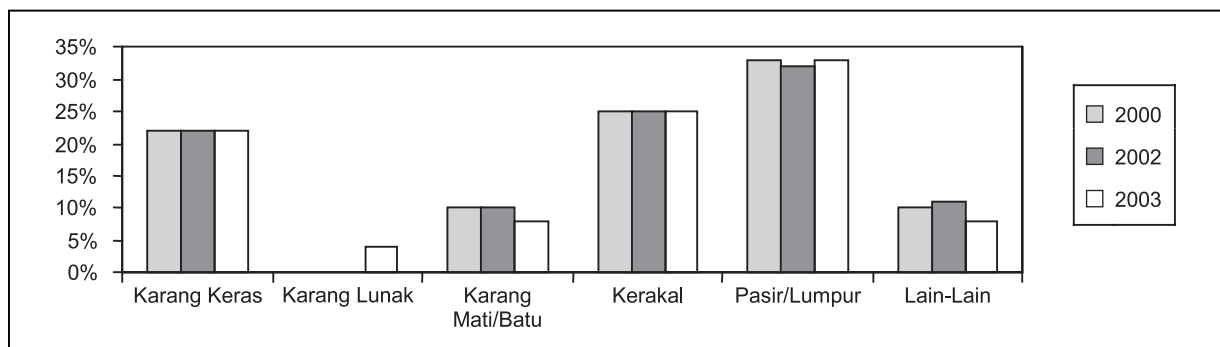
Monitoring Manta Tow telah dilaksanakan sejak tahun 2000 pada dua lokasi, yaitu di kawasan Cagar Alam Tanjung Api di Kabupaten Poso dan Suaka Marga Satwa Pulau Pasoso di Kabupaten Donggala. Baik di Cagar Alam Tanjung Api maupun di Suaka Marga Satwa (SMS) di Pulau Pasoso terjadi perubahan antara kategori-kategori penutupan karang keras relatif kecil, yaitu mayoritas dalam Kategori Rusak dan Sedang. Meskipun kecil, kehilangan sisa wilayah dalam kategori Sangat Baik di Tanjung Api dinilai sebagai sesuatu yang signifikan. Perubahan tersebut searah dengan persepsi subjektif oleh pengamat-pengamat bahwa terjadinya penurunan kondisi secara luas di wilayah Cagar Alam Tanjung Api. Di SMS Pulau Pasoso indikasi-indikasi mendukung hipotesis adanya variasi dengan musim, tetapi untuk dibuktikan benar atau salah masih diperlukan monitoring lanjutan (jangka panjang). Data dapat dilihat pada Tabel dan Gambar 3.3.a sampai 3.3.d sebagai berikut.

- **Manta Tow di CA Tanjung Api**

Tabel 3.3.a Perubahan Komposisi Substrat di CA Tanjung Api

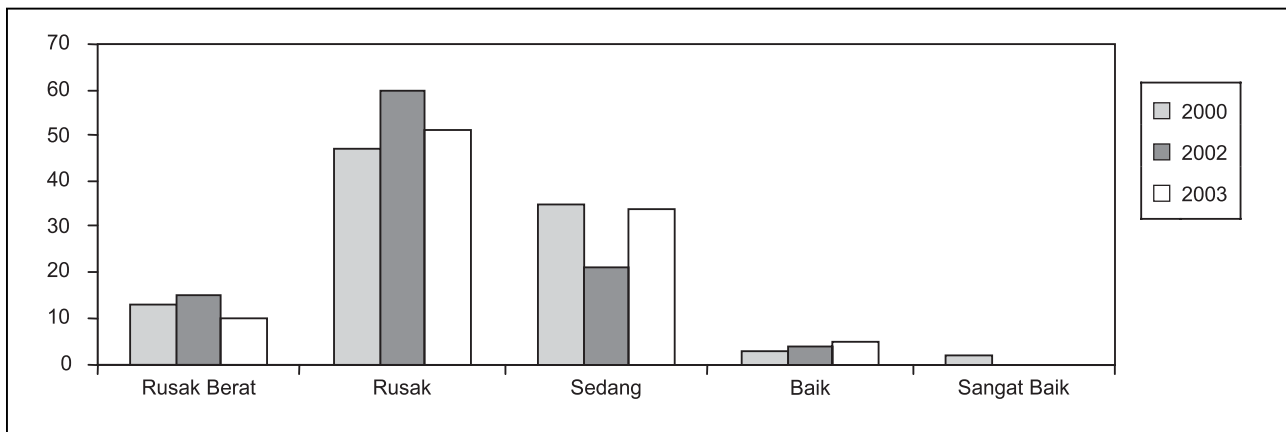
(Persen)

Kategori	Tj Api 2000	Tj Api 2002	Tj Api 2003	Rata-rata	Variance
Karang keras	22	22	22	22	0
Karang lunak	0	0	4	1	3
Karang Mati/Batu	10	10	8	9	2
Kerakal	25	25	25	25	0
Pasir/Lumpur	33	32	33	33	1
Lain-lain	10	11	8	10	2

Gambar 3.3.a Perubahan Komposisi Substrat di CA Tanjung Api

Tabel 3.3.b Manta Tow: Perubahan Kondisi Terumbu Karang di CA Tanjung Api (%)

Kondisi Terumbu Karang	T Api 2000	T Api 2002	Perubahan 2000-2002	T Api 2003	Perubahan 2002-2003	Perubahan 2000-2003
1 Rusak Berat	13	15	+2	10	-5	-3
2 Rusak	47	60	+13	51	-9	4
3 Sedang	35	21	-14	34	13	-1
4 Baik	3	4	+1	5	1	2
5 Sangat Baik	2	0	-2	0	0	-2

Gambar 3.3.b Perubahan Kondisi Terumbu Karang di CA Tanjung Api (%)

Gambar 3.3.a. dan 3.3.b. memperlihatkan secara jelas bahwa penutupan dasar laut (substrat) didominasi oleh Karang Mati dan Kerakal serta kondisi yang dominan adalah Rusak.

Perubahan yang paling menonjol secara visual pada saat pengamatan adalah peningkatan dalam jumlah ukuran dan tingkat kerusakan bekas-bekas pengeboman. Daya tarik wilayah antara Transek 2 dan Transek 3 yang sebelumnya merupakan lokasi terindah sekarang sangat menurun dengan adanya beberapa tebing karang yang hancur akibat pengeboman. Lokasi sekitar Transect 3 sudah sangat rusak oleh aktivitas pengeboman berdasarkan pada survai tahun 2002. Tetapi pada monitoring 2003 dikatakan oleh satu pengamat "telah menjadi lapangan bola" atau termasuk dalam kategori rusak berat.

Meskipun penutupannya masih rendah, jenis substrat Karang Lunak tidak teramati sama sekali pada Survei-Survei tahun 2000 serta 2002, sehingga adanya penutupan oleh jenis substrat tersebut tahun 2003 merupakan suatu perubahan yang signifikan. Penutupan oleh Karang Lunak berupa sejumlah kecil koloni yang masing-masing menutupi areal yang cukup luas, bukan penyebaran secara umum.

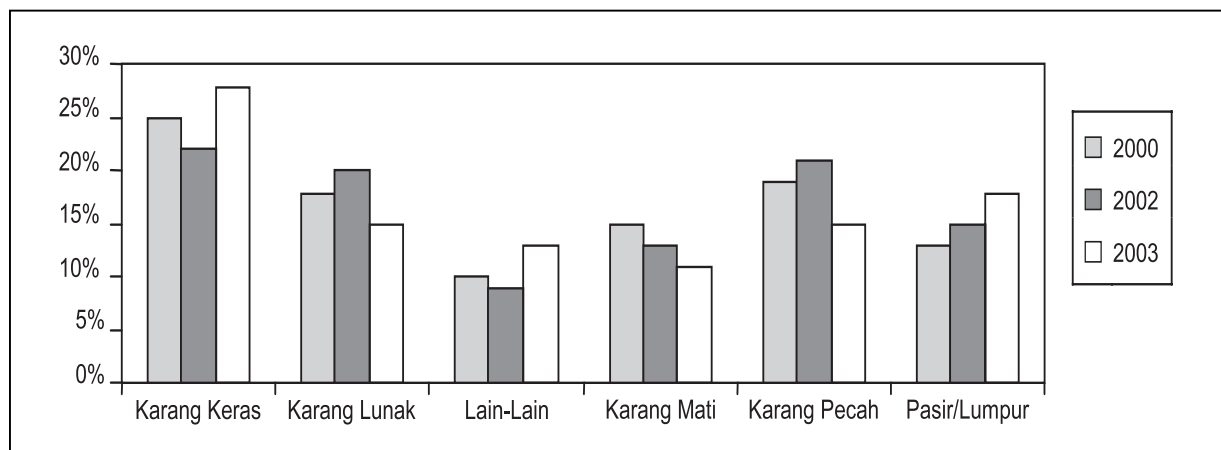
- **Manta Tow di SMS Pulau Pasoso**

Tabel 3.3.c Perubahan Komposisi Substrat di Pulau Pasoso

(Persentase)

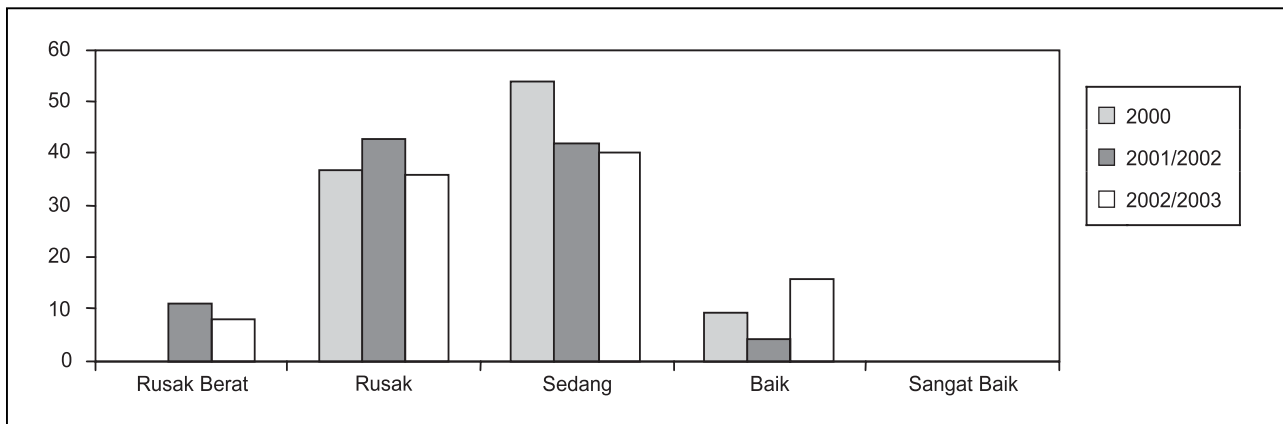
Jenis Substrat	Pasoso 2000	Pasoso 2001/2002	Pasoso 2002/2003	Rata-rata	Variance
Karang keras	25	22	28	25	0-3
Karang lunak	18	20	15	18	0-3
Karang Mati/Batu	15	13	11	13	0-2
Kerakal	19	21	15	18	1-3
Pasir/Lumpur	13	15	18	15	0-3
Lain-lain	10	9	13	11	1-3

Gambar 3.3.c Perubahan Penutupan Dasar di Pulau Pasoso



Tabel 3.3.d Perubahan Kondisi Terumbu Karang di Pulau Pasoso (%)

Kondisi Terumbu Karang	Pasoso 2000	Pasoso 2001/2002	Perubahan 2000 – 2001/2002	Pasoso 2002/2003	Perubahan 2001/2002 – 2002/2003	Perubahan 2000 – 2002/2003
1 Rusak Berat	0	11	+11	8	-3	+8
2 Rusak	37	43	+6	36	-7	-1
3 Sedang	54	42	-12	40	-2	-14
4 Baik	9	4	-5	16	+12	+7
5 Sangat Baik	0	0	0	0	0	0

Gambar 3.3.d Perubahan Kondisi Terumbu Karang di Pulau Pasoso

Gambar 3.3.c dan 3.3.d memberikan indikasi bahwa kondisi rata-rata sedikit membaik antara tahun 2001/2002 dan tahun 2002/2003 meskipun dibanding dengan hasil survai tahun 2000 persentase Rusak Berat mengalami peningkatan dan persentase dalam kondisi Sedang terjadi penurunan. Faktor-faktor lain yang perlu diperhitungkan termasuk ketidaklengkapan survai tahun 2000 serta tahun 2002/2003. Perubahan-perubahan akibat musim akan berubah apabila dalam pengamatan dilakukan oleh orang yang berbeda maka data yang dihasilkan akan bias karena penilaiannya tidak sama. Diharapkan bahwa monitoring jangka panjang akan memberikan jawaban tentang “trend” atau arah perubahan yang lebih jelas. Peningkatan penutupan karang keras dan persentase dalam kategori “Baik” diduga akibat peningkatan kesadaran dan tindakan pengawasan oleh penduduk Pulau Pasoso terutama Pak Achmad yang sering disebutkan sebagai “Penjaga Pulau” oleh masyarakat sekitarnya.

Berdasarkan pengamatan, kerusakan baru akibat pengeboman dan pembiusan masih tetap terjadi pada nelayan tradisional, sedangkan kerusakan oleh jangkar-jangkar perahu-perahu yang berlabuh baik untuk perlindungan dari cuaca maupun untuk kegiatan penangkapan ikan memberikan dampak kerusakan yang sangat nyata. Pemindahan pasir berskala besar dengan cuaca dan musim merupakan hal yang teramati pada setiap kunjungan ke Pulau Pasoso baik dalam rangka survai/monitoring terumbu karang maupun khusus kegiatan lainnya.

(ii) *Survai/Monitoring ReefCheck (Substrat)*

Kegiatan Survai dan monitoring ReefCheck dilakukan pada 4 wilayah yaitu Kadongo/Talise (Kec. Tawaeli) di Kotamadya Palu, Labuana (Kec. Sirenja) serta Pulau Pasoso (Kec. Balaesang di Kabupaten Donggala dan Tanjung Api (Kec. Ampana Kota/Ampana Tete) di Kabupaten Poso. Survai pertama (base line survey) dilaksanakan pada tahun 2001/2002, dengan pemasangan tanda-tanda transek permanen pada semua lokasi. Monitoring berikutnya dilaksanakan pada tahun 2002/2003. Salah satu komponen dalam kegiatan survai ReefCheck adalah survai penutupan dasar atau substrat. Hasil tercantum dalam Tabel-tabel serta Gambar-gambar berikut.

- **ReefCheck Tawaeli**

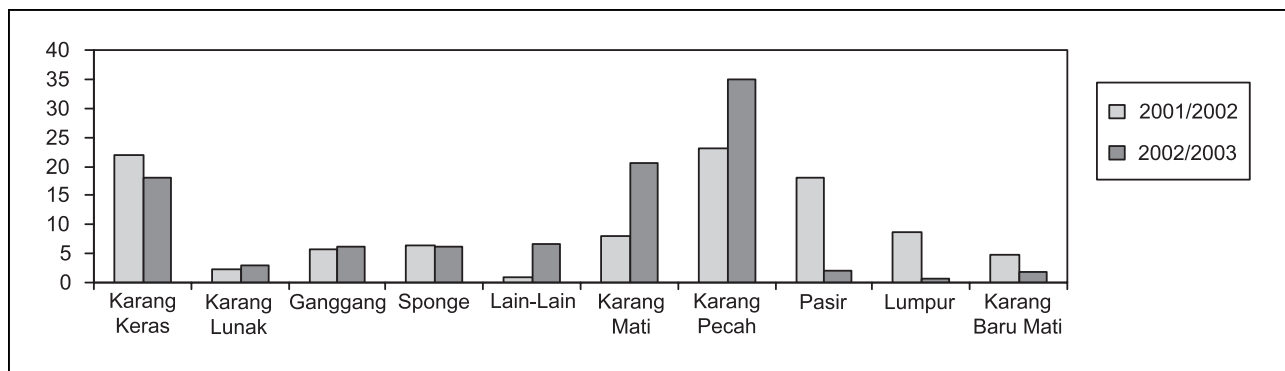
Tawaeli terpilih sebagai salah satu lokasi survai/monitoring karena merupakan tempat pelatihan bagi tim survai YACL. Dua transek permanen terletak masing-masing di Kadongo, dimana pada tahun 2001 terjadi berlimpahan hama karang lipan laut *Acanthaster plancii* yang mengakibatkan kematian karang keras skala besar dalam jangka waktu berapa minggu. Saat pelatihan dan survai pertama di Kadongo serta di Talise sampai monitoring terakhir belum ada penyerangan lipan laut. Pencurian tali transek pernah terjadi lebih daripada satu kali meskipun adanya sosialisasi sehingga tali selalu perlu diawasi dan tidak dapat di tinggalkan. Umumnya partisipasi masyarakat baik dan 4 pemuda lokal telah menjadi anggota tim survai YACL.

Tabel 3.4.a ReefCheck: Komposisi Substrat di Tawaeli

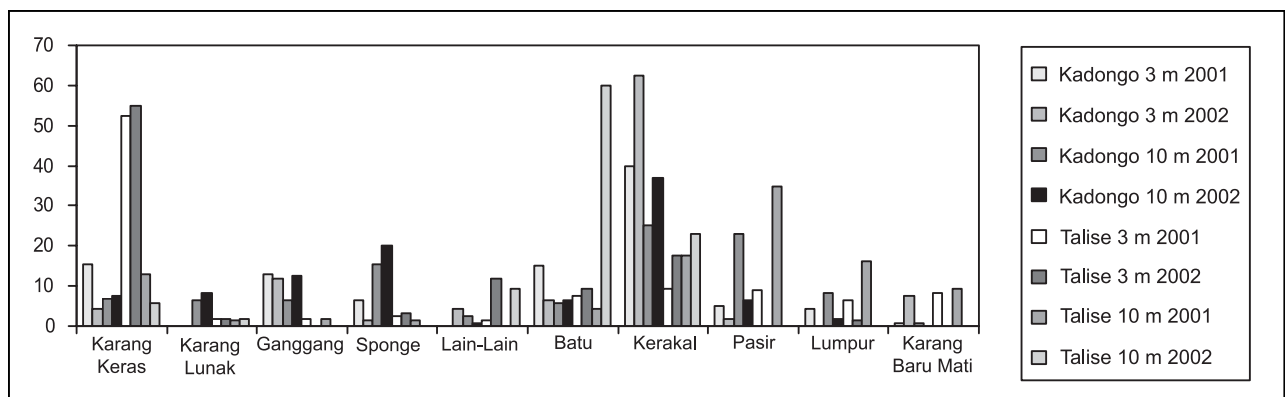
2001/02	Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
	Kadongo	3 m	15.6	0.0	13.1	6.3	0.0	15.0	40.0	5.0	4.4	0.6
	Kadongo	10 m	6.9	6.3	6.3	15.6	2.5	5.6	25.0	23.1	8.1	0.6
	Talise	3 m	52.5	1.9	1.9	2.5	1.3	7.5	9.4	8.8	6.3	8.1
	Talise	10 m	13.1	1.3	1.9	1.3	0.0	4.4	17.5	35.0	16.3	9.4
	Rata-rata Tawaeli		22.0	2.3	5.8	6.4	0.9	8.1	23.0	18.0	8.8	4.7
2002/03	Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
	Kadongo	3 m	4.4	0.0	11.9	1.3	4.4	6.3	62.5	1.9	0.0	7.5
	Kadongo	10 m	7.5	8.1	12.5	20.0	0.6	6.3	36.9	6.3	1.9	0.0
	Talise	3 m	55.0	1.9	0.0	3.1	11.9	9.4	17.5	0.0	1.3	0.0
	Talise	10 m	5.6	1.9	0.0	0.0	9.4	60.0	23.1	0.0	0.0	0.0
	Rata-rata Tawaeli		18.1	3.0	6.1	6.1	6.6	20.5	35.0	2.0	0.8	1.9
	Perubahan		-3.9	+0.7	+0.3	-0.3	+5.7	+12.4	+12.0	-16.0	-8.0	-2.8

Gambar 3.4.a. ReefCheck – Komposisi dan Perubahan Substrat di Tawaeli

1. Secara Keseluruhan (Rata-rata)



2. Per Lokasi/Kedalaman



Dari hasil ReefCheck penurunan penutupan oleh pasir dan lumpur akibat perubahan musim sangat nyata, terutama pada kedalaman 10 m di Talise. Penurunan karang keras di kedalaman 10 m di Talise diduga terutama sebagai akibat pembuangan jankar. Meskipun jumlah lipan laut sudah menurun pada tingkat “normal”, kematian karang keras pada kedalaman 3 m di Kadongo masih berlangsung dengan tingkat karang baru mati hampir seimbang dengan penurunan karang keras. Peningkatan kerakal di kedalaman 10 m di Kadongo diduga akibat pindahan pecahan bekas pemangsaan lipan laut, sedangkan peningkatan di 3 m disebabkan oleh pecahan karang mati tersebut baik oleh faktor alam maupun oleh aktivitas penangkapan ikan termasuk pemasangan bubu, pembuangan jangkar dsb.

Penyebab penurunan penutupan pasir di Talise selain kekurangan sedimentasi termasuk pemindahan pecahan karang, serta tumbuhan alga pada musim panas/kering yang menutupi pasir yang tetap berada dibawah penutupan tersebut.

- **ReefCheck Pasoso**

Pulau Pasoso terpilih sebagai lokasi monitoring dengan pemasangan transek permanen karena Suaka Marga Satwa (SMS) tersebut telah disurvei pada tahun 2000 dengan metode Manta Tow, sehingga keindahan terumbu karangnya serta kekurangan dalam pengawasan DLP (Daerah Perlindungan Laut) tersebut teramati oleh YACL. YACL bekerjasama dengan Pemerintah daerah, melakukan beberapa aktivitas pendataan lainnya yang bertujuan mendukung pengelolaan yang berkelanjutan di SMS Pulau Pasoso.

Transek permanen berjumlah 4, satu pada setiap bagian Pulau dimana kondisi-kondisi alam dan tekanan oleh aktivitas manusia berbeda, sehingga diharapkan 4 transek tersebut dapat mewakili kondisi terumbu karang “Fringing Reef” yang berada sekeliling Pulau Pasoso. Transek 1 dan 2 terletak di bagian Timur/Selatan dan Selatan, di depan pantai-pantai bertelur penyu hijau, *Chelonia mydas*, satwa yang dilindungi yang merupakan satu alasan penting untuk pembentukan SMS tersebut, serta keduanya digunakan sebagai tempat berlabuh kapal (tergantung dari arah angin).

Transek 3 di bagian Barat dan Transek 4 di bagian Utara Barat merupakan lokasi penangkapan ikan serta biota laut lainnya, tetapi perahu-perahu kecenderungan kurang berlabuh disana. Pada survei tahun 2000, wilayah sekitar Transek 3 kelihatan sangat rusak terutama oleh berbagai metode “destructive fishing”, tetapi sebagian besar pecahan telah ditutupi oleh karang lunak. Transek 4 tidak jauh dari ujung Utara, dimana tingkat kerusakan alami terumbu karang oleh cuaca cukup tinggi. Mungkin ini penyebab tingkat kerusakan berkurang, karena telah terlindung dari kerusakan akibat ombak tetapi karena masih dekat zona pecahan ombak. Hal ini mungkin dirasakan tidak terlalu nyaman oleh nelayan yang berkunjung ke Pulau Pasoso.

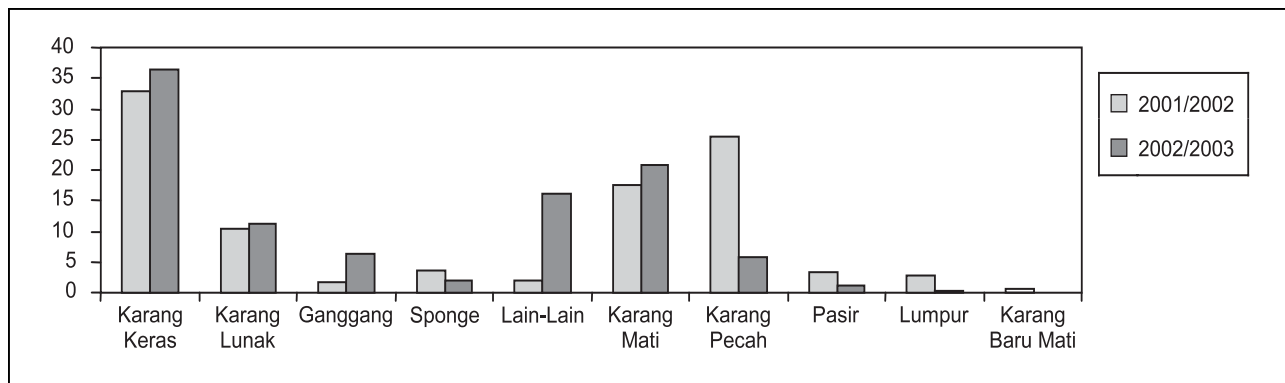
Berbeda dengan hasil Manta Tow dengan monitoring ReefCheck menunjukkan penurunan penutupan pasir/lumpur di Pulau Pasoso yang berbeda. Ini disebabkan oleh pindahan pasir yang kebutuhan memindahkan pasir dari lokasi transek permanen kepada lokasi-lokasi yang lain, dan tidak merupakan indikasi penurunan pasir akibat penambangan atau intervensi manusia lainnya ataupun kurang ketersediaannya pasir akibat perubahan besar dalam ekosistem.

Peningkatan penutupan Ganggang (FS), Karang Lunak (SC), Sponge (SP) serta biota lainnya (OT) menyebabkan penurunan kategori Kerakal (RB). Hal tersebut merupakan indikator bahwa pemulihan secara alami dalam satu ekosistem telah mulai dan tingkat kerusakan baru rendah kecuali pada lokasi pembuangan jankar seperti yang terjadi transek 2 di kedalaman 10 m, dan masih ada peningkatan meskipun kecil dalam penutupan oleh Karang Keras (HC). Namun perlu memonitoring terus karena jika peningkatan alga terjadi secara berlebihan, hal tersebut mungkin merupakan indikator terjadinya nutrifikasi. Penutupan lain-lain (OT) seperti lamun yang secara alami meningkat karena lokasi perairan tenang tetapi apabila terjadi ombak yang besar maka lamun akan hilang terbawa oleh arus.

Peningkatan penutupan karang mati (RC) diduga akibat pemindahan pasir/lumpur (SD/SI) yang sebelumnya menutupi karang mati/batu tersebut. Tingkat penutupan oleh karang baru mati (RKC) menurun menjadi nol pada lokasi transek-transek, namun disekitarnya masih terdapat karang baru mati serta sejumlah ekor lipan laut *Acanthaster planci* serta bekas-bekas pemangsanya. Sesuatu yang perlu diperhatikan pada monitoring/kunjungan akan datang untuk mengantisipasi kerusakan skala besar, meskipun saat itu jumlah lipan laut masih dalam batas “normal” dan belum merupakan berlimpahan yang mengkhawatirkan.

Tabel 3.4.b ReefCheck: Komposisi Substrat di Pasoso

2001/02	Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
	Pasoso 1	3 m	20.6	2.5	0.0	0.6	0.0	27.5	34.4	3.8	10.6	0.0
	Pasoso 1	10 m	26.3	0.6	2.5	1.9	0.6	23.1	36.9	0.0	8.1	0.0
	Pasoso 2	3 m	47.5	3.1	0.6	0.6	2.5	11.9	28.8	1.9	0.0	3.1
	Pasoso 2	10 m	42.5	0.0	1.3	5.6	2.5	13.1	29.4	2.5	2.5	0.6
	Pasoso 3	3 m	27.5	13.1	3.1	5.0	0.6	18.8	26.9	4.4	0.0	0.6
	Pasoso 3	10 m	26.3	9.4	3.8	8.8	2.5	18.1	22.5	8.8	0.0	0.0
	Pasoso 4	3 m	36.9	25.0	0.6	0.6	1.9	13.1	20.0	1.9	0.0	0.0
	Pasoso 4	10 m	36.3	28.8	1.9	5.6	5.6	13.8	5.6	2.5	0.0	0.0
	Rata-rata Pasoso		33.0	10.3	1.7	3.6	2.0	17.4	25.5	3.2	2.7	0.5
2002/03	Pasoso 1	3 m	36.9	3.1	0.6	0.6	8.8	45.0	1.9	3.1	0.0	0.0
	Pasoso 1	10 m	26.3	1.3	1.3	1.3	10.6	53.1	0.6	5.6	0.0	0.0
	Pasoso 2	3 m	48.8	1.9	1.9	1.9	21.3	17.5	6.9	0.0	0.0	0.0
	Pasoso 2	10 m	35.6	0.6	6.9	0.0	14.4	26.9	15.6	0.0	0.0	0.0
	Pasoso 3	3 m	25.6	15.6	13.1	3.1	21.9	11.3	9.4	0.0	0.0	0.0
	Pasoso 3	10 m	36.3	10.0	24.4	1.3	10.0	7.5	9.4	0.0	1.3	0.0
	Pasoso 4	3 m	44.4	22.5	1.3	0.0	28.1	3.1	0.6	0.0	0.0	0.0
	Pasoso 4	10 m	37.5	35.6	1.3	6.3	14.4	2.5	0.6	0.6	1.3	0.0
	Rata-rata Pasoso		36.4	11.3	6.3	1.8	16.2	20.9	5.6	1.2	0.3	0.0
	Perubahan		+3.4	+1.0	+4.6	-1.8	+14.2	+3.5	-19.9	-2.0	-2.4	-0.5

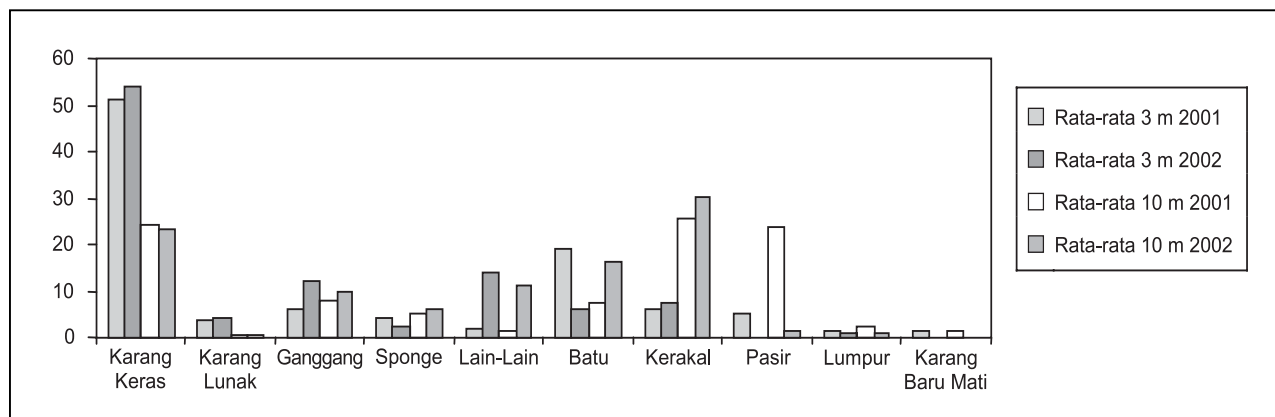
Gambar 3.4.b ReefCheck: Perubahan Komposisi Substrat di Pasoso


• ReefCheck Labuana

Labuana merupakan salah satu dusun dari Desa Lende, Kecamatan Sirenja, terpilih sebagai lokasi survei oleh karena merupakan daerah dengan potensi pariwisata di mana kondisi terumbu karang masih baik terutama di kedalaman sekitar 3 m serta keinginan masyarakat setempat untuk pelestariannya. Tiga transek terpasang, Transek 1 di reef terdekat perkampungan, Transek 2 di depan perkampungan di sebelah Timur (Dusun dari desa Lombonga, Kecamatan Balaesang) dan Transek 3 pada Tanjung Karang yang melindungi Labuana dari cuaca di sebelah Barat kampung. Pencurian tali transek bersama botol pelampungnya terjadi pada Transek 2, tetapi setelah sosialisasi dengan masyarakat setempat belum terjadi kembali.

Tabel 3.4.c ReefCheck: Komposisi Substrat di Labuana

2001/02	Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
	Labuana 1	3 m	63.1	5.0	3.8	3.8	2.5	12.5	3.8	3.1	0.0	2.5
	Labuana 1	10 m	17.5	0.0	17.5	6.9	3.1	5.6	33.1	13.1	0.6	2.5
	Labuana 2	3 m	44.4	1.3	6.9	5.6	2.5	18.1	7.5	11.3	0.6	1.9
	Labuana 2	10 m	28.1	0.0	4.4	1.3	0.6	6.3	25.6	31.3	1.9	0.6
	Labuana 3	3 m	46.3	4.4	6.9	3.8	0.6	26.3	7.5	1.3	3.1	0.0
	Labuana 3	10 m	27.5	1.3	2.5	6.9	0.6	10.6	18.1	26.9	5.0	0.6
	Rata-rata Labuana		37.8	2.0	7.0	4.7	1.7	13.2	15.9	14.5	1.9	1.4
2002/03	Labuana 1	3 m	72.5	5.0	3.8	1.9	7.5	0.6	8.8	0.0	0.0	0.0
	Labuana 1	10 m	21.9	0.0	14.4	6.3	21.9	15.6	15.6	1.3	3.1	0.0
	Labuana 2	3 m	45.6	1.3	26.3	2.5	9.4	6.3	6.3	0.0	2.5	0.0
	Labuana 2	10 m	26.3	0.0	5.6	3.1	8.1	20.6	33.1	3.1	0.0	0.0
	Labuana 3	3 m	44.4	5.6	5.6	1.9	24.4	11.3	6.9	0.0	0.0	0.0
	Labuana 3	10 m	21.9	0.6	9.4	8.1	3.8	13.1	43.1	0.0	0.0	0.0
	Rata-rata Labuana		38.8	2.1	10.8	4.0	12.5	11.3	19.0	0.7	0.9	0.0
	Perubahan		+1.0	+0.1	+3.8	-0.7	+10.8	-2.0	+3.1	-13.8	-1.0	-1.4

Gambar 3.4.c ReefCheck: Perubahan Komposisi Substrat di Labuana

Perubahan dalam penutupan dasar laut oleh Ganggang dan Lain-lain mengalami peningkatan sedangkan Pasir mengalami penurunan serta batu/karang mati di kedalaman 3 m di Labuana dimana sebagian pasir dan batu telah ditutupi oleh tumbuhan tersebut diduga terutama sebagai akibat fluktuasi bermusim (*seasonal fluctuation*). Survei pertama dilaksanakan pada akhir musim hujan sedangkan monitoring berikut terjadi pada akhir musim kemarau sepanjang 5 bulan. Namun ada kemungkinan juga bahwa sebagian penutupan oleh tumbuhan tersebut merupakan dampak nutrifikasi akibat kekurangan sanitasi ataupun aktivitas pertanian. Diharapkan bahwa monitoring berikut akan memberikan jawaban solusi yang menjadi penyebab utama terjadinya peningkatan karang mati/batu pada kedalaman 10 m. Dugaan sementara adalah pembuangan jangkar relatif kecil yang dilakukan secara rutin oleh nelayan yang memancing pada wilayah tersebut. Jika keinginan masyarakat untuk pembentukan DPL kemungkinan besar penurunan kondisi akan berhenti dan pemulihan secara alami dapat berjalan dengan baik.

- **ReefCheck Tanjung Api**

Cagar Alam Tanjung Api terpilih untuk program survai awal yang dilaksanakan pada tahun 2000 dalam rangka program “Reefs at Risk South East Asia” karena merupakan Kawasan Lindung (DPL) dengan status Nasional di Sulawesi Tengah yang mempunyai komponen Laut, tetapi data tentang kondisi komponen laut tersebut belum tersedia. Survai tersebut membuktikan bahwa DPL tersebut belum dilindungi secara efektif dan sangat terancam oleh aktivitas masyarakat baik lokal maupun non-lokal terutama pengeboman dan pembiusan. Sedimentasi juga merupakan ancaman sekunder pada bagian Timur, dekat Desa Tete B, akibat aktivitas pengebangan kayu yang tidak bertanggungjawab dalam pelaksanaan HPH serta pengebangan liar oleh pihak-pihak lain. Pada tahun 2002, terlihat sangat jelas bahwa pengebangan hutan secara besar-besaran telah dimulai di bagian Barat Cagar Alam dan telah mengakibatkan tingkat kerusakan. Pada saat monitoring tahun 2003, tingkat sedimentasi di dasar laut pada kedalaman survai sangat rendah, namun sedimentasi yang melayang sangat tinggi sehingga mengakibatkan kekeruhan air. Oleh karena sedimen tersebut halus dan melayang lama, kemungkinan besar akan terbawah jauh oleh arus sebelum turun ke dasar laut, sehingga tidak menutupi dasar laut di wilayah transek. Dugaan tersebut belum terbukti tetapi sebaiknya merupakan suatu titik perhatian pada monitoring berikut.

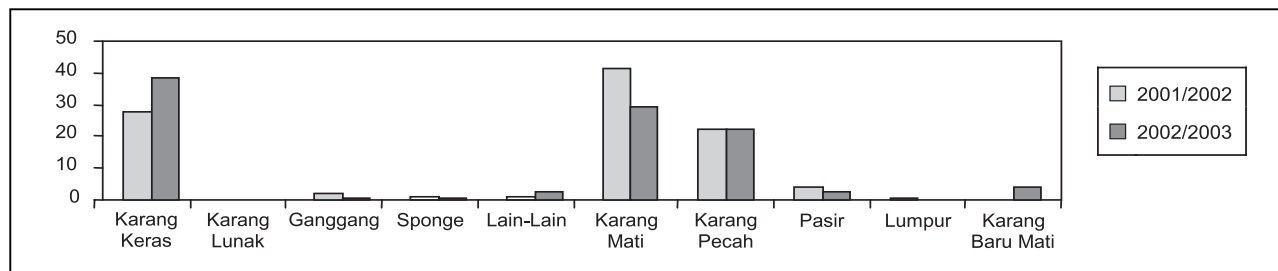
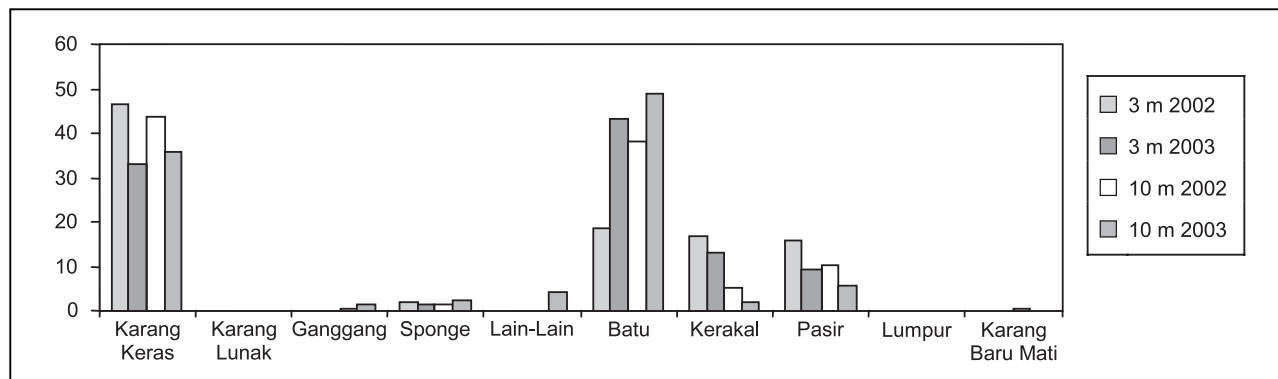
Empat transek permanen terpasang, yang terpilih untuk mewakili terumbu karang “Fringing reef” secara keseluruhan. Transek 1 terletak di depan wilayah pengebangan hutan, dekat pelabuhan Labuan sehingga pembuangan jangkar juga sering terjadi. Transek 2 pada bagian terindah di sebelah Barat, yang umumnya bersifat tebing, tetapi oleh karena ReefCheck tidak menerima data dari wilayah bersifat tebing, tim YACL berusaha mencari lokasi yang berlandai, meskipun hanya panjang 50m di kedalaman 10 m dan masih bersifat tebing kecil diantara 3 m dan 10 m. Transek 3 terletak pada wilayah di sebelah Barat yang bersifat landai dan sering menjadi lokasi penangkapan ikan termasuk dengan pengeboman atau penebaran umpan yang beracun. Transek 4 terpasang dekat lokasi “Api Alam” yang memberikan namanya pada Tanjung Api. Di pantai maupun di laut terjadi pengeluaran gas dari bumi yang mudah untuk menyala. Lokasi api alam sering menjadi lokasi rekreasi masyarakat lokal pada hari minggu. Meskipun belum tersosialisasi dengan baik, sebagian turis mancanegara yang melewati Ampana juga dapat mengunjunginya. Akibatnya tingkat sampah yang tersebar sekitar lokasi tersebut cukup tinggi.

Pada saat monitoring, sebagian tanda permanen telah hilang, akibat pengeboman. Tidak ada tanda yang hilang pada Transek 1. Pada Transek 2, sebagian terumbu telah hancur total dan longsor ke bawah akibat pengeboman. Pada Transek 3 dan 4, sebagian tanda hancur bersama dengan substrat sekitarnya. Anggota Tim survai yang bertugas memasang transek berusaha untuk memasang garis transek baru pada karang yang masih baik atau dengan banyak bibit, bukan diatas karang bekas transek semula, sehingga sebenarnya data tersebut tidak merupakan monitoring, tetapi survai baru dengan bias. Juga, karena banyak karang baru hancur dan belum mati, sebagian Karang Keras yang tercatat bakal menjadi Karang Baru Mati/Kerakal dalam waktu yang dekat.

Dengan pertimbangan-pertimbangan tersebut, kecuali di Transek 1, hasil monitoring tidak dinilai layak untuk memberikan gambaran tentang perubahan sebenarnya dalam kondisi wilayah terumbu karang di Cagar Alam Tanjung Api, tetapi jumlah besar dan keanekaragaman karang mudah atau bibit karang merupakan bukti bahwa masih terdapat terumbu karang yang mampu berkembangbiak di DPL tersebut. Meskipun tingkat kerusakan telah tinggi dan sangat mempengaruhi kondisi ekosistem serta daya tarik pariwisata, jika aktivitas kerusakan karang dapat dihentikan ataupun dikurangi, Cagar Alam Tanjung Api akan kembali sebagai suatu kawasan DPL sangat indah dengan keanekaragaman terumbu karang tinggi.

Tabel 3.4.d ReefCheck: Komposisi Substrat di Tanjung Api

2001/02	Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
	T Api 1	3 m	46.9	0.0	0.0	1.9	0.0	18.8	16.9	15.6	0.0	0.0
	T Api 1	10 m	43.8	0.0	0.6	1.3	0.0	38.1	5.0	10.6	0.0	0.6
	T Api 2	3 m	21.3	0.0	6.3	0.0	0.0	68.8	3.8	0.0	0.0	0.0
	T Api 2	10 m	20.0	0.0	1.3	3.8	0.0	63.8	6.3	2.5	2.5	0.0
	T Api 3	3 m	18.1	0.0	2.5	1.3	1.3	41.9	35.0	0.0	0.0	0.0
	T Api 3	10 m	13.8	0.0	3.8	0.0	0.6	24.4	56.3	0.0	0.0	1.3
	T Api 4	3 m	25.0	0.0	0.0	1.3	0.6	43.8	27.5	1.9	0.0	0.0
	T Api 4	10 m	33.8	0.0	1.3	0.0	5.0	30.6	26.9	2.5	0.0	0.0
	Rata-rata T. Api		27.8	0.0	2.0	1.2	0.9	41.3	22.2	4.1	0.3	0.2
2002/03	T Api 1	3 m	33.1	0.0	0.0	1.3	0.0	43.1	13.1	9.4	0.0	0.0
	T Api 1	10 m	35.6	0.0	1.3	2.5	4.4	48.8	1.9	5.5	0.0	0.0
	T Api 2	3 m	56.3	0.0	0.0	1.3	1.3	24.4	15.0	1.1	0.0	0.6
	T Api 2	10 m	28.1	0.0	0.0	7.5	0.6	3.1	9.4	0.0	0.0	1.3
	T Api 3	3 m	33.8	1.3	1.9	5.0	11.3	27.5	19.4	0.0	0.0	0.0
	T Api 3	10 m	15.6	0.0	0.0	2.5	0.0	18.8	62.5	0.0	0.0	0.6
	T Api 4	3 m	48.8	0.0	0.0	0.0	11.8	23.8	15.6	0.0	0.0	0.0
	T Api 4	10 m	38.1	0.6	0.0	0.0	1.3	30.0	28.8	1.2	0.0	0.0
	Rata-rata T. Api		38.6	0.3	0.4	2.7	4.1	29.3	22.1	2.3	0.0	0.3
	Perubahan		+10.8	+0.3	-1.6	+1.5	+3.2	-12.1	-0.1	-1.8	-0.3	+0.1

Gambar 3.4.d ReefCheck: Komposisi Substrat di Tanjung Api**1. Secara Keseluruhan, Tahun 2002 serta Tahun 2003****2. Perubahan Pada Transek 1**

(c) Data ReefCheck – Tabulasi Hasil Survei-Survei Jenis-Jenis Indikator

Tabel 3.5.a Ikan Indikator dan hewan Langka di Tawaell

Lokasi	2001/2002										2002/2003										Perubahan %					Arah Perubahan Rata-rata
Jenis/Indikator	Kadongo	3 m	10 m	Talise	3 m	10 m	Rata-rata	Rata-rata	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	Kadongo	3 m	10 m	Talise	3 m	10 m	Talise	Kadongo	3 m	10 m
Ikan:																										
Ikan Kupu-kupu Chaetodontidae	22	8	67	62	44.5	35	39.8	65	9	71	52	68	30.5	49.3	43	1	4	-10	+	-						
Ikan Bbir Tebal Haemulidae	6	2	2	4	4	3	3.5	3	0	12	10	7.5	5	6.5	-3	-2	10	6	-	+						
Ikan Bungawara Lufjanidae	3	0	5	10	4	5	4.5	24	0	21	4	22.5	2	12.3	21	0	16	-6	+	+						
Kerapu Tikus Cromileptes altivelis	0	0	0	1	0	0.5	0.3	0	0	0	0	0	0	0	0	0	0	-1	0	-						
Kerapu Serranidae >30 cm	14	0	0	1	7	0.5	3.6	3	1	0	0	1.5	0.5	1	-11	1	0	-1	-	-						
Ikan Napoleon Cheilinus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Ikan Kakatua Besar Bolbometopon muricatum	2	0	3	2	2.5	1	1.8	2	0	6	5	4	2.5	3.3	0	0	3	3	0	+						
Ikan Kakatua Lainnya Scardae	11	3	3	1	7	2	4.5	10	0	7	8	8.5	4	6.3	-1	-3	4	7	-	+						
Belut Moray Murenidae	0	0	0	1	0	0.5	0.3	0	0	1	0	0.5	0	0.3	0	0	1	-1	0	0						
Hewan Langka:																					Perubahan					
Penyu					0	0	0					0	0	0					0							
Duyung	1				<1	0	<1	1				<1	0	<1					0							
Ikan Hu					0	0	0					0	0	0					0							

Tabel 3.5.b Ikan Indikator dan Hewan Langka di Pasoso

Lokasi	2001/2002																2002/2003																2003/2004															
	Rata-rata								Rata-rata								Rata-rata								Rata-rata								Rata-rata															
	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata															
Jenis/Indikator	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	3 m	10 m	Rata-rata															
Ikan:																																																
Ikan Kupu-kupu Chaetodontidae	50	27	22	54	28	31	35	45	34	39	37	31	53	32	23	28	25	57	53	37	39	38	19	28	10	31	0	-6	22	8	+																	
Ikan Blar Tegal Haemulidae	0	3	1	0	1	1	4	6	1.5	2.5	2	0	0	0	4	0	3	0	0	0	1.8	0.9	0	0	1	4	-1	2	-4	-6	-																	
Ikan Bungawera Lutjanidae	1	6	3	3	5	3	7	12	4	6	5	17	16	0	0	0	0	6	6	5.8	5	5.9	16	10	3	-5	-3	-1	4	+																		
Korapu Tikus Cromiidae altivelis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
Korapu Serranidae > 30 cm	4	7	4	0	7	4	7	5	5.5	4	4.8	1	7	1	3	2	2	0	0	1	3	2	0	0	0	3	-5	-2	-7	-5	-																	
Ikan Napoleon Cheilinus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
Ikan Kakatua Besar Bombramon munitatum	0	5	0	0	2	0	5	13	1.8	4.5	3.1	0	0	4	10	4	4	1	1	2.3	3.8	3	0	0	4	10	2	4	-4	-12	P																	
Ikan Kakatua Lainnya Scolidae	18	28	23	12	27	21	10	14	20	19	19	4	4	3	4	2	2	0	8	4.5	4.5	4.5	-44	-24	-30	-8	-25	-19	-1	-6	-																	
Beliut Moray Muraenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
Hewan Langka:																																																
Penyu						1			0	<1	<1								2	0	<1	<1									1	+																
Duyung									0	0	0									0	0	0										0	0															
Ikan Hiu									0	0	0									0	0	0										0	0															

Tabel 3.5.c Ikan Indikator dan Hewan Langka di Labuana

Lokasi	Jenis/Indikator	2001/2002										2002/2003										Perubahan						Arah Perubahan			
		3 m	10 m	Labuana 1	3 m	Labuana 2	10 m	3 m	Labuana 3	10 m	Rata-rata	3 m	10 m	Labuana 1	3 m	Labuana 2	10 m	3 m	Labuana 3	10 m	Rata-rata	3 m	10 m	Labuana 1	3 m	Labuana 2	10 m		3 m	Labuana 3	10 m
Ikan:																															
	Ikan Kupu-kupu Chaetodontidae	46	41	47	30	36	52	43	41	42	97	43	26	36	28	27	50	35	43	51	2	-21	6	-8	-25	+					
	Ikan Bbir Tebal Haemulidae	3	9	1	34	0	1	1.3	15	8	3	1	6	5	0	1	3	2.3	27	0	-8	5	-29	0	0	-					
	Ikan Bungawara Lutjanidae	16	8	10	17	7	29	11	18	15	94	37	3	30	3	2	33	23	28	78	29	-7	13	-4	-27	+					
	Kerapu Tikus Cromileptes altivelis	0	0	1	1	0	0	0.3	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	-					
	Kerapu Seranidae >30 cm	5	0	8	2	2	0	5	0.7	2.8	7	4	0	2	2	0	3	2	2.5	2	4	-8	0	0	0	-					
	Ikan Napoleon Cheilinus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Ikan Kakatua Besar Bobometopon muricatum	0	2	0	0	0	0	0	0.7	0.3	0	0	1	0	1	6	0.7	2	1.3	0	-2	1	0	1	6	+					
	Ikan Kakatua Lainnya Scaridae	0	14	0	13	13	20	4.3	16	10	8	3	0	3	4	1	4	2.3	3.2	8	-11	0	-10	-9	-19	-					
	Belut Moray Muraenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lain-lain/Hewan Langka:																															
	Penyu							0	0	0							0	0	0												N
	Duyung							0	0	0					1		<1	0	<1									+1			P
	Ikan Hiu							0	0	0							0	0	0												N

Tabel 3.5.d Ikan Indikator dan Hewan Langka di Tanjung Api

Lokasi	2001/2002												2002/2003												Perubahan						Rata-rata		Arabi Perubahan
	3 m	10 m	10 m	10 m	10 m	3 m	10 m	10 m	10 m	10 m	3 m	10 m	3 m	10 m	10 m	10 m	10 m	10 m	10 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m	3 m	10 m					
Jenis/Indikator	T Api 1	T Api 1	3 m	T Api 2	10 m	T Api 3	3 m	T Api 4	3 m	T Api 4	10 m	Rata-rata	10 m	Rata-rata	Rata-rata		Rata-rata		Rata-rata		Rata-rata		Rata-rata		Rata-rata		Rata-rata						
Ikan:	2001/2002												2002/2003												Perubahan						Rata-rata		Arabi Perubahan
Ikan Kupu-kupu Chaetodontidae	24	27	30	17	12	19	42	36	27	25	26	13	10	25	14	4	9	2	3	10	9	10	-11	-17	-6	-3	-8	-10	-40	-33	-		
Ikan Bibir Tebal Haemulidae	2	5	1	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	-2	1	0	0	0	0	0	0	-		
Ikan Bungkawa Luganidae	6	3	1	2	2	1	1	8	3	4	3	1	1	1	11	0	0	0	0	0	4	2	-5	-2	0	9	-2	-1	-1	-8	-		
Kerapu Tikus Cromileptes altivelis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Kerapu Serandak >30 cm	0	0	0	0	3	3	5	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-3	-5	0	0	-		
Ikan Napoleon Cheilinus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Ikan Kakatua Besar Bodianus lineatus	2	0	0	0	0	1	10	8	3	2	3	2	2	2	0	5	0	0	0	2	0	1	0	2	0	0	5	-1	-10	-8	-		
Ikan Kakatua Lainnya Scorpaenidae	57	18	16	8	23	23	33	39	27	22	25	1	2	0	3	0	17	0	2	0	7	4	-36	-16	-5	-23	-8	-33	-37	-	-		
Belut Moray Muraenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Lain-lain/Hewan Langka:	2001/2002												2002/2003												Perubahan						Rata-rata		Arabi Perubahan
Penyu							1		<1	0	<1																					-	
Duyung									0	0	0																					0	
Ikan Hiu							1		>1	0	>1																					-	

Tabel 3.6.a Data Invertebrata di Tawaeli

Lokasi	2001/2002																2002/2003								Rata-rata				Perubahan				Arah Perubahan Rata-rata
	2001/2002								2002/2003								Rata-rata				Perubahan												
	Kadongo	10 m	3 m	Talise	10 m	3 m	Rata-rata	10 m	Kadongo	10 m	3 m	Talise	10 m	3 m	Rata-rata	10 m	Kadongo	10 m	3 m	Talise	10 m	3 m	Rata-rata	10 m	3 m	Talise	10 m	3 m	Talise				
Jenis/Indikator	3 m	10 m	Kadongo	Talise	3 m	10 m	Rata-rata	10 m	3 m	Rata-rata	10 m	3 m	Rata-rata	10 m	3 m	Rata-rata	3 m	10 m	Kadongo	10 m	3 m	Talise	10 m	3 m	Rata-rata	3 m	10 m	Kadongo	10 m	3 m	Talise		
	3	0	0	0	0	0	0	1.5	0	0.75	0	0	0	0.5	0	0.25	0	0	0	0	1	0	0	0	0	0	0	1	0	0	-		
	17	0	9	6	13	3	8	11	0	1	2	6	1	3.5	-6	0	-4	-															
	7	0	0	0	3.5	0	1.75	0	0	0	0	0	0	0	-7	0	0	-															
Teripang Neras/Hitam <i>T. ananias/S. chloronotus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	2	0	0	0	1	0	0.5	2	0	0	0	0	1	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	0	0	4	1	2	0.5	1.25	0	0	4	1	2	0.5	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	2	0	1	0	1.5	0	0.75	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
Lobster Panuliridae	0	0	1	0	0.5	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
	Kerusakan: (skala 0-3)																2002/2003								Perubahan								
	2	2	2	2	2	2	2	2	2	2	1	0	2	1	1.5	1.25	0	-1	-2	0	-												
	0	1	2	2	1	1.5	1.25	2	1	0	0	1	0.5	0.75	2	0	-2	-															
Pemulutan	1	0	0	0	0.5	0	0.25	1	0	1	0	1	0	0.5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	+	

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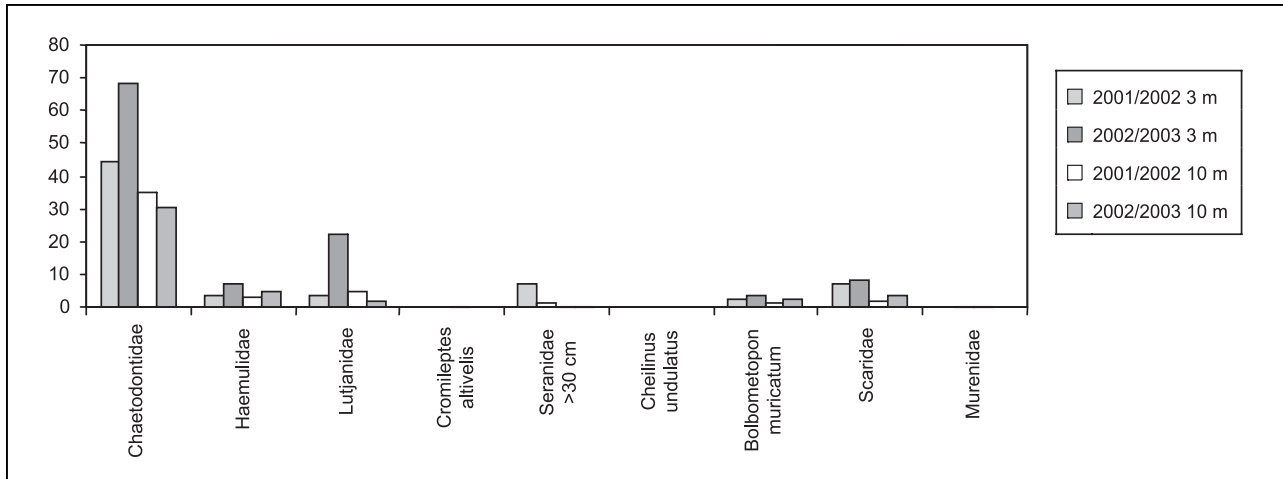
Tabel 3.6.c Data Invertebrata di Labuana

Lokasi	2001/2002												2002/2003												Perubahan											
	Rata-rata						Rata-rata						Rata-rata						Rata-rata						Rata-rata											
	3 m	10 m	Labuana 1	3 m	10 m	Labuana 3	3 m	10 m	Labuana 3	3 m	10 m	Labuana 2	3 m	10 m	Labuana 1	3 m	10 m	Labuana 2	3 m	10 m	Labuana 3	3 m	10 m	Labuana 2	3 m	10 m	Labuana 3	10 m	Rata-rata							
Jenis/Indikator	3 m	10 m	Labuana 1	3 m	10 m	Labuana 2	3 m	10 m	Labuana 3	3 m	10 m	Labuana 2	3 m	10 m	Labuana 1	3 m	10 m	Labuana 2	3 m	10 m	Labuana 3	3 m	10 m	Labuana 2	3 m	10 m	Labuana 1	3 m	10 m	Arah Perubahan						
Invertebrata	3	1	2	0	0	0	1.67	0.33	1	13	4	0	0	0	0	4.33	1.33	2.83	10	3	-2	0	0	0	+											
Udang berbeling <i>Stenopus hispidus</i>	3	0	5	2	3	1	3.67	1	2.33	18	5	9	0	4	2	10.3	2.33	6.33	15	5	4	-2	1	1	+											
Bulu Babi <i>Diademae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Landak Laut <i>Cidaridae</i>	0	1	0	0	0	0	0	0.33	0.17	0	0	0	0	0	2	0	0.67	0.33	0	-1	0	0	0	2	+											
Teripang Nenas/Hitam <i>T. ananas/S. chloronotus</i>	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0.67	0	0.33	2	0	0	0	0	0	+											
Lipan Laut (COT) <i>Acanthaster planci</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0	0.33	2	0	0	0	0	0	+											
Kina <i>Tridacnae</i>	18	3	5	4	1	0	8	2.33	5.17	18	1	4	1	2	1	8	1	4.5	0	-2	-1	-3	1	1	-											
Triton Terompet <i>Charonia tritonis</i>	0	0	0	1	0	0	0	0.33	0.17	0	0	0	0	2	0	0.67	0	0.33	0	0	0	-1	2	0	+											
Lobster <i>Panuliridae</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0.33	1	0.67	0	2	0	0	1	1	+											
Kerusakan: (skala 0-3)	1	2	2	1	1	2	1.33	1.67	1.5	1	2	2	1	0	1	1	1.33	1.17	0	0	0	0	-1	-1	-											
Kerusakan Karang	1	1	1	1	1	1	1	1	1	1	2	1	1	0	1	0.67	1.33	1	0	1	0	0	-1	0	0											
Sampah	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0*	0.67	0	0.33	1	0	1	0	0	0	+											

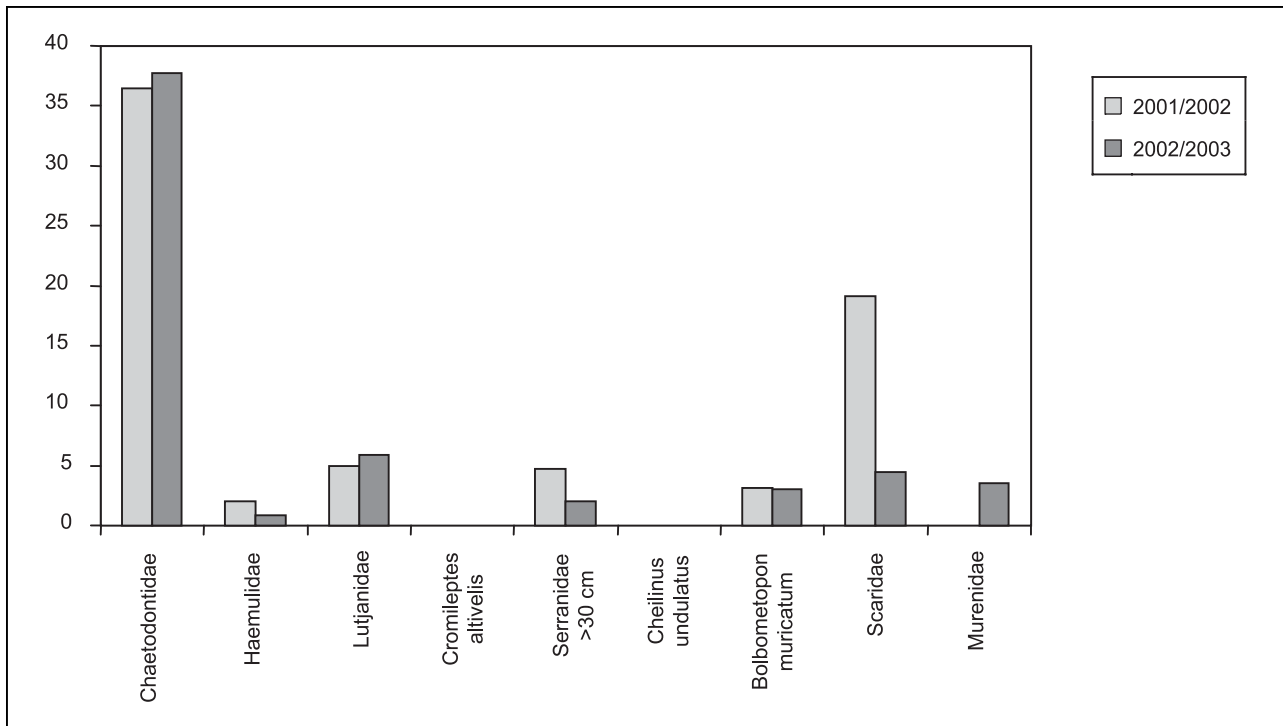
* Dugaan penyakit karang di lokasi tersebut.

Tabel 3.6.d Data Invertebrata di Tanjung Api

Lokasi	2001/2002										2002/2003										Perubahan												
Jenis/Indikator	T Api 1	T Api 1	3 m	T Api 2*	10 m	3 m	T Api 3	10 m	3 m	T Api 4	10 m	3 m	T Api 4	Rata-rata	3 m	10 m	Rata-rata	Rata-rata	10 m	3 m	T Api 1	10 m	T Api 1	3 m	T Api 2*	10 m	3 m	T Api 3	10 m	3 m	T Api 4	T Api 4	Arah Perubahan Rata-rata
Invertebrata																																	
Udang berbeling <i>Stenopus hispidus</i>	3	2	0	0	0	0	0	1	0	1	0	1	0	0.5	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Bulu Babi <i>Diademaa</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0.5	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	+	
Lendak Laut <i>Cidariae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Teripang Nerasa/Hiam <i>T. ananias</i> / <i>S. chlorotus</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0.5	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	+	
Lipan Laut (COT) <i>Acanthaster planci</i>	0	0	0	0	0	0	0	0	1	0	0.3	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-?	
Kima <i>Micranea</i>	8	4	6	9	0	0	25	1	9.8	3.5	6.6	4	5	4	5	0	4	2	3.5	3.3	4	1	2	4	0	0	0	0	0	0	0	3	-
Timon Terompet <i>Charonia tritonis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lobster <i>Penuridae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Kerusakan: (skala 0-3)	2001/2002										2002/2003										Perubahan												
Kerusakan Karang	3	3	2	3	3	3	3	2	2	2.5	2.8	2.6	3	3	3	3	3	2	3	2.8	2.9	0	0	1	0	0	0	0	0	1	0	+	
Sampah	0	0	0	0	0	0	0	1	0	0.3	0	0.1	0	0	0	0	1	1	0.3	0.3	0	0	0	0	0	0	0	0	0	0	1	+	
Pernyahan	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0.8	0.3	0.5	1	0	1	0	0	0	0	0	0	1	1	+		

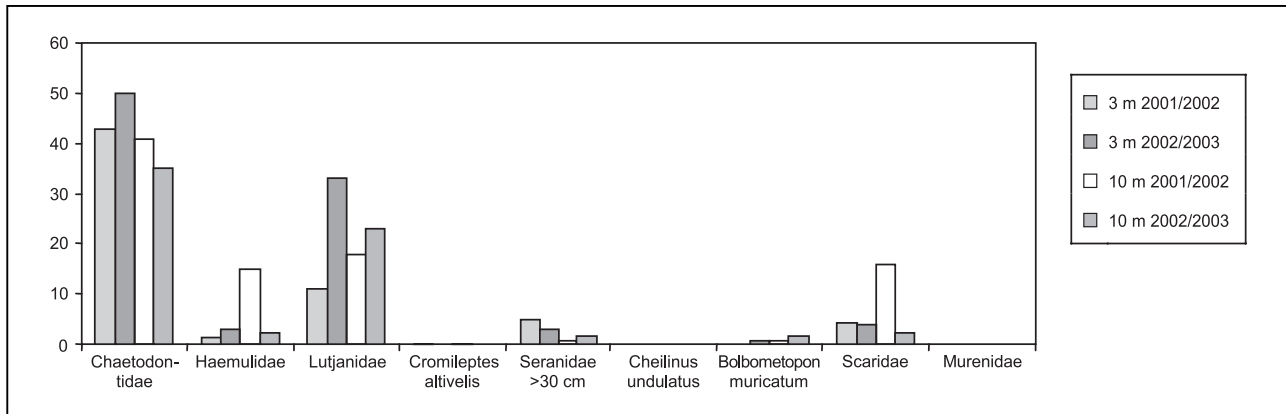
(d) Data ReefCheck – Gambar dan Pembahasan Survei Jenis-Jenis Indikator**Gambar 3.5.a Ikan Indikator di Tawaeli**

Dari Gambar 3.5.a ada indikasi peningkatan stok ikan di Tawaeli, kecuali ikan kerapu (*Seranidae*) yang jumlahnya berkurang. Peningkatan *Chaetodontidae* dan *Lutjanidae* cukup besar di kedalaman 3 m, tetapi ada juga indikasi pemindahan dari kedalaman 10 m ke 3 m khusus *Scaridae*, *Lutjanidae* dan *Chaetodontidae*, yang mungkin akibat perubahan kondisi atau jam/cuaca/musim survei. Namun secara umum tidak ada perubahan besar dalam komposisi stok ikan. Ada indikasi korelasi antara kondisi karang dan stok ikan. Monitoring akan datang diharapkan akan memberikan gambaran “trend” (arah perubahan) yang lebih jelas.

3.5.b Ikan Indikator di Pasoso

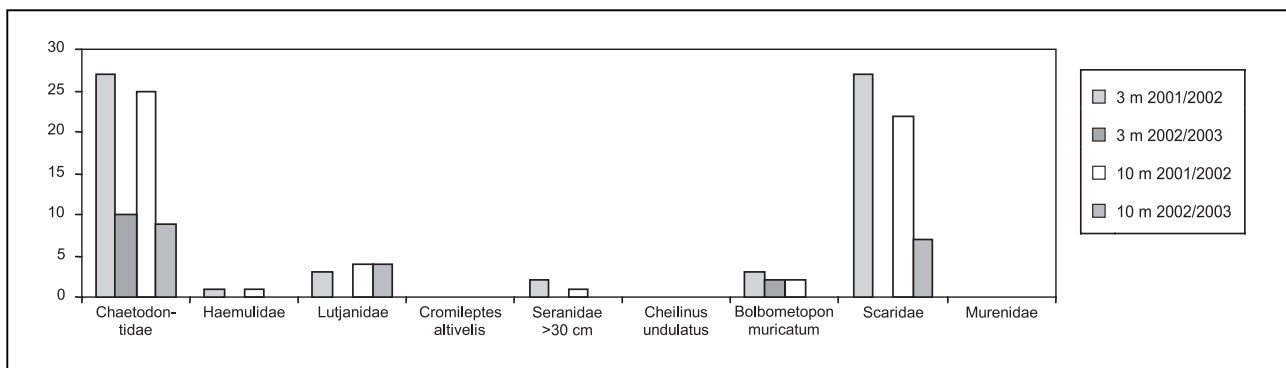
Perbedaan data ikan baik jenis maupun jumlah antara kedalaman 3 m dan 10 m di Pasoso sangat sedikit, sehingga tidak dipisah dalam Gambar 3.5.b. Ikan kerapu (Seranidae), Kakatua (Scaridae) dan Bibir Tebal (Haemulidae) menurun, sedangkan jumlah ikan indikator lainnya stabil atau cenderung meningkat. Ada rekrutmen Belut Moray (Murenidae) yang dulu kosong pada lokasi transek. Penurunan jumlah ikan yang teramati mungkin akibat aktivitas penangkapan ikan, atau merupakan dampak perbedaan dalam waktu, musin atau cuaca. “*Trend*” (arah perubahan) diharapkan akan diperjelas oleh monitoring akan datang.

3.5.c Ikan Indikator di Labuana



Haemulidae dan Scaridae mengalami penurunan, pada jenis Lutjanidae mengalami peningkatan, serta jenis Chaetodontidae jumlahnya hampir sama antara kedalaman 10 m ke 3 m. Pada jenis ikan yang lain perubahannya kecil, dan mungkin tidak signifikan. *Trend* kelihatannya tidak jauh beda dengan di Pasoso dan mungkin menandai perubahan di Pantai Barat secara lebih luas. Belum tentu perubahan-perubahan yang terjadi itu merupakan akibat dari faktor-faktor dalam pengambilan data seperti musim, waktu survai dan lain sebagainya atau *trend* riil. Diharapkan bahwa monitoring jangka panjang akan memberikan jawaban lebih jelas.

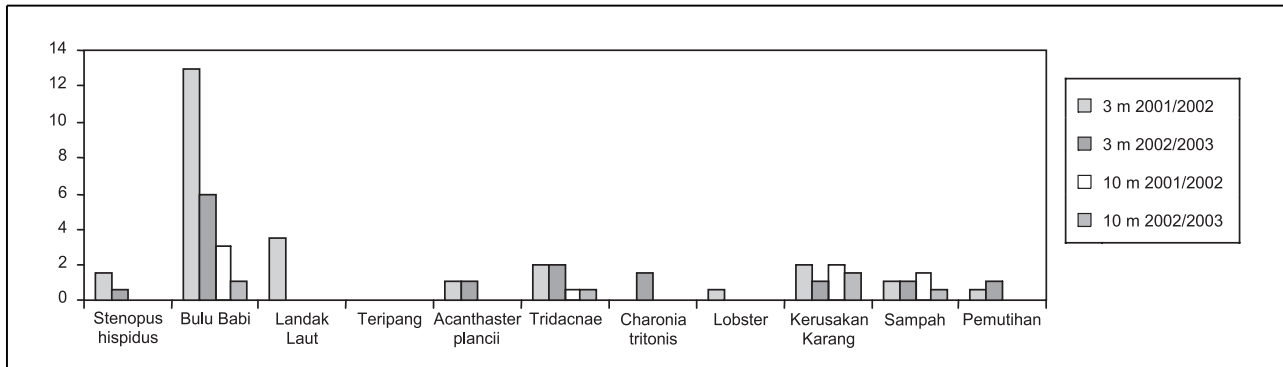
3.5.d Ikan Indikator di Tanjung Api



Lokasi Tanjung Api mengalami perubahan yang sangat besar dibanding dengan lokasi lainnya, dengan penurunan cukup besar pada semua ikan indikator, kecuali yang jumlahnya tidak ada pada survai tahun 2001/2002 dan pada survai tahun 2003 juga tetap tidak ada. Hal tersebut diduga akibat peningkatan aktivitas pengeboman dan pembiusan pada lokasi tersebut. Masyarakat nelayan di sekitar

wilayah CA Tanjung Api mengatakan bahwa sudah tidak dapat memenuhi kebutuhan hidup dengan menggunakan metode penangkapan tradisional. Dengan metode penangkapan dengan menggunakan bom juga semakin sulit mendapatkan ikan.

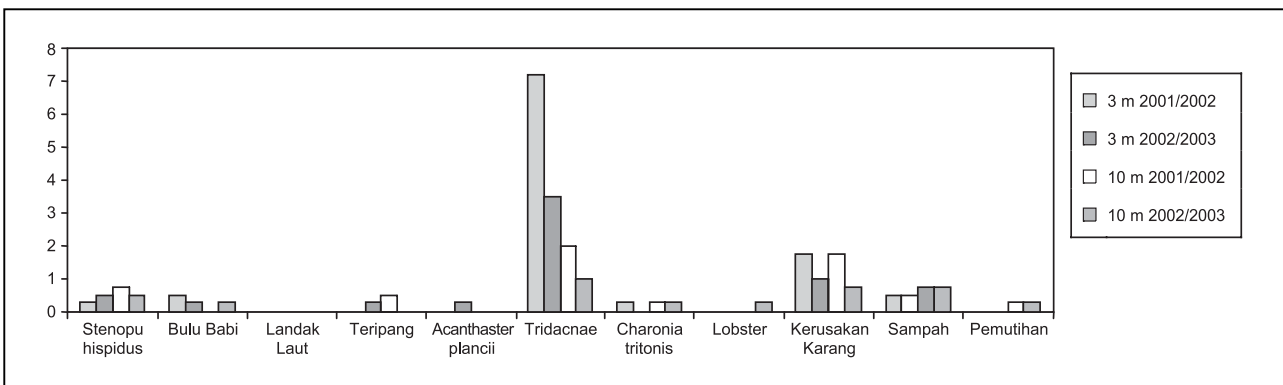
Gambar 3.6.a Data Indikator Invertebrata dan Kerusakan di Tawaeli



Berdasarkan Gambar 3.6.a penurunan sejumlah jenis invertebrata kelihatan secara jelas. Perbedaan antara kedalaman 3 m dan 10 m juga sangat nyata. Di Kadongo semua jenis Invertebrata indikator jumlahnya nol baik pada tahun 2001/2002 maupun tahun 2002/2003.

Tingkat kerusakan baru yang diakibatkan oleh serta sampah stabil atau menurun, sedangkan pemutihan meningkat di 3 m. Diduga perubahan sampah dan pemutihan merupakan akibat faktor-faktor musiman, dengan cuaca tenang, suhu laut yang meningkat dan kurangnya debit sungai yang masuk kelaut.

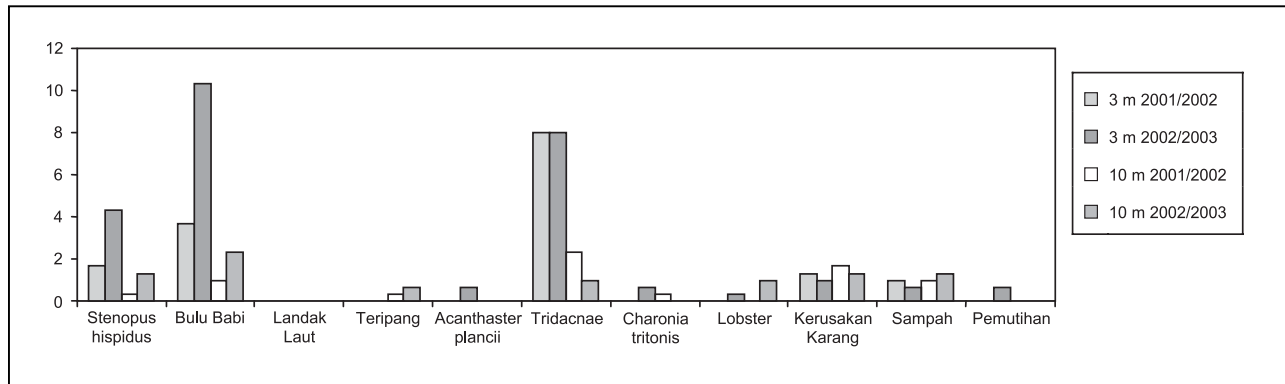
3.6.b Data Indikator Invertebrata dan Kerusakan di Pasoso



Gambar 3.6.b. Menjelaskan bahwa terjadinya penurunan secara drastis dalam populasi kima (Tridacnae), terutama di kedalaman 3 m dimana mudah diambil tanpa peralatan selam. Hal tersebut disebabkan oleh program penangkaran tukik penyu yang sempat diamati oleh tim YACL, dimana pada awalnya kima tersebut diberikan sebagai pakan pada tukik. Kerusakan baru menurun meskipun masih ada pengrusakan lainnya, sedangkan tingkat sampah meningkat. Pemutihan terjadi pada monitoring tahun 2002/2003, hal ini diduga sebagai akibat perubahan musim. Meskipun masih ada perubahan-perubahan lain tetapi dalam skala kecil. Tetapi dengan ditemukannya lobster pada saat monitoring

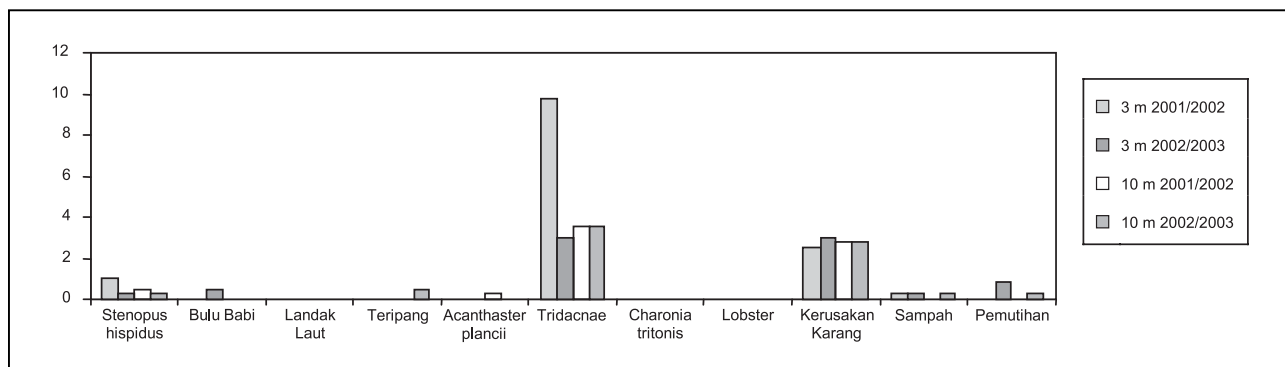
merupakan sesuatu yang positif, dan adanya lipan laut merupakan alasan nyata untuk melaksanakan monitoring lanjutan. Diharapkan bahwa monitoring jangka panjang akan memberikan gambaran kebijakan-kebijakan yang lebih jelas dan terarah.

3.6.c Data Indikator Invertebrata dan Kerusakan di Labuana



Berdasarkan Gambar 3.6.c. Populasi udang berbeling dan bulu babi (*Diadema*) meningkat. Pada umumnya, di kedalaman 3 m indikator stabil atau membaik, kecuali ditemukan sejumlah lipan laut dan pemutihan karang. Sedangkan di 10 m terjadi penurunan populasi kima serta peningkatan sampah. Kerusakan karang baru lebih banyak ditemukan pada kedalaman 10 m yang diduga akibat pembuangan jangkar pada saat memancing. Pemutihan karang diduga merupakan akibat pembusukan. Tetapi ada juga indikasi akibat penyakit karang terutama khusus karang meja (*Acropora spp.*) yang menurun secara perlahan-lahan.

3.6.d Data Indikator Invertebrata dan Kerusakan di Tanjung Api



Gambar 3.6.d. menjelaskan bahwa kondisi Invertebrata yang sangat memprihatinkan. Pada survei awal menurun lagi pada monitoring di CA Tanjung Api. Hal tersebut sangat jelas bahwa dalam pengambilan data garis transek dipindahkan pada areal yang "paling baik". Sehingga diduga data tahun 2002-2003 sebenarnya melebihi keadaan pada lokasi yang disurvei pada tahun 2001-2002 ditambah dengan pernyataan satu anggota time survei bahwa daripada mencatat nol pada semua kotak Invertebrata dia mencari diluar "belt transect" selebar 5 m dalam areal lebih luas. Pada survei tahun 2003 tidak ada ditemukan lipan laut ataupun tanda-tanda jejaknya. Terjadinya pemutihan karang yang teramati diduga kuat bahwa pemutihan tersebut merupakan dampak aktivitas pembusukan. Berdasarkan informasi dari masyarakat disekitarnya bahwa kerusakan baru bukan hanya akibat pengeboman tetapi diduga kuat bahwa sebagian juga merupakan dampak aktivitas pengambilan kima dengan pemakaian linggis besi. Dugaan tersebut diperkuat oleh penurunan tajam dalam jumlah populasi kima. Selain peningkatan sampah di dasar, tim survei juga melihat peningkatan pencemaran sampah yang melayang baik di permukaan air maupun didalam air terutama pada saat dilakukan manta tow.

(e) Data ReefCheck – Ancaman-ancaman dan Catatan

Berdasarkan hasil pendataan “*Site Description*” dalam survai/monitoring ReefCheck. Data ancaman-ancaman dan sumber kerusakan dapat dilihat dalam Tabel 7 seperti dibawah ini.

Tabel 7. Ancaman dan Sumber Kerusakan

Ancaman	Tawaeli	Pasoso	Labuana	Tanjung Api
Pengeboman	Tingkat rendah	Penurunan tetapi masih ada tanda bekas	Masyarakat mengatakan tidak terjadi tetapi tanda-tanda kelihatan, meskipun sedikit	Sering, dan meningkat baik dalam frekuensi maupun teknologi (“remote control”)
Pembusuan	Tingkat rendah	Ada tanda-tanda bekas baru	Tidak ada tanda baru yang jelas tetapi ada dugaan terjadi meskipun sedikit	Sering terjadi, semprotan (komersil) dan penyebaran umpan beracun (konsumsi)
Pembuangan Jangkar	Sering, secara rutin tergantung bulan, sebagian berupa batu-batu yang dilepaskan. Pada kedalaman tertentu	Bekas baru sangat jelas. Perahu turis (1 besar), tetapi mayoritas perahu perikanan/perdagangan menggunakan beberapa jangkar	Sering, secara rutin tergantung bulan, sebagian berupa batu-batu yang nanti dilepaskan. Pada kedalaman tertentu	Sedang kecuali tinggi dekat pelabuhan Labuan. Mayoritas nelayan dan pengujung ke CA tidak membuang jangkar
Penambang Karang	Tidak ada tanda baru tetapi pernah terjadi dan masih terjadi penambangan kecil	Belum ada tanda-tanda penambangan karang	Tidak kelihatan tetapi di kampung tetangga, Lombonga sangat tinggi	Rendah, terutama dekat Labuana, dulu tinggi saat pabrik kapur masih aktif
Risiko Overfishing (penangkapan berlebihan) – selain yang diatas	Ya, tinggi (pancing, panah, jala/jaring, bubu, “gleaning”)	Ya, sedang (pancing, kompressor, jaring/jala)	Ya (sedang) (pancing, kompressor, “gleaning”)	Ya (tinggi) (pancing, kompressor, penyelaman alami)
Penangkapan Invertebrata	Rendah/Sedang Untuk konsumsi (kima, mollusca lainnya, udang, lobster dll)	Tinggi, eningkatan. Kima sebagai pakan tukik penyu. Crustacea dan mollusca untuk konsumsi. Komersil seperti Lobster, teripang, mollusca	Tinggi. “Gleaning” saat air surut (mollusca, crustacea untuk konsumsi). Komersil kompressor: lola, teripang, lobster, mollusca lain	Tinggi. Apa saja yang bernilai ekonomis ataupun dapat dimakan sebagian dengan kompressor (kima, teripang, lola & mollusca lain, lobstre & crustacea lain dsb)
Berlimpahan Lipan Laut (COT)	Pernah terjadi 2001 di Kadongo. Masih ada sedikit	Tidak	Tidak	Tidak
Sedimentasi	Tinggi. Asal sungai-sungai (tingkat kerusakan tinggi di hulu) & pabrik kerakal	Rendah, banyak pindahan pasir	Sedikit pada saat survai, mungkin meningkat musim hujan, ancaman jika ada perubahan pemanfaatan lahan	Tinggi dekat Labuan (TR1 di depan hutan lindung (CA) yang telah ditebang. Rendah pada bagian-bagian lainnya
Pollusi/Sampah & Eutrophikasi (Peningkatan Nutrien)	Limbah (cair dan sampah plastik dll) dari Kota Palu serta Pelabuhan Pantaloan dan pemukiman sekitar Teluk Palu. Pupuk dll dari pertanian	Sampah/limbah dari kapal-kapal termasuk PELNI serta pemukiman penduduk pulau & di Pantai Barat. Banyak sampah plastik.	Limbah lokal dan sampah yang hanyut. Tidak ada sanitasi.	Limbah dari Kota Ampana & pedesaan sekitarnya, terutama plastik. Pupuk dll dari pertanian baru di CA.
Lain-lain		Penyu: Pengambilan telur serta penangkaran tidak profesional		

Setiap lokasi mempunyai ancaman-ancaman yang berbeda, dan terjadi sedikit perubahan antara 2001/2002 dan 2002/2003 di Labuana dan Tawaeli. Di SMS Pulau Pasoso pengambilan telur penyu hijau telah berubah hal ini disebabkan terutama adanya penangkaran yang tidak profesional dan mengancam lingkungan terutama populasi kima (*Tridacnae*), yang pada umumnya juga merupakan jenis yang dilindungi oleh peraturan Nasional dan Internasional. Pihak dari Pemerintahan khususnya BAPPEDALDA Propinsi telah melakukan pemantauan lokasi dalam rangka persiapan untuk penataan SMS Pulau Pasoso termasuk pendataan dan pelestarian populasi satwa yang dilindungi seperti Penyu Hijau (*Chelonia mydas*).

Catatan: Meskipun banyaknya tekanan terhadap ekosistem terumbu karang mengakibatkan kondisi umum lokasi pengamatan tidak sesuai dengan apa yang diharapkan diharapkan dan kecenderungan menurun dalam keadaan kritis tetapi tidak ada lokasi monitoring yang “tanpa harapan” apabila dilakukan pencegahan secepat mungkin masih bisa pulih kembali. Menurut penilaian tim survai, semua masih dapat di “selamatkan” dan dikembalikan pada keadaan indah dan produktif jika masyarakat bersama pemerintah bertindak secara bijak dalam pembangunan pada masa akan datang.

Perubahan sikap positif masyarakat yaitu menyadari akan daerah pesisir dan laut oleh masyarakat setempat terjadi di kawasan Pulau Pasoso, Dusun Labuana dan Tawaeli. Perencanaan kegiatan lanjutan seharusnya membangkitkan dan mendukung kepedulian dengan melibatkan masyarakat setempat dalam langkah-langkah usaha pelestarian yang nyata. Khususnya SMS Pulau Pasoso, data yang telah diambil menjadi dasar untuk beberapa kegiatan dan perencanaan, dalam rangka mengefektifkan status kawasan lindung tersebut. Data berupa dokumentasi sangat efektif dalam proses penyadaran baik di tengah masyarakat maupun pihak Pemerintah dan pengambil kebijakan. Sedangkan data berupa angka-angka memberikan kredibilitas tetapi akan lebih mudah dipahami jika telah dipresentasikan dalam bentuk grafik. Khususnya Labuana, kegiatan ekowisata telah mulai dan masyarakat ingin membentuk suatu DPL yang berbasis masyarakat. YACL hanya membantu memfasilitasi kegiatan yang dilakukan oleh masyarakat setempat.

Keadaan di kawasan Cagar Alam Tanjung Api merupakan lokasi yang sangat memprihatinkan dan keadaan semakin kritis dan komplek. Di kawasan Cagar Alam tersebut memiliki keunikan yang sangat indah serta keanekaragaman hayati sangat tinggi. Jika tidak ada langkah-langkah yang positif untuk menangani situasi maka keadaan akan semakin parah, tim survai menilai bahwa monitoring tahun 2004 jelas akan mengalami penurunan yang semakin tajam. Bahkan tanpa upaya penanganan yang serius akan menjadi kondisi yang sangat menurun sampai dikategorikan tidak layak lagi sebagai Kawasan Lindung. Yang diperlukan sekarang ini adalah penanganan yang baik pemerintah maupun pihak-pihak yang peduli terhadap kelestarian lingkungan yang dilakukan secara terpadu. YACL juga sedang mencari dan menilai peluang dalam rangka pelestarian sumberdaya alam yang efektif di CA tersebut dan mengembalikan potensi alami yang begitu besar pada keadaan semula.

Hasil monitoring ReefCheck, terutama pada lokasi CA Tanjung Api ada beberapa beberapa poin dan pertanyaan tentang prosedur-prosedur serta standarisasi metode yang dibahas baik secara internal maupun secara lebih luas melalui pertemuan GCRMN/ReefCheck di Cebu setelah ITMEMS2⁷ melalui jaringan internet.

4. SURVAI-SURVAI BARU/AWAL

Data survai baru berupa baik data survai awal (baseline survey) yang merupakan langkah awal program monitoring maupun survai-survai pada lokasi baru yang kemungkinan besar tidak atau belum akan dilanjutkan dengan kegiatan monitoring tetapi bertujuan memberikan gambaran tentang keadaan saat sekarang pada wilayah-wilayah tertentu dan tambahan data/metode pada lokasi survai/monitoring sebelumnya. Kegiatan survai baru diuraikan dalam Tabel 4.1 di bawah ini.

⁷ International Tropical Marine Ecosystems Management Symposium, Manilla, 23-27 March 2003.

Tabel 4.1 Kegiatan Survei Baru Tahun 2002/2003

Lokasi	Reef Check	Manta Tow	LIT	Life Form	(UM) Video	Lain-lain	Keterangan/ Kerjasama
1. Kabupaten Donggala & Kotamadya Palu							
Tonggolobibi (P Barat)		X		X	X	X	MCRMP
Panggalaseang (P Barat)		X		X	X	X	MCRMP
Sioyong (P Barat)		X		X	X	X	MCRMP
Rerang (P Barat)		X		X	X	X	MCRMP
Labean (P Barat)		X		X	X	X	MCRMP
Lombonga (P Barat)		X		X	X	X	MCRMP
Pulau Pasoso (P Barat)			X		X	X	IPB/DPK
Labuana (P Barat)			X		X		
Tawaeli (Teluk Palu)		(X) ¹	X		X		
Kakafu (Teluk Palu)	X				X		Tanda Permanen
Manta Tow Teluk Palu		X					
2. Kabupaten Poso							
Taningkola (Togean)		X	X	X	X	X	MCRMP
Tumbulawa (Togean)		X	X	X	X	X	MCRMP
Malenge (Togean)		X	X	X	X	X	MCRMP
Kabalutan (Togean)		X	X	X	X	X	MCRMP
Kadidiri (Togean)			X	X		X	IPB/DPK
Teluk Kilat (Togean)			X	X		X	IPB/DPK
Bambu (Togean)			X	X		X	IPB/DPK
Lebiti (Togean)				X		X	IPB/DPK
CA Tanjung Api			X		X		
Ampana Tete	X	X	X		X		

¹ Dalam rangka Survei Manta Tow Teluk Palu.

Data survei-survei tersebut tercantum dalam Tabel-Tabel dan Gambar-Gambar sebagai berikut yaitu Data Manta tow pada Tabel 4.2 sampai 4.4 serta Gambar 4.1 sampai 4.4; Data ReefCheck pada Tabel dan Gambar 4.5 sampai 4.9 dan data LIT pada Tabel dan Gambar 4.10 sampai 4.12. Khusus program MCRMP di Pantai Barat, data “Life-form” juga diambil dengan menggunakan kategori-kategori LIT dan Indikator-ReefCheck serta beberapa indikator tambahan, tetapi tidak dimasukkan pada laporan ini. Semua data hasil survei berupa angka dibulatkan karena tingkat akurasi metodologi tidak membenarkan penampilan data dengan angka pecahan. Selain data yang dimasukkan pada laporan ini. Pada sebagian lokasi data sosio-ekonomi, kualitas air, pemanfaatan SDA dan hewan langka, data ekosistem lain dan informasi lingkungan secara umum juga pernah diambil dan dapat dilihat pada laporan lain.

(a) Data Manta Tow

Data Manta Tow dibagi pada tiga wilayah yaitu Teluk Palu (Kabupaten Donggala dan Kotamadya Palu), Pantai Barat (Kabupaten Donggala), dan di Teluk Tomini, Kabupaten Poso (Kepulauan Togean dan Desa Tete B di daratan ke sebelah Timur dari CA Tanjung Api).

(i) Manta Tow di Teluk Palu

Tabel 4.2 Manta Tow di Sekeliling Teluk Palu (Termasuk Tawaeli)

4.2.a Komposisi Substrat

(Persentase)

Lokasi	HC	SC	OT	RC	RB	S
Labuan	25	13	10	20	12	20
Tawaeli	24	10	9	13	23	21
Tondo	18	16	9	16	25	16
Rilanta	23	14	7	21	18	17
Kakafu	27	8	8	21	24	12
Donggala Selatan	24	8	9	28	20	11
Donggala Kota	20	12	9	18	27	14
Tanjung Karang	18	10	12	21	31	8
Rata-rata Teluk Palu	22.6	11.2	8.9	19.1	22.7	15.4

4.2.b Kondisi Terumbu Karang

(Persentase)

Lokasi	Jumlah Tow ¹	Panjang Survei (, 0.5 km)	Kategori (Penutupan Karang Keras) %				
			1 Rusak Berat	2 Rusak	3 Sedang	4 Baik	5 Sangat Baik
Labuan	13	4	15	27	50	8	0
Tawaeli	44	6	32	22	27	9	0
Tondo	20	5	65	25	10	0.0	0
Rilanta	35	8	21	43	27	9	0
Kakafu	26	7	21	31	36	10	2
Donggala Selatan	20	3.5	8	40	20	32	0
Donggala Kota	20	3	22	25	30	23	0
Tanjung Karang	22	3	36	45	14	5	0
Rata-rata Teluk Palu	200	39.5	28	32	26	13	1

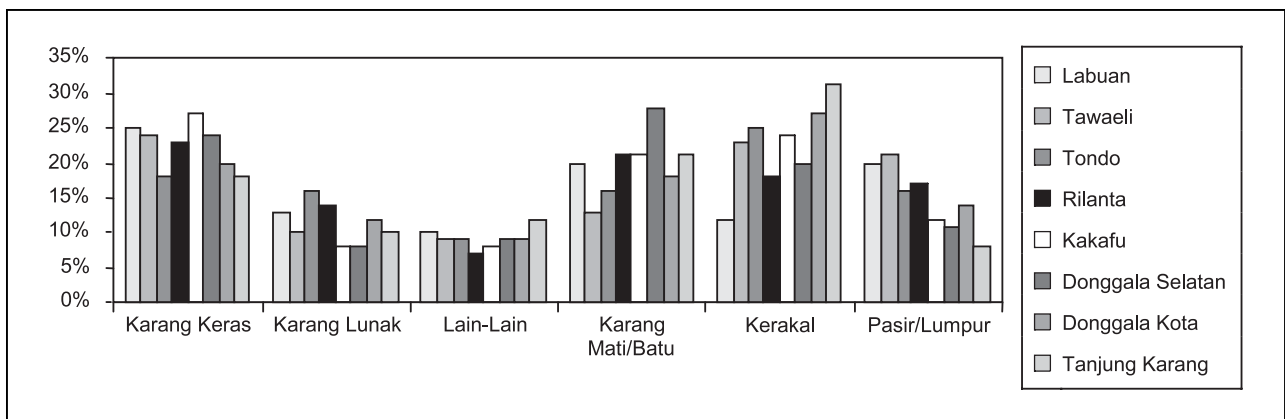
¹ Satu Tow = pengamatan selama 2 menit.

Survei Manta Tow di Teluk Palu tidak menutupi seluruh pingiran Teluk, karena pada sebagian Teluk Palu kualitas air terlalu rendah (0-2 m) sehingga dasar laut tidak kelihatan serta beberapa lokasi tidak mempunyai terumbu karang. Kekeruhan yang tinggi terjadi terutama dekat Kota Palu akibat sedimentasi dan polusi dari Sungai Palu serta disekitar muara-muara sungai. Teluk Palu dikelilingi oleh pegunungan yang cukup terjal dan sebagian besar hutan asli sudah gundul. Indikasi terjadinya kerusakan ekosistem di hulu akan terlihat debit air sungai, batu-batuan, sedimentasi dan erosi sekitar muara sungai.

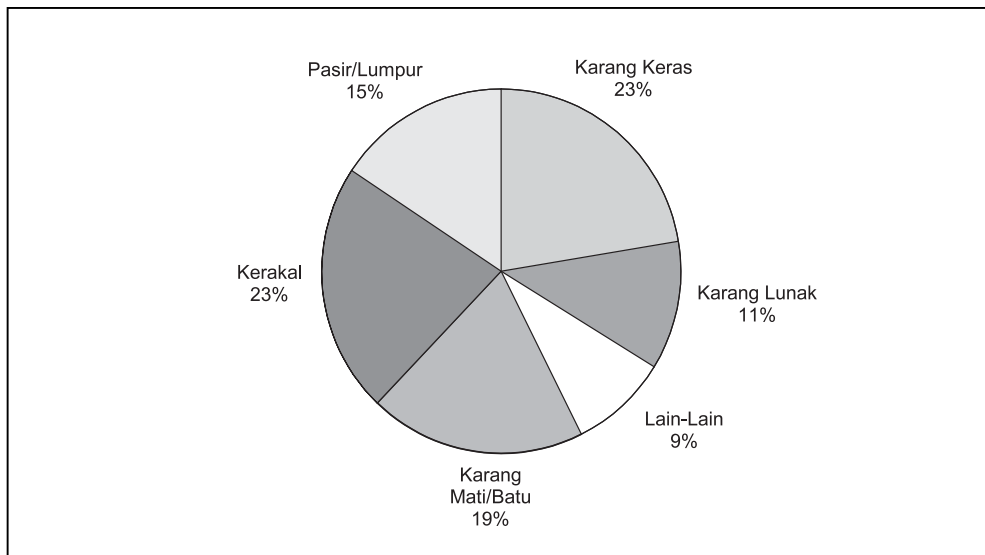
Berdasarkan Gambar 4.1 dan 4.2, kondisi serta komposisi terumbu karang di Teluk Palu sangat beragam dan bagian besar dalam kondisi Rusak atau Rusak Berat. Meskipun begitu, masih ditemukan terumbu karang dalam kondisi Baik dan Sangat Baik.

Gambar 4.1 Teluk Palu Manta Tow Survei Data

4.1.a Komposisi Substrat Teluk Palu



Komposisi Substrat per lokasi di Teluk Palu¹



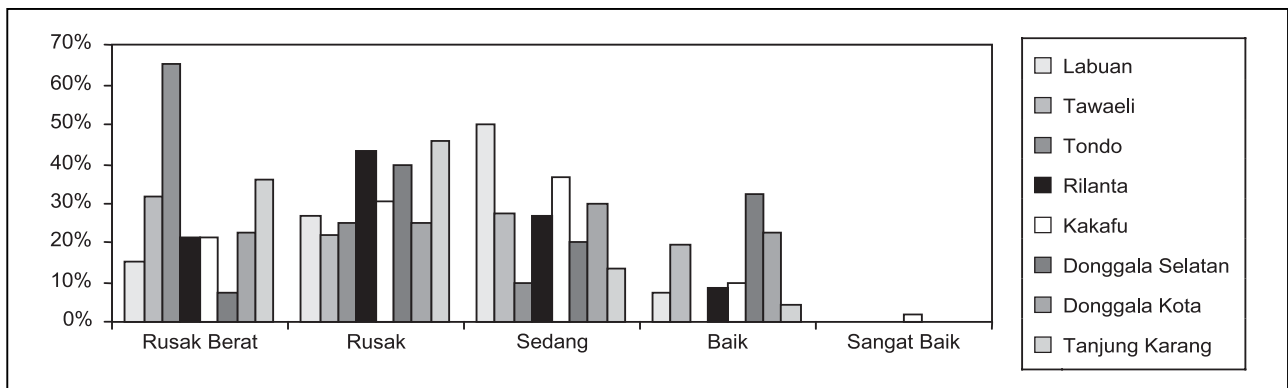
Komposisi Substrat Rata-rata di Teluk Palu

¹ Batas-batas lokasi-lokasi tersebut dapat dilihat pada Peta Survei di CD Lampiran, dan urutannya dari muara Teluk Utara ke muara Selatan.

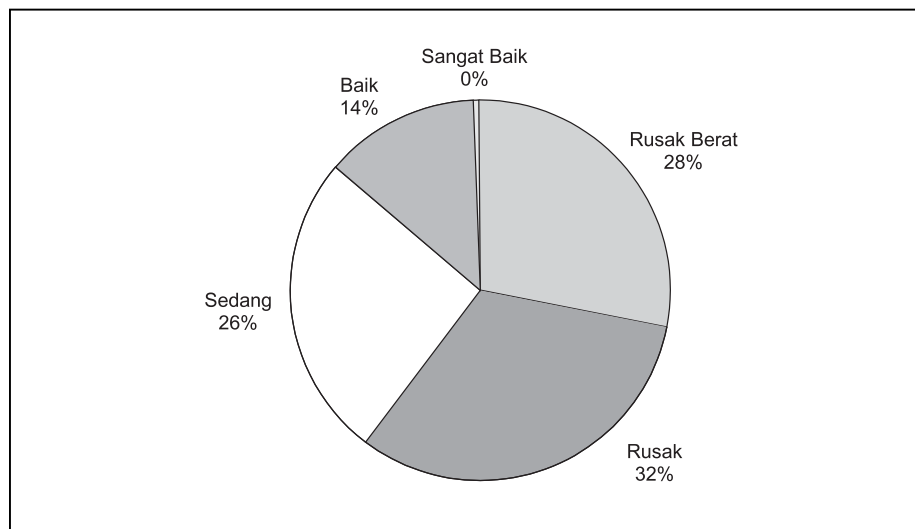
Kondisi terumbu karang disekitar pusat pariwisata Tanjung Karang pada ujung Selatan Barat Teluk Palu jauh dari baik. Hal tersebut disebabkan oleh penambangan karang yang digunakan sebagai batu fondasi, produksi kapur dan kebutuhan bangunan lainnya, serta aktivasi pengeboman yang dulu sering terjadi sekitar Tanjung tersebut. Meskipun aktivitas tersebut telah berhenti atau sangat berkurang, kondisi tanjung terus terkikis oleh ombak karena terumbu karang berfungsi sebagai perlindungan dari abrasi telah berkurang ataupun hilang.

Satu sumber kerusakan terumbu karang yang baru adalah pekerjaan pelebaran jalan lalu lintas dari Kota Donggala sampai Tanjung Karang. Jalan tersebut dibuat dengan menggali tebing batu kapur, dan sebagian besar batu yang digali terbuang ke laut disekitarnya baik secara sengaja maupun tidak sengaja oleh kontraktor serta para pekerjanya. Hal tersebut melanggar aturan Pemerintah dan mengakibatkan beberapa tebing terjadi longsor. Namun berdasarkan pengamatan, karang dibawah yang tertimpa oleh batu besar tidak merupakan ancaman jangka panjang, karena areal yang terkena relatif kecil dan batu-batu besar dapat menjadi substrat yang baik untuk media penempel karang baru. Ancaman akibat penutupan terumbu karang oleh sedimen berupa kerakal dan lumpur adalah sesuatu yang harus diperhatikan secara serius dan perlu monitoring serta tindakan untuk mengatasi sedimentasi lanjutan akibat abrasi tebing/longsor yang diakibatkan oleh adanya hujan yang membawa sedimentasi.

4.2.b Kondisi Terumbu Karang di Teluk Palu



Kondisi Terumbu Karang per Lokasi di Teluk Palu



Kondisi Rata-rata Terumbu Karang di Teluk Palu

(ii) Manta Tow di Pantai Barat (Selat Makassar)

Tabel 4.3 Manta Tow di Pantai Barat, Kabupaten Donggala.

4.3.a Komposisi Substrat

(Persentase)

Lokasi	LC	DC	HC	SC	OT	RC	RB	S
Tonggolobibi	40	60	19	9	12	18	10	32
Panggalaseang	38	62	18	11	10	19	23	20
Rerang	50	50	25	12	13	12	17	21
Sioyong	59	41	27	21	12	12	14	15
Labean	40	60	17	11	12	24	13	22
Lombonga	46	54	24	12	9	21	18	16
Rata-rata	45	55	22	12	11	18	16	21
Kategori	3	4	2	2	2	2	2	2

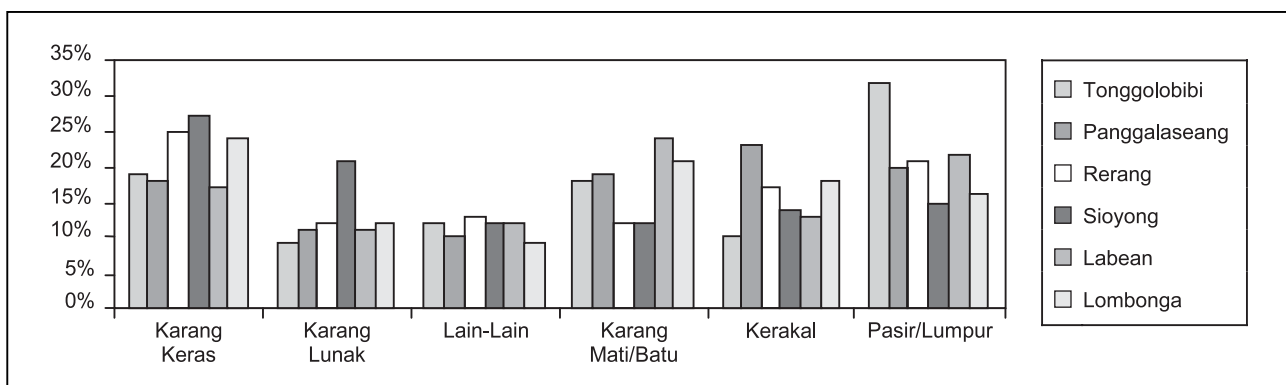
4.3.b Kondisi Terumbu Karang

(Persentase)

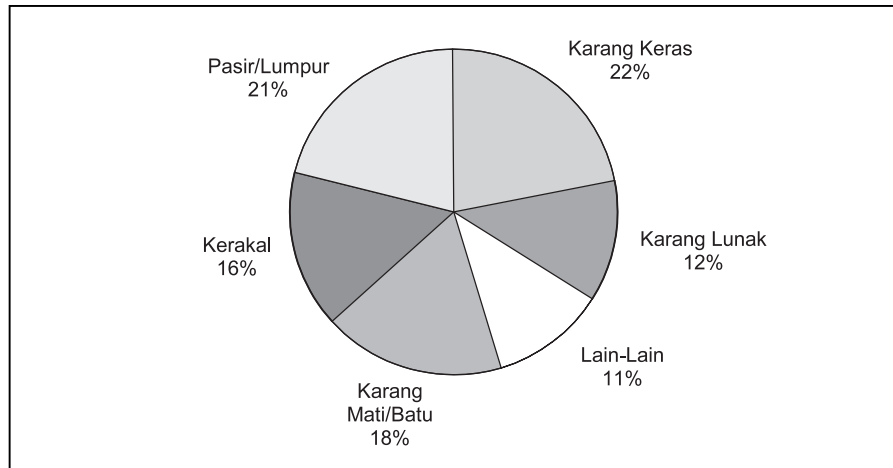
Lokasi	Rusak Berat	Rusak	Sedang	Baik	Sangat Baik	% HC	Kategori Rata-rata
Tonggolobibi	36	29	14	21	0	19	2
Panggalaseang	10	36	36	19	0	18	2
Rerang	21	33	21	25	0	25	2
Sioyong	13	13	50	25	0	27	2
Labean	33	54	13	0	0	17	2
Lombonga	10	45	40	0	5	24	2
Rata-rata	20	35	29	15	1	22	2

Gambar 4.3 Data Manta Tow di Pantai Barat Kabupaten Donggala

4.3.a Komposisi Substrat

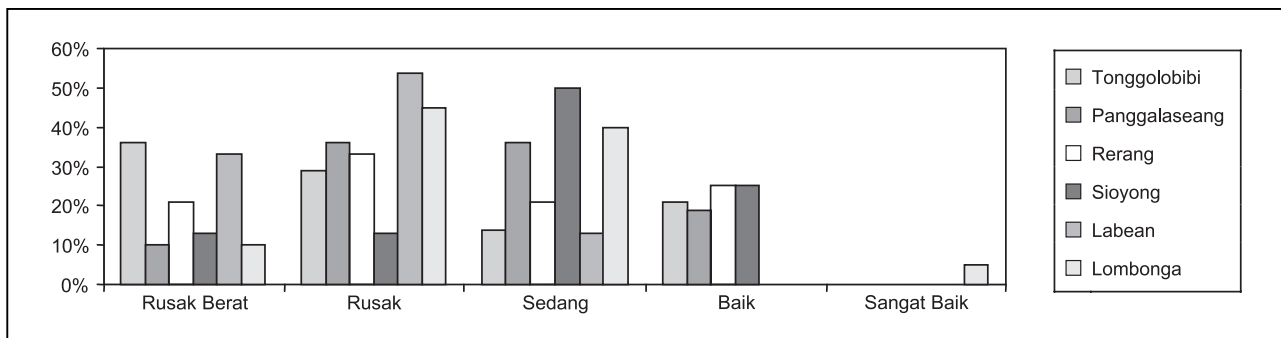


Komposisi Substrat per Lokasi di Pantai Barat

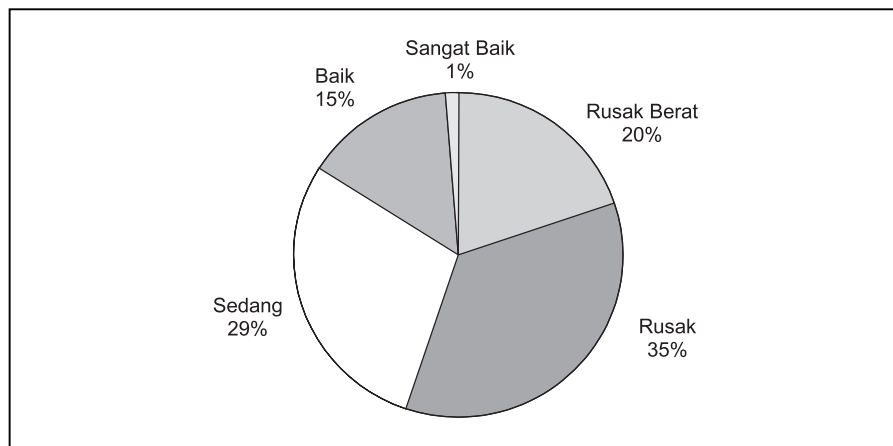


Komposisi Substrat Rata-rata di Pantai Barat

4.3.b Kondisi Terumbu Karang di Pantai Barat



Kondisi Terumbu Karang per Lokasi di Pantai Barat



Kondisi Terumbu Karang Rata-rata di Pantai Barat

Berdasarkan Gambar 4.3, kondisi di Pantai Barat adalah dalam kategori Rusak dan sebagian dalam kategori rusak berat. Tetapi masih ada sebagian besar yang dalam kondisi Sedang ataupun Baik tetapi relatif masih sangat baik. Sebagian lokasi sedimentasinya sangat tinggi hal ini disebabkan oleh penambang karang dan aktivitas perikanan “destructive fishing” seperti pengeboman dan pembiusan.

Dampak-dampak tersebut berkurang maka kondisi tersebut akan membaik dimana tekanan-tekanan menurun ada tanda-tanda pemulihan alami ekosistem seperti bibit-bibit karang akan tumbuh. Ada beberapa lokasi yang diduga mengalami nutrifikasi karena sebagian penutupan biota lainnya meliputi jenis-jenis lumut dan alga lain yang merupakan indikator adanya nutrifikasi.

(iii) *Manta Tow di Teluk Tomini*

**Tabel 4.4 Manta Tow di Teluk Tomini, Kabupaten Poso
(Kepulauan Togean dan Tete B)**

4.4.a Komposisi Dasar Laut

(Persentase)

Manta Tow	Jumlah Tow	HC	SC	OT	RC	RB	S
Malenge	10	17	9	13	25	16	20
Kabalutan	12	16	10	9	26	24	15
Taningkola	10	20	9	13	22	19	17
Tumbulawa	10	14	10	10	29	26	11
Siatu	10	13	12	13	23	19	20
Togean Rata-rata	52	16	10	12	25	21	16
Tete B	13	27	2	6	26	32	7

4.4.b Komposisi Dasar Laut di Daratan (termasuk CA Tj. Api)

(Persentase)

Lokasi ¹	Jumlah Tow	Length (0.5 km)	Approximate Persentase Benthic Penutupan						HC Kategori
			HC	SC	OT	DC	RB	S	
Tete B – Pal 1	13	2	27	2	6	26	32	7	2
Pal 1 – Tow akhir 2002	27	4	17	6	9	26	34	8	2
Tow akhir 2002 – Tanjung	20	2.5	25	3	6	23	33	10	2
Tanjung – Api Alam	21	2.5	24	5	8	23	35	5	2
Api Alam – TR4 & TR3	18	3	26	5	10	30	26	3	2
TR3 – TR2	20	2.5	17	2	5	24	45	7	2
TR2 – Pal 71 di Labuan	20	3.5	23	1	8	21	32	15	2
Rata-rata Lama	99	14	23	3	8	24	34	8	2
Rata-rata Baru	40	6	21	4	8	26	33	8	2
Rata-rata 2003	139	20	22	4	8	25	33	8	2
Rata-rata CA	126	18	22	4	8	25	33	8	2

¹ Pal adalah nama resmi untuk tanda-tanda batas Cagar Alam yang berjumlah 71. Nomor 1 terletak di pantai sebelah Timur di perbatasan dengan Tete B, sedangkan nomor 71 terletak di tengah laut di depan kampung Labuan sebelah Barat Tanjung. Pal 1 merupakan titik awal dari semua survai/monitoring Manta Tow di CA Tanjung Api, dari tahun 2000 sampai 2003. Tanjung adalah ujung Utara Tanjung Api. Pada tahun 2002, karena Pal 71 telah rusak dan belum diganti, titik akhir monitoring sebelah Timur salah. Lama adalah lokasi monitoring 2002, yaitu data di kotak abu-abu, sedangkan Baru adalah lokasi yang belum disurvei sebelumnya yaitu data di kotak-kotak putih di atas.

4.4.c Kondisi Terumbu Karang

(Persentase)

Kategori	Rusak Berat	Rusak	Sedang	Baik	Sangat Baik	% HC	Kategori Rata-rata
Malenge	45	35	20	0	0	17	2
Kabalutan	50	42	8	0	0	16	2
Taningkola	25	55	10	10	0	19	2
Tumbulawa	55	45	0	0	0	14	2
Siatu	55	30	15	0	0	13	2
Rata-rata di Togean	46	41	11	2	0	16	2
Tete B	4	39	38	19	0	27	2

4.4.d Kondisi Terumbu Karang di Daratan (termasuk CA Tj. Api)

(Persentase)

Lokasi	Jumlah Tow	Persentase Tow dalam Kategori					Arah	Sebelah
		1	2	3	4	5		
Tete B – Pal 1	13	4	38	39	19	0	S-U	ST
Pal 1 – Tow akhir 2002	27	30	55	15	0	0	S-U	ST
Tow akhir 2002 – Tanjung	20	3	42	45	10	0	ST-UB	UT
Tanjung – Api Alam	21	7	60	33	0	0	T-B	U
Api Alam – TR4 & TR3	18	0	29	65	6	0	UT-SB	UB
TR3 – TR2	20	18	62	20	0	0	S-U	SB
TR2 – Pal 71 di Labuan	20	3	60	25	12	0	T-B	S
Rata-rata Lama	99	6	51	38	6	0		
Rata-rata Baru	40	17	47	27	10	0		
Rata-rata 2003	139	9	49	35	7	0		
Rata-rata CA	126	10	51	34	5	0		

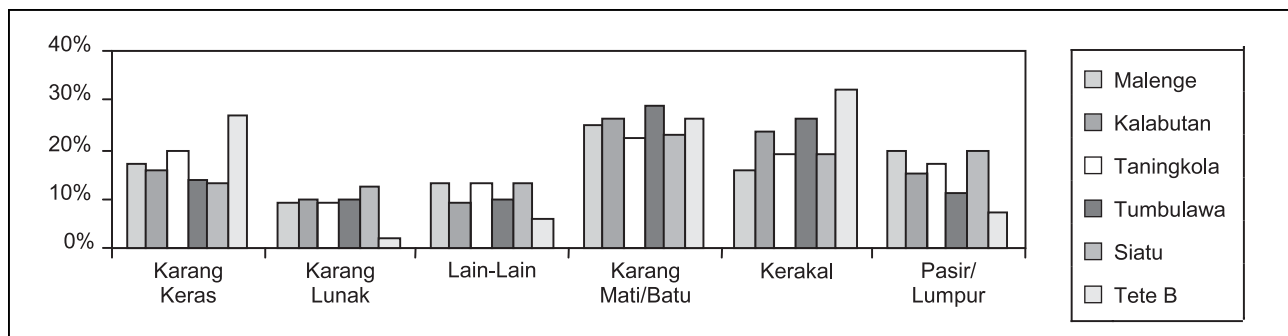
Berdasarkan data dalam Tabel 4.4 diatas serta Gambar 4.4 dibawah, maka kondisi terumbu karang di Teluk Tomini dalam kategori Rusak. Hal tersebut sesuai dengan penilaian subjektif oleh pengamat-pengamat bahwa mayoritas terumbu karang terutama yang berbentuk “fringing reef”, telah mengalami penurunan oleh aktivitas manusia baik secara langsung maupun tidak langsung.

Tete B adalah desa tetangga dengan CA Tanjung Api di sebelah Timur, dan “fringing reef” nya dapat dibandingkan dengan terumbu karang sekeliling CA tersebut. Oleh karena itu, data di CA tanjung Api juga dimasuki pada Tabel 4.4. Kondisi rata-rata di Tete B mendekati kategori “Sedang”, dan persentase dalam kategori “Baik” ini lebih tinggi dari pada di Kepulauan Togean. Hal ini sangat berlawanan dengan kondisi umum kawasan Tete B dalam keadaan telah rusak total oleh pengeboman sedangkan Kepulauan Togean mempunyai terumbu karang yang indah. Kondisi di Tete B juga lebih baik dibanding dengan mayoritas CA Tanjung Api, sedangkan yang bagian CA kondisi terbaik terdapat batasan Barat di Labuan, meskipun kerusakan oleh sedimentasi dan pembuangan jangkar sangat jelas. Hal tersebut sesuai dengan yang diharapkan secara umum di kawasan perairan Propinsi Sulawesi Tengah seperti tim survai YACL dan secara global oleh sebagian besar peneliti kondisi terumbu karang, yaitu bahwa terumbu karang yang dekat pemukiman (kampung), dimana aktivitas manusia teramati langsung oleh penduduk, pada umumnya kurang rusak oleh pengeboman dibanding dengan lokasi-lokasi sedikit lebih jauh dimana aktivitas tersebut mudah dilaksanakan tanpa ada yang mengawasi.

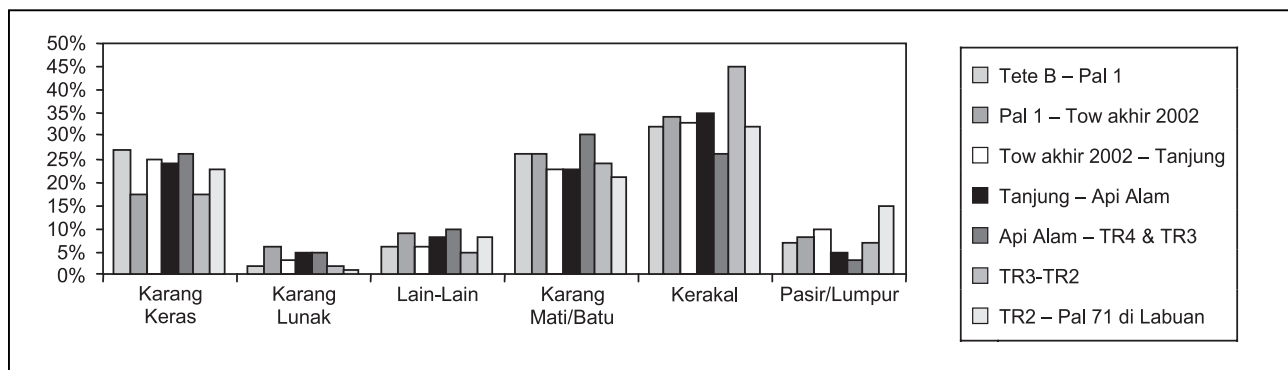
Meskipun penyebab degradasi dan prognosis bervariasi masing-masing lokasi, ini merupakan dampak dari aktivitas manusia bukan akibat faktor-faktor alami. Dalam jangka waktu relatif dekat (dibawah 100 tahun, mayoritas dibawah 20 tahun), terumbu karang di Kepulauan Togean yang terkenal di dunia pariwisata sebagai taman laut yang indah dalam keadaan yang sangat memprihatinkan. Namun keadaan umum seperti kecerahan, kebersihan dan suhu air sangat mendukung untuk pertumbuhan karang dan keanekaragaman terumbu karang masih tergolong tinggi. Penutupan karang hidup yang terendah diantara semua lokasi survei di perairan Sulawesi Tengah terdapat di Kepulauan Togean. Pemilik-pemilik usaha pariwisata dan pihak-pihak lain yang tergantung dari sektor pariwisata merasa khawatir bahwa 5 tahun kedepan terumbu karang di Kepulauan Togean tidak akan layak sebagai Obyek Wisata. Tim survei menilai prediksi tersebut mempunyai kemungkinan dan bakal terjadi jika tidak ada perubahan dalam perilaku manusia terhadap alam laut dan pesisir termasuk Masyarakat dan Pemerintah setempat serta pengunjung untuk melestarikannya.

Gambar 4.4. Data Manta Tow di Teluk Teluk Tomini Kabupaten Poso (Fringing Reef)

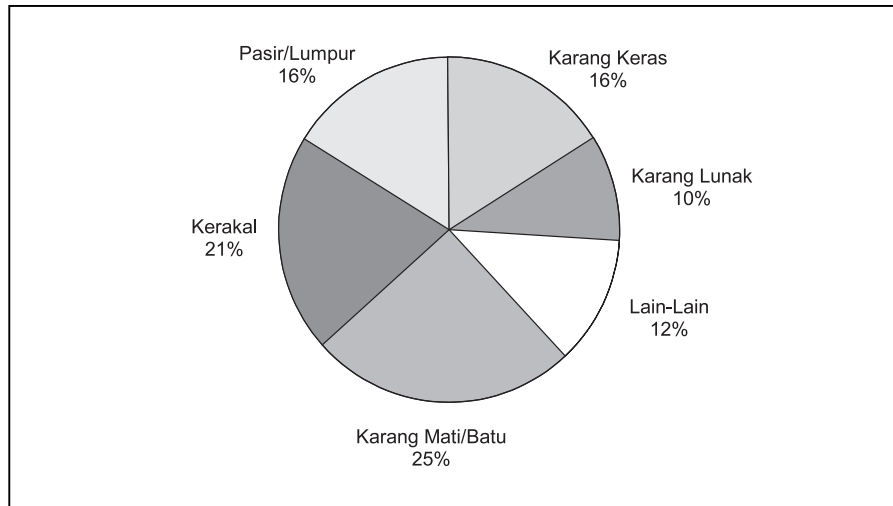
4.4.a Komposisi Substrat di Teluk Tomini



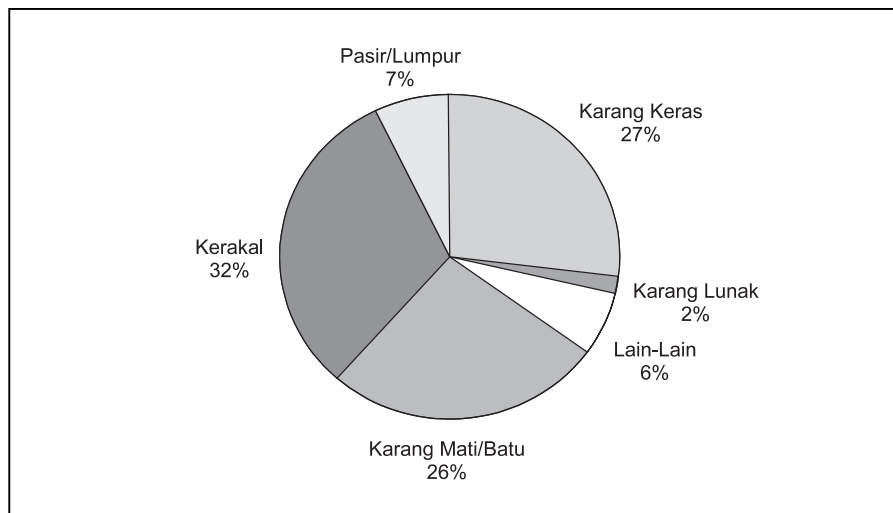
Komposisi Substrat di Teluk Tomini menurut Lokasi



Komposisi Substrat di Tete B dan Perbandingan dengan CA Tanjung Api

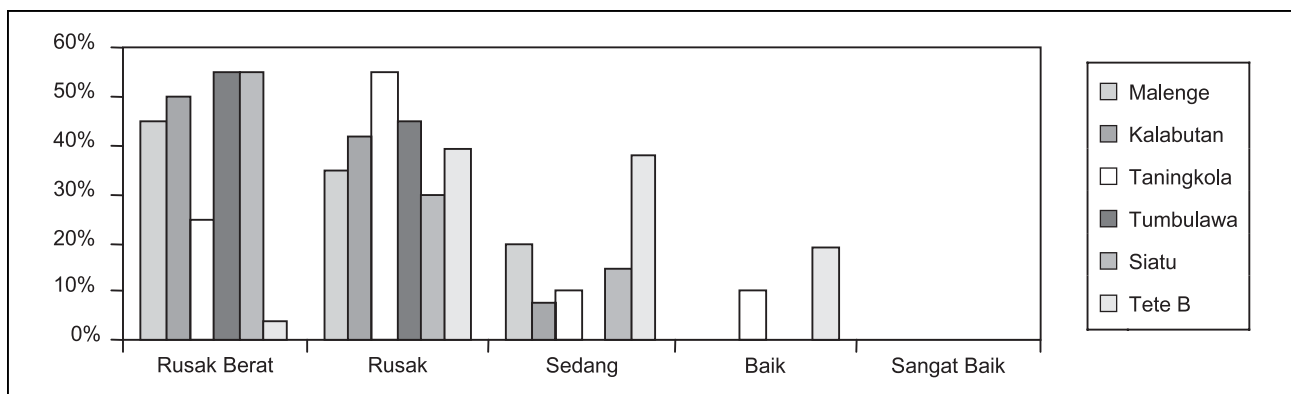


Komposisi Substrat khusus "Fringing Reefs" di Kepulauan Togean

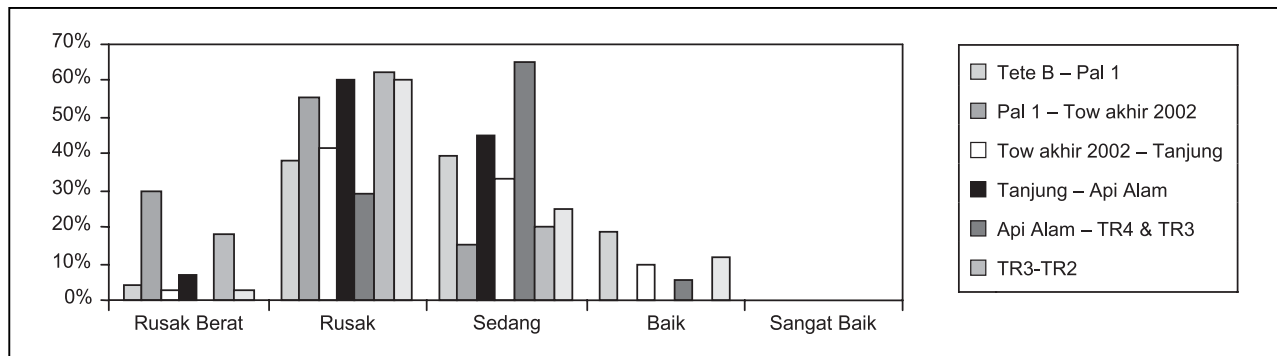


Komposisi Substrat di Tete B

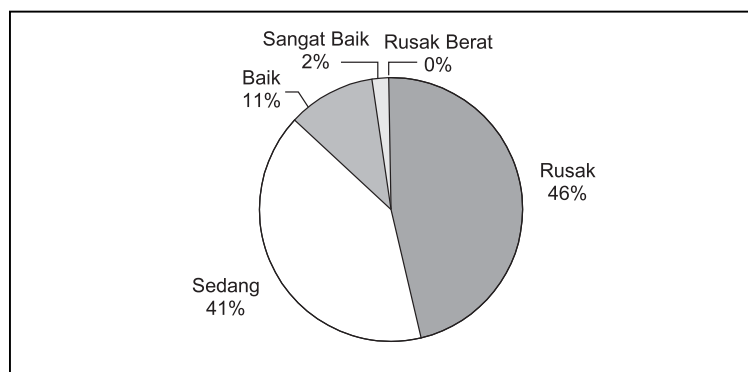
4.4.b Kondisi Terumbu Karang di Teluk Tomini



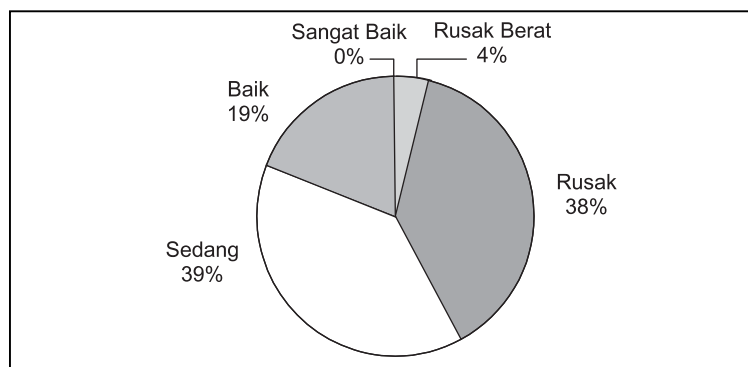
Kondisi Terumbu Karang di Teluk Tomini menurut Lokasi



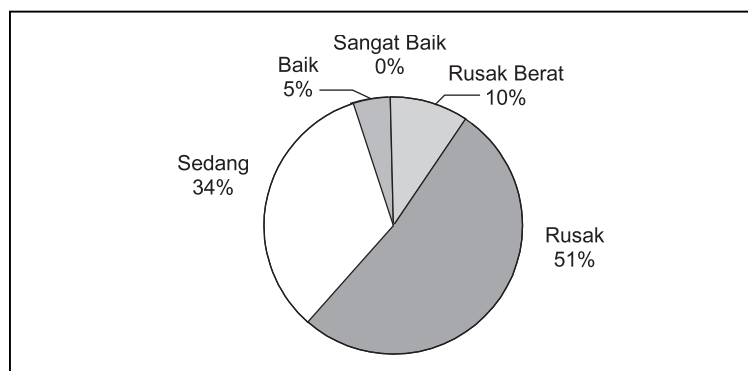
Kondisi Terumbu Karang di Tete B dan Perbandingan dengan CA Tanjung Api



Kondisi “Fringing Reefs” di Kepulauan Togean



Kondisi “Fringing Reefs” di Tete B



Kondisi Terumbu Karang di CA Tanjung Api

Gambar 4.4 Menjelaskan bahwa kondisi “fringing reef” di Teluk Tomini sangat memprihatinkan terutama di Kepulauan Togean. Lokasi terbaik dikawasan Tete B yang tidak mempunyai status kawasan lindung. Sedangkan CA Tanjung Api dan “finging reef” dicalonkan sebagai Taman Wisata Laut Kepulauan Togean sangat mengalami penurunan. Khususnya CA Tanjung Api, kelihatan bahwa lokasi yang disekitar perkampungandisebelah tanjung merupakan kawasan paling rusak.

(iv) *Kesimpulan Data Manta Tow 2002/2003*

Data Survei/Monitoring Manta Tow di Sulawesi Tengah menurut wilayah survei tercantum dalam Tabel dan Gambar 4.5 dibawah ini.

Tabel 4.5 Data Manta Tow 2002/2003

4.5.a Manta Tow 2002/2003 – Sampel Kondisi Terumbu Karang di Sulawesi Tengah

(Persentase)

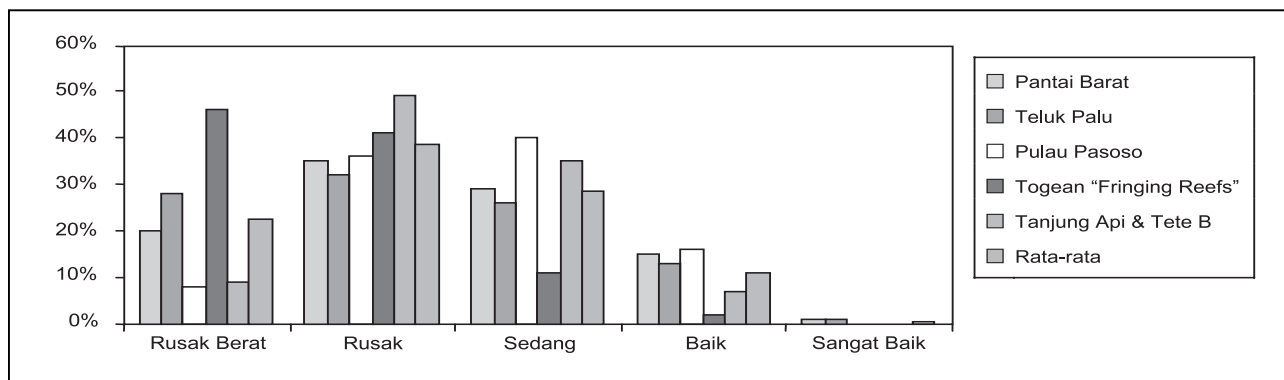
Lokasi	Rusak Berat	Rusak	Sedang	Baik	Sangat Baik
Pantai Barat	20	35	29	15	1
Teluk Palu	28.0	32.0	26.0	13.0	1.0
Pulau Pasoso	8	36	40	16	0
Togean “Fringing Reefs”	46	41	11	2	0
Tanjung Api & Tete B	9	49	35	7	0
Rata-rata	22	39	28	11	0

4.5.b Manta Tow 2002/2003 – Sampel Komposisi Substrat di Sulawesi Tengah

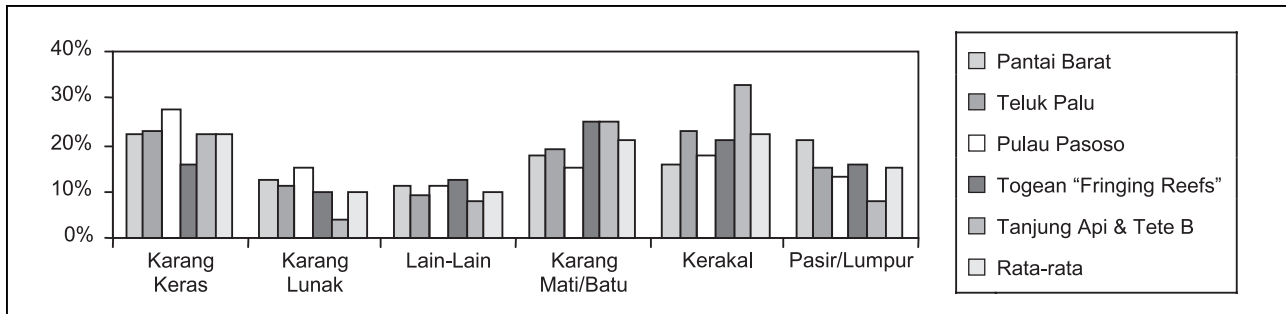
(Persentase)

Lokasi	HC	SC	OT	RC	RB	S
Pantai Barat	22	12	11	18	16	21
Teluk Palu	23	11	9	19	23	15
Pulau Pasoso	28	15	11	15	18	13
Togean “Fringing Reefs”	16	10	12	25	21	16
Tanjung Api & Tete B	22	4	8	25	33	8
Rata-rata	22.0	10.0	10.0	21.0	22.0	15.0

Gambar 4.5 Kesimpulan Data Manta Tow 2002/2003 di Sulawesi Tengah



Kondisi Terumbu Karang – Manta Tow



Komposisi Substrat – Manta Tow

Menurut Tabel dan Gambar 4.5, perbedaan antara wilayah-wilayah survai di Sulawesi Tengah cukup berbeda dengan penutupan karang keras serta karang lunak ditemukan yang tertinggi di SMS Pulau Pasoso. dimana kondisi secara umum kondisinya diatas rata-rata. Kerakal (pecahan karang mati) tertinggi di CA Tanjung Api, dimana pengeboman terjadi secara rutin. Batu/karang mati tertinggi terdapat di CA Tanjung Api serta Kepulauan Togean, terutama akibat tingkat pembusuan. Pasir/lumpur tertinggi terdapat di Pantai Barat, terutama akibat sedimentasi yang merupakan dampak kerusakan di daratan, sedangkan sebagian besar pasir di Kepulauan Togean merupakan fase akhir dalam proses alami untuk pembentukan pasir dari pecahan karang serta biota laut lainnya.

(b) Data ReefCheck:

Dari dua lokasi baru survai ReefCheck pada tahun 2002/2003 yang pertama adalah dilokasi Kakafu di pantai Selatan Barat Teluk Palu, di luar Kotamadya Palu dalam Kabupaten Donggala. Data dari lokasi tersebut bertujuan mewakili sebelah Selatan Teluk Palu untuk melengkapi data Kadongo dan Talise dalam monitoring rutin di Teluk Palu, dan tanda transek permanen sudah terpasang. Pantai di kawasan Kakafu dilewati oleh jalan raya Palu-Donggala dan didaratnya terdapat tebing yang ditutupi oleh tumbuhan.

Lokasi kedua adalah di Desa Tete B, Kecamatan Ampanan Tete, Kabupaten Poso, dekat perbatasan Timur CA Tanjung Api. Tanda permanen di Desa Tete B tidak terpasang, dengan asumsi monitoring dapat dilakukan atau tidak akan sangat tergantung dari berkembangnya di CA Tanjung Api. Maka dari itu introduksi dan pemakaian bom yang diledakan dari jauh (remote detonated) CA Tanjung Api serta semua wilayah sekitarnya akan cepat hancur jika tidak ada penegakan hukum dan pelestarian yang efektif.

Terumbu karang pada kampung sebelah yaitu Uebone telah rusak oleh aktivitas pengeboman hingga dapat dikatakan bahwa fungsi ekologisnya sebagai terumbu karang hilang. Degradasi tersebut terjadi antara Januari 2002 dan Tahun Baru 2003 dimana survai snorkel kualitatif terlaksana oleh satu anggota tim survai YACL. Pada 2002, lokasi tersebut dinilai sebagai lokasi sangat potensil untuk kegiatan eko-wisata dan sebagai lokasi survai/monitoring dimana terumbu karang memiliki keanekaragamannya tinggi dan ikan berlimpah. Pada awal 2003, hampir tidak ada karang hidup ataupun ikan yang teramati. Menurut informasi dari masyarakat setempat bahwa yang melakukan pengrusakan adalah oknum-oknum dan masyarakat lokal yang menghancurkan Uebone dan CA Tanjung Api.

Bagian daratan CA Tanjung Api juga terancam oleh kegiatan penebangan hutan untuk pembukaan lahan, penebangan kayu, pemburuan jenis satwa yang dilindungi. Sebelah belakang Tete B di lokasi survai baru, keadaan lokasi berupa pantai berpasir putih serta kebun-kebun kelapa yang sudah tinggi-tinggi bahkan umurnya diperkirakan telah mencapai 100 tahun lebih. Beberapa pohon mangrove masih bertahan, tetapi umumnya tua dan jumlah anaknya sangat rendah. Dilokasi tersebut direncanakan sebagai lokasi pembibitan (*hatchery*) Kerapu terutama khusus Kerapu Tikus (*Cromileptes altivelis*) oleh Dinas Perikanan Kabupaten Poso. Pada saat melakukan survai dengan memberi tanda tanda merah yang pada pohon-pohon kelapa yang telah dicat di 4 lokasi. Rencananya proyek tersebut direncanakan di Uebone akan tetapi dipindahkan ke lokasi Tete B tanpa alasan yang tidak jelas. Banyak rumor yang tersebar di masyarakat kekuatan politik dan kecemburuan sosial antara dua Desa. Sepanjang kurang lebih 20 mil di pesisir Teluk Tomini dari CA Tanjung Api ke arah Timur, air tawar yang berasal dari daratan membawa pasir dan bebatuan terjadi di beberapa titik antara lain pada satu titik dibelakang lokasi survai, air tawar keluar di tengah laut dangkal dan sejak lama oleh penduduk setempat membuat sumur yang dikelilingi beton di tengah laut.

(i) *Data ReefCheck baru – Substrat*

Data komposisi substrat di Kakafu dan Tete B serta perbandingan dengan wilayah sekitarnya tercantum dalam Tabel dan Gambar 4.6.

Tabel 4.6 Data ReefCheck – Komposisi Substrat**4.6.a Komposisi Substrat di Kakafu***(Persentase)*

Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Kakafu	3 m	55	0	14	1	1	12	9	8	0	0
Kakafu	10 m	32	1	8	9	0	9	24	17	0	0
Rata-rata Kakafu		43	1	11	5	1	11	16	12	0	0

4.6.b Perbandingan antara Kakafu dan Lokasi-Lokasi lain di Teluk Palu*(Persentase)*

Lokasi	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Kakafu	43	1	11	5	1	11	16	12	0	0
Talise	30	2	0	2	11	34	20	0	1	0
Kadongo	6	4	12	10	3	6	50	4	1	4
Teluk Palu	26	2	8	6	5	17	29	5	1	1

4.6.c Komposisi Substrat di Tete B*(Persentase)*

Lokasi	Kedalaman	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tete B	3 m	46	0	1	6	1	35	7	3	0	1
Tete B	10 m	36	0	0	2	4	39	18	1	0	0
Rata-rata Tete B		41	0	1	4	3	37	12	1	0	1

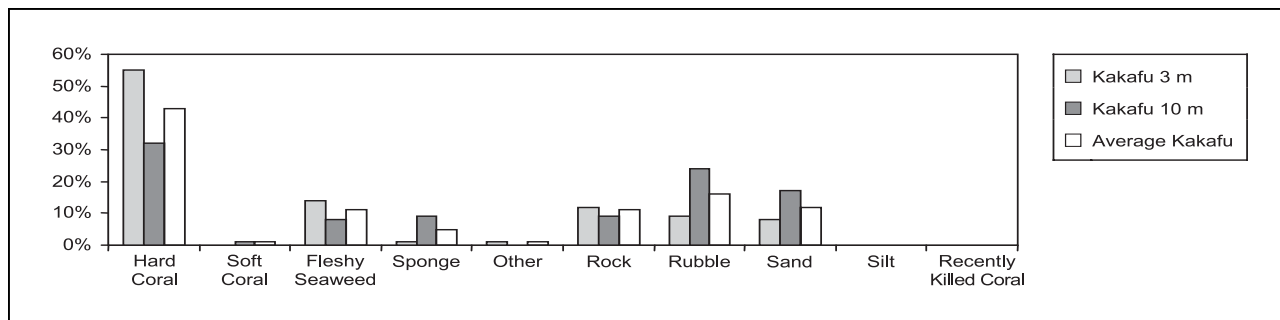
4.6.d Perbandingan antara Tete B dan Lokasi-Lokasi di CA Tanjung Api*(Persentase)*

Lokasi	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tete B	41.0	0.0	1.0	4.0	3.0	37.0	12.0	1.0	0.0	1.0
Tj Api 1	34.0	0.0	1.0	2.0	2.0	46.0	8.0	7.0	0.0	0.0
Tj Api 2	56.0	0.0	0.0	6.0	1.0	18.0	16.0	1.0	0.0	2.0
Tj Api 3	24.0	1.0	1.0	4.0	5.0	23.0	41.0	0.0	0.0	1.0
Tj Api 4	43.0	1.0	0.0	0.0	6.0	27.0	22.0	1.0	0.0	0.0
Rata-rata	39.0	1.0	1.0	3.0	3.0	30.0	20.0	2.0	0.0	1.0

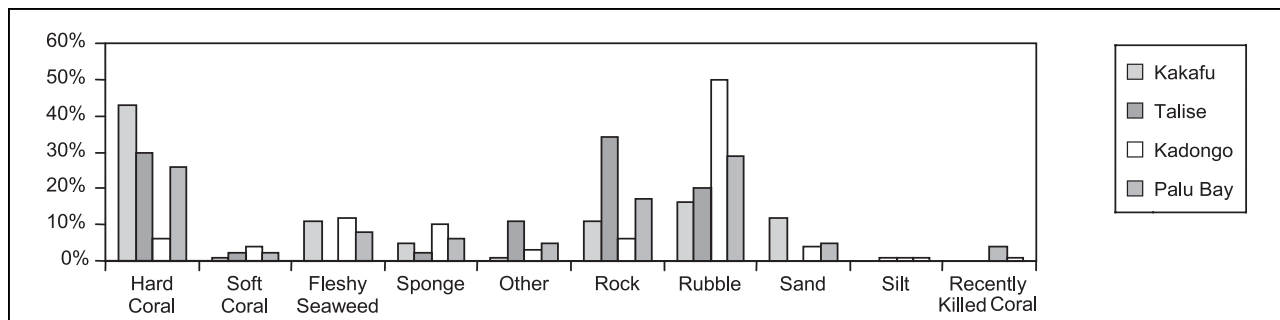
Berdasarkan data di Tabel dan Gambar 4.6 m, bahwa kondisi terumbu karang di Kakafu lebih baik dibanding dengan lokasi lainnya di Teluk Palu, hal ini berdasarkan hasil survai Manta Tow. Lokasi Kakafu kecenderungan mengalami arus cukup kencang dan arah arus yang tidak menentu sehingga kegiatan survai tidak mudah tetapi hal tersebut juga merupakan faktor perlindungan sehingga kondisinya tetap relatif baik.

Kondisi terumbu karang di Tete B juga lebih baik dibanding dengan mayoritas lokasi di CA Tanjung Api. Penutupan tinggi oleh karang keras pada monitoring di Transek 2,3 dan 4 disebabkan cara pemasangan ulang tali transek dikarenakan tanda permanennya hancur dengan cara dalam pemasangan tali transek mencari terumbu karang terbaik disekitarnya.

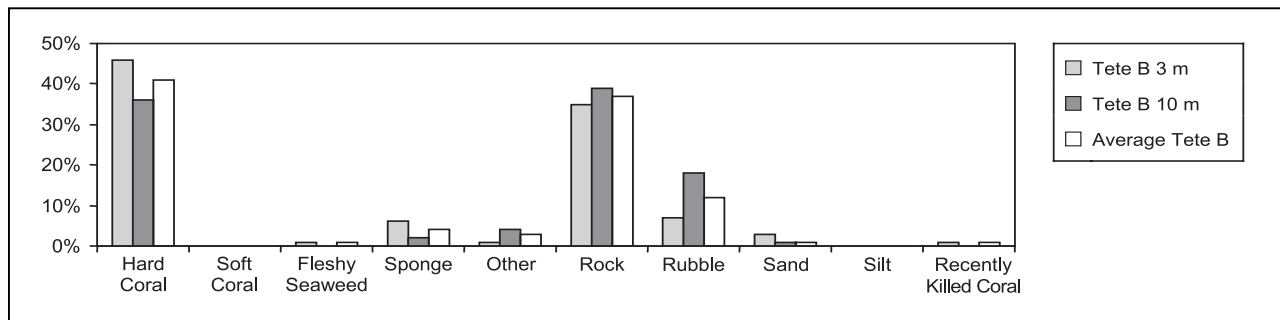
Gambar 4.6 Data ReefCheck – Komposisi Substrat (Line Transect)



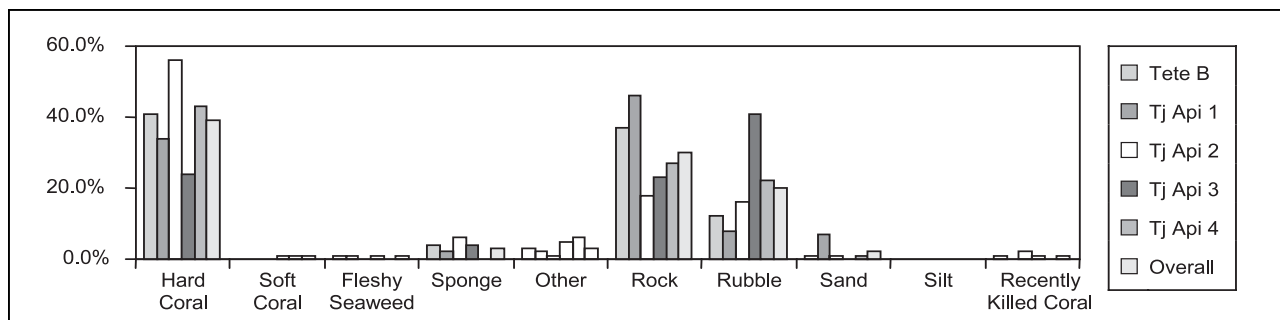
ReefCheck – Komposisi Substrat di Kakafu, Teluk Palu



ReefCheck – Komposisi Substrat di Teluk Palu – Perbandingan



ReefCheck – Komposisi Substrat di Tete B



ReefCheck – Komposisi Substrat di Tete B dan CA Tanjung Api – Perbandingan

(ii) Data ReefCheck Baru – Jenis-Jenis Indikator

Tabel 4.7 ReefCheck Data – Jenis-Jenis Ikan Indikator

4.7.a Data Jenis-Jenis Ikan Indikator Pada Lokasi-Lokasi Baru

Lokasi	Kakafu	Kakafu	Kakafu		Tete B	Tete B	Tete B
Kedalaman	3 m	10 m	Rata-rata		3 m	10 m	Rata-rata
Ikan:							
Ikan Kupu-kupu Chaetodontidae	199	130	164.5		18	58	38
Ikan Bibir Tebal Haemulidae	0	1	0.5		0	0	0
Ikan Bungawara Lutjanidae	36	48	42		7	38	22.5
Kerapu Tikus Cromileptes altivelis	0	1	0.5		0	0	0
Kerapu Seranidae >30 cm	10	2	6		1	0	0.5
Ikan Napoleon Cheilinus undulatus	0	0	0		0	0	0
Ikan Kakatua Besar Bolbometopon muricatum	0	1	0.5		4	0	2
Ikan Kakatua Lainnya Scaridae	33	17	25		2	14	8
Belut Moray Murenidae	0	0	0		0	0	0
Hewan Langka:							
Penyu	0	0	0		0	0	0
Duyung	0	0	0		0	0	0
Ikan Hiu	0	0	0		0	0	0

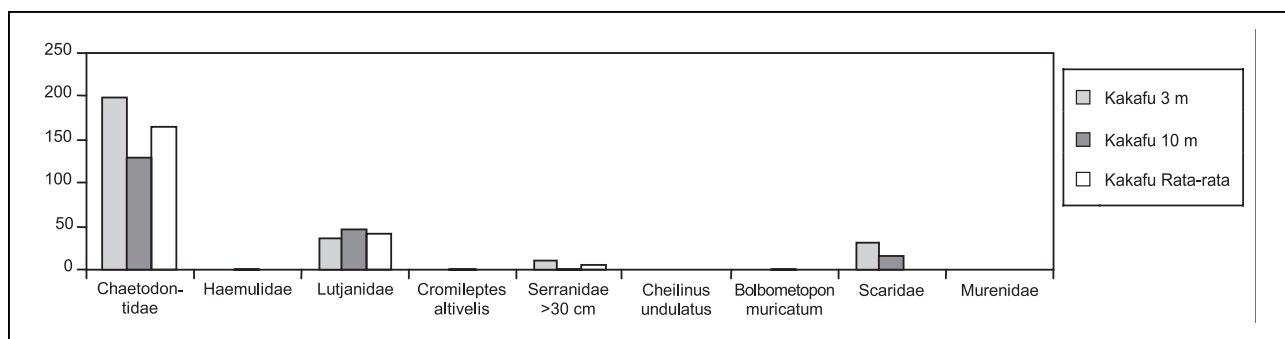
4.7.b Perbandingan antara Kakafu dan Lokasi-Lokasi Monitoring di Teluk Palu

Lokasi	Kakafu	Kadongo	Talise	Teluk Palu
Ikan:				
Ikan Kupu-kupu Chaetodontidae	164.5	37	61.5	87.7
Ikan Bibir Tebal Haemulidae	0.5	1.5	11	4.3
Ikan Bungawara Lutjanidae	42	12	12.5	22.2
Kerapu Tikus Cromileptes altivelis	0.5	0	0	0.2
Kerapu Seranidae >30 cm	6	2	0	2.7
Ikan Napoleon Cheilinus undulatus	0	0	0	0.0
Ikan Kakatua Besar Bolbometopon muricatum	0.5	1	5.5	2.3
Ikan Kakatua Lainnya Scaridae	25	5	7.5	12.5
Belut Moray Murenidae	0	0	0.5	0.2
Hewan Langka:				
Penyu	0	0	0	0.0
Duyung	0	<1	0	<1
Ikan Hiu	0	0	0	0.0

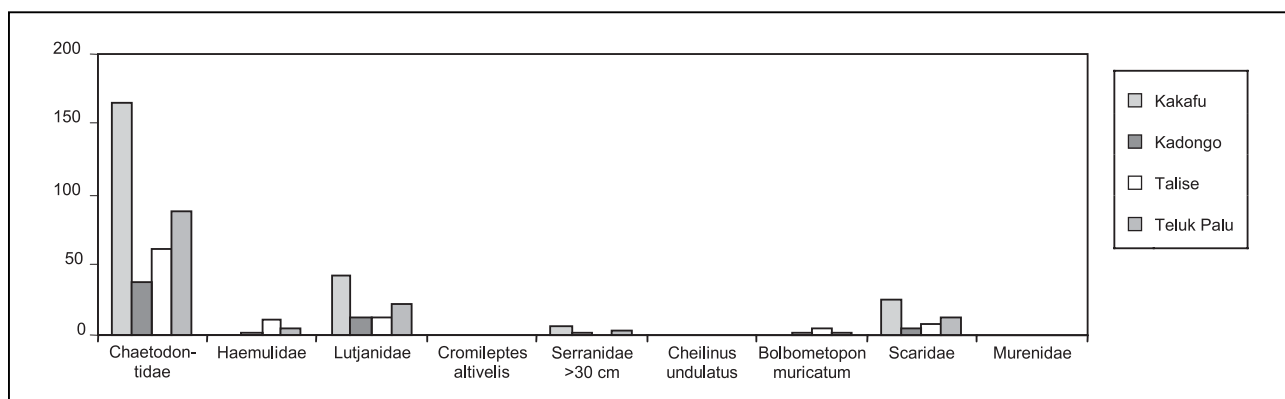
4.7.c Perbandingan antara Tete B dan Lokasi-Lokasi Monitoring di CA Tanjung Api

Lokasi	Tete B	T Api 1	T Api 2	T Api 3	T Api 4	Rata-rata
Ikan:						
Ikan Kupu-kupu Chaetodontidae	38	11.5	19.5	6.5	13	17.7
Ikan Bibir Tebal Haemulidae	0	0.5	0.5	0.0	0.25	0.3
Ikan Bungawara Lutjanidae	22.5	1	6	0.0	3	6.5
Kerapu Tikus Cromileptes altivelis	0	0	0	0.0	0	0.0
Kerapu Seranidae >30 cm	0.5	0.5	0	0.0	0	0.2
Ikan Napoleon Cheilinus undulatus	0	0	0	0.0	0	0.0
Ikan Kakatua Besar Bolbometopon muricatum	2	2	0	2.5	1.25	1.6
Ikan Kakatua Lainnya Scaridae	8	1.5	1.5	8.5	5	4.9
Belut Moray Murenidae	0	0	0	0.0	0	0.0
Hewan Langka:						
Penyu	0	0	0	0	0	0
Duyung	0	0	0	0	0	0
Ikan Hiu	0	0	0	0	0	0

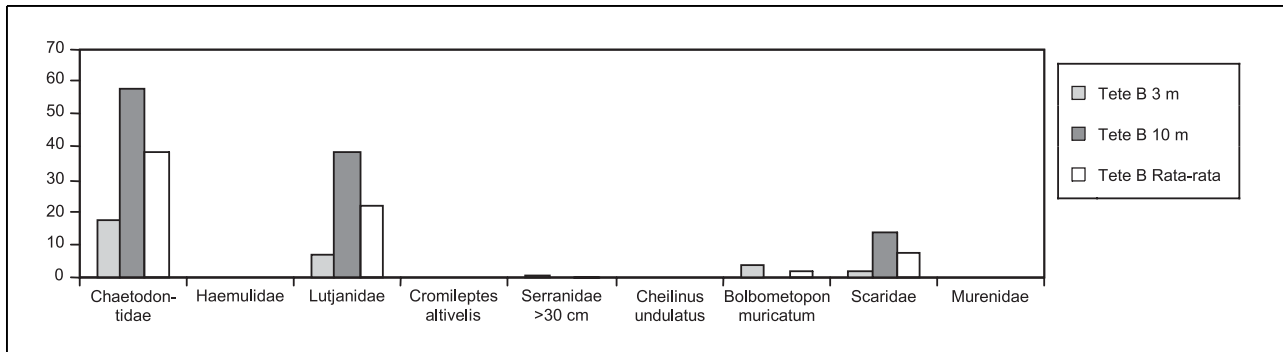
Gambar 4.7 ReefCheck – Hasil Survei Ikan Indikator



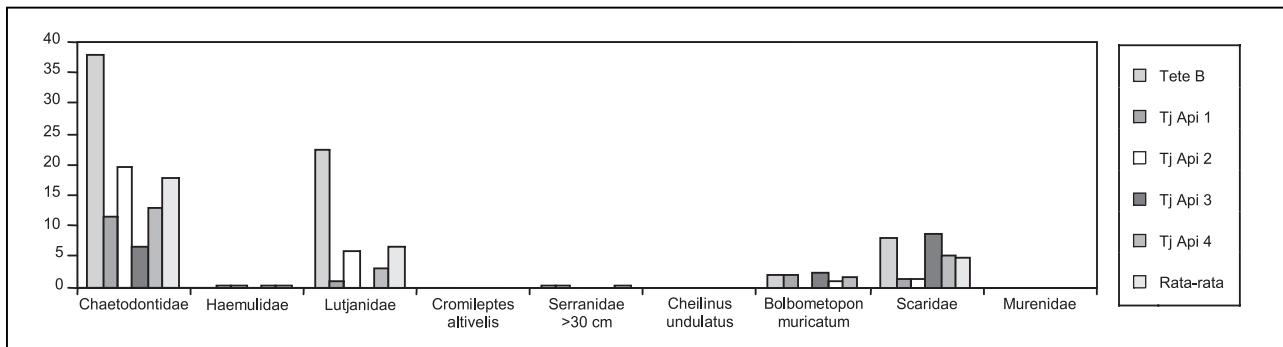
Ikan Indikator di Kakafu



Ikan Indikator – Perbandingan antara Kakafu dan Lokasi-Lokasi Monitoring di Teluk Palu



Ikan Indikator di Tete B



Ikan Indikator – Perbandingan antara Tete B dan Lokasi-Lokasi Monitoring di CA Tanjung Api

Data di Tabel dan Gambar 4.7 mengindikasikan bahwa populasi ikan pada dua lokasi survei baru lebih baik dibanding dengan lokasi yang terdekat monitoring. Hal tersebut diduga kuat terkait dengan kondisi terumbu karang yang relatif baik pada transek-transek baru tersebut serta terumbu karang disekitarnya. Meskipun begitu, distribusi jenis ikan yang berjumlah banyak dan jenis langka/tidak ditemukan, sehingga jenis yang ditemukan tidak jauh berbeda. Perbedaan hanya pada jumlah ikan saja berdasarkan hasil pengamatan di transek-transek lain di sekitarnya, baik di Teluk Palu khususnya Kakafu maupun di CA Tanjung Api khususnya Tete B.

Angka nol pada dua lokasi baru tersebut khusus Haemulidae, *Cromileptes altivelis*, *Cheilinus undulatus* dan Murenidae serta angka rendah khusus Serranidae >30 cm yang teramati merupakan indikasi tekanan berat oleh kegiatan penangkapan ataupun aktivitas manusia lainnya. Khusus tiga jenis yang berjumlah banyak (Chaetodontidae, Lutjanidae dan Scaridae), di Kakafu kebanyakan di kedalaman 3m sedangkan di Tete B mayoritas di kedalaman 10 m. hal ini diduga berkaitan dengan kualitas air atau faktor lain seperti waktu, cuaca, musim, kondisi karang dan sebagainya? Di Tete B ada indikasi bahwa didekat perkampungan serta didepan kebun kelapa, frekuensi aktivitas penangkapan ilegal berkurang dibanding dengan di Cagar Alam. Sehingga perbedaan antara lokasi Tete B dan lokasi-lokasi di dalam CA Tanjung Api sangat besar. Meskipun demikian, jumlah ikan indikator jauh dibawah angka-angka di Teluk Palu.

Pada saat pengamatan ikan, jenis-jenis hewan langka juga teramati tetapi pada saat survei berlangsung tidak ada yang terlihat oleh tim YACL. Menurut hasil wawancara dengan penduduk, jumlah penyu dan duyung telah menurun tajam di semua wilayah survei. Di Teluk Palu tim YACL pernah melihat penyu sisik dan hijau, termasuk satu ekor dengan luka berat (diduga akibat panah) di kepalanya serta satu ekor dengan gejala-gejala penyakit "fibropapiloma" yang menjadi perhatian besar di Dunia pemerhati penyu saat ini. Lebih darisatu kali tim survei pernah mengamati satu ekor Duyung di Kadongo, Teluk Palu dan menurut cerita oleh masyarakat sekitar ada satu ekor atau yang lainnya sering mengunjungi wilayah Donggala.

(iii) Data ReefCheck – Jenis-jenis Invertebrata Indikator

Tabel 4.8 Data ReefCheck – Jenis-jenis Invertebrata Indikator

4.8.a Data Invertebrata Indikator di Lokasi-Lokasi Baru

Lokasi	Kakafu	Kakafu	Kakafu		Tete B	Tete B	Tete B
Kedalaman	3 m	10 m	Rata-rata		3 m	10 m	Rata-rata
Jenis-Jenis Invertebrata Indikator							
Udang berbeling <i>Stenopus Hispidus</i>	2	16	9		0	2	1
Bulu Babi <i>Diadema</i> spp.	7	8	7.5		2	0	1
Landak laut Cidaridae	0	0	0		0	0	0
Teripang (<i>Stichopus chloronotus</i> & <i>Thelenota ananas</i>)	2	1	1.5		0	0	0
Lipan laut <i>Acanthaster plancii</i>	0	0	0		0	0	0
Kima Tridacnae	0	1	0.5		12	6	9
Triton terompet <i>Charonia tritonis</i>	0	0	0		1	0	0.5
Udang Lobster Paniliridae	0	0	0			2	1
Kerusakan Dan Lain-Lain: (skala 0-3)							
Kerusakan Baru	3	2	2		2	2	2
Sampah	1	0	1		0	0	0
Pemutihan	0	1	1		1	1	1

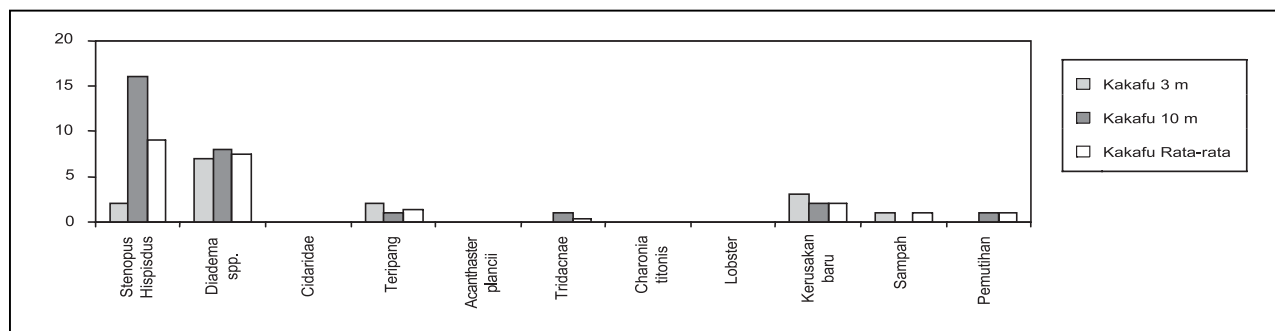
4.8.b Perbandingan antara Invertebrata di Kakafu dan di Lokasi² Monitoring di Teluk Palu

Lokasi	Kakafu	Kadongo	Talise	Teluk Palu
Jenis-Jenis Invertebrata Indikator				
Udang berbeling <i>Stenopus Hispidus</i>	9	0	<1	3
Bulu Babi <i>Diadema</i> spp.	8	5	2	5
Landak laut Cidaridae	0	0	0	0
Teripang (<i>Stichopus chloronotus</i> & <i>Thelenota ananas</i>)	2	0	0	<1
Lipan laut <i>Acanthaster plancii</i>	0	1	0	<1
Kima Tridacnae	<1	0	2	1
Triton terompet <i>Charonia tritonis</i>	0	1	<1	<1
Udang Lobster Paniliridae	0	0	0	0
Kerusakan Dan Lain-Lain: (skala 0-3)				
Kerusakan Baru	2	2	1	2
Sampah	1	2	0	1
Pemutihan	1	1	1	1

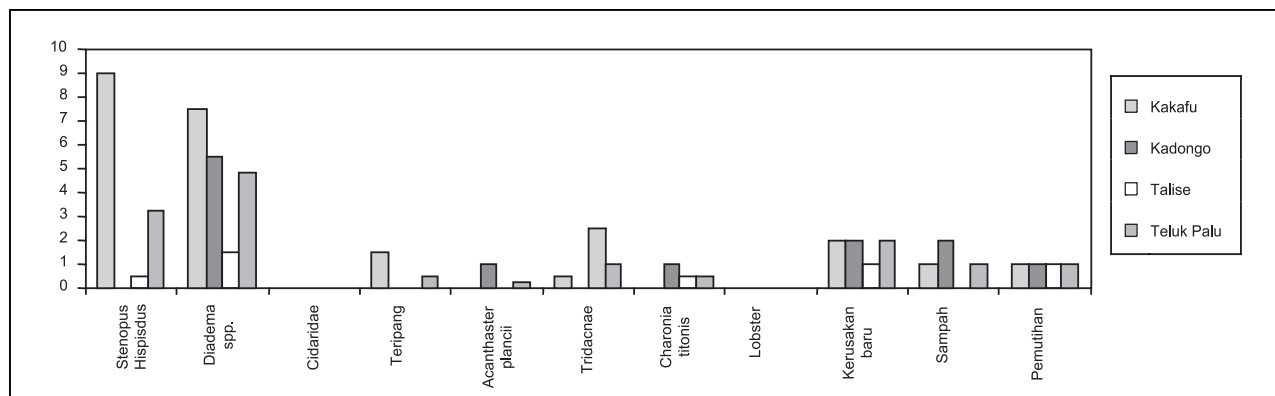
4.8.c Perbandingan antara Invertebrata di Tete B dan di Lokasi2 Monitoring di CA Tanjung Api

Lokasi	Tete B	Tj Api 1	Tj Api 2	Tj Api 3	Tj Api 4	Rata-rata
Jenis-Jenis Invertebrata Indikator						
Udang berbeling <i>Stenopus Hispidus</i>	1	0	0	0	1	<1
Bulu Babi <i>Diadema spp.</i>	1	0	0	0	1	<1
Landak laut <i>Cidaridae</i>	0	0	0	0	0	0
Teripang (<i>Stichopus chloronotus</i> & <i>Thelenota ananas</i>)	0	0	0	0	1	0
Lipan laut <i>Acanthaster planci</i>	0	0	0	0	0	0
Kima <i>Tridacnae</i>	9	4	4	0	4	4
Triton terompet <i>Charonia tritonis</i>	<1	0	0	0	0	<1
Udang Lobster <i>Paniliridae</i>	1	0	0	0	0	<1
Kerusakan Dan Lain-Lain: (skala 0-3)						
Kerusakan Baru	2	3	3	3	2	3
Sampah	0	0	0	0	1	1
Pemutihan	1	1	1	0	1	1

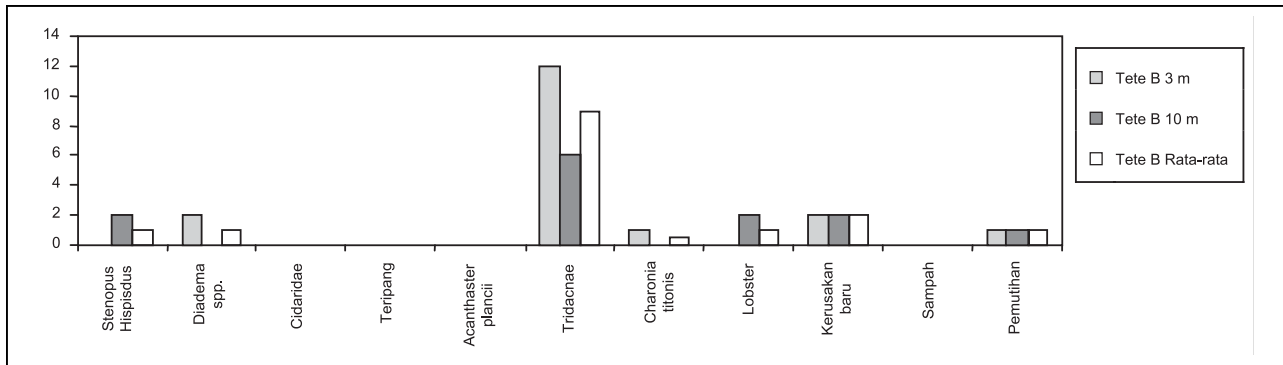
Gambar 4.8 ReefCheck Survei Data Indikator Invertebrata Species & Lain-lain



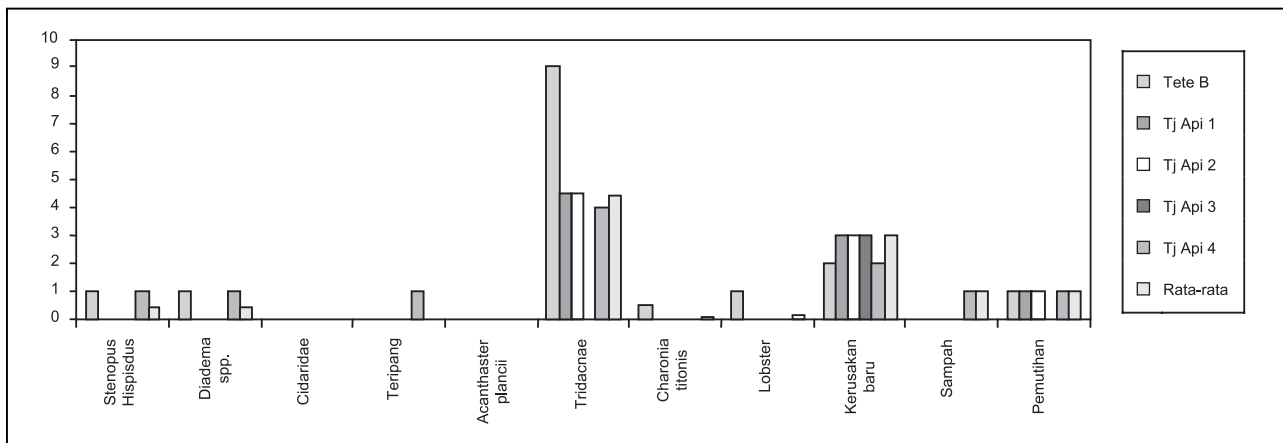
Invertebrata Indikator di Kakafu



Perbandingan antara Invertebrata Indikator di Kakafu dan Lokasi-lokasi Monitoring di Teluk Palu



Invertebrata Indikator di Tete B



Perbandingan Invertebrata Indikator antara Tete B dan 4 Lokasi Monitoring di CA Tanjung Api

Pengamatan jenis-jenis invertebrata Indikator juga diikuti sertakan dalam penilaian tingkat kerusakan karang (yang dibagi antara yang akibat pengeboman, pembuangan jangkar dan penyebab lainnya), penyakit karang, pemutihan karang, dan sampah (yang dibagi antara yang asal dari aktivitas penangkapan dan jenis sampah lainnya). Dalam penilaian hasil pendataan tersebut dengan skala 0 sampai 3 (kosong, sedikit, sedang, tinggi), angka rata-rata dibulatkan ke atas.

Dari Tabel dan Gambar 4.8 Kakafu mempunyai populasi udang (*Stenopus hispidus*) tinggi, sedangkan jumlah kima (*Tridacnae*) di Tete B cukup menonjol. Rata-rata jumlah invertebrata yang mempunyai nilai komersil relatif kecil pada semua lokasi di Teluk Palu dan di dalam/sekitar CA Tanjung Api. Pengambilan invertebrata pada dua lokasi tersebut sangat tinggi, sehingga diduga kuat bahwa merupakan akibat overfishing, bukan kecenderungan alami.

Di Kakafu dan di Tete B tim melihat beberapa lobster kecil (anakan/juvenil) di luar transek, tetapi lobster dewasa pada transek hanya terdapat di Tete B (1 ekor). Menurut masyarakat aktivitas penangkapan lobster meningkat akibat penurunan hasil tangkapan lainnya, seperti penurunan permintaan ikan hidup sejak penyebaran penyakit SARS.

Ukuran kima (*Tridacnae*) di Tete B umumnya masih kecil, sehingga di duga bahwa kima berukuran besar telah diambil, seperti di CA Tanjung Api. Pengambilan tersebut baik khusus dagingnya (terutama individu berukuran besar) maupun khusus kerangnya (semua ukuran). Peningkatan pengambilan disebabkan antara lain oleh permintaan pasar baru, yaitu untuk pembuatan kapur berkualitas tinggi sebagai bahan campuran buah pinang yang digunakan terutama oleh masyarakat adat/asli yang masih hidup di hutan di padalaman Ampana (antara lain, suku Wana).

Meskipun tidak ada lipan laut (*Acanthaster planci*) pada areal transek di Kakafu ataupun di Tete B, tetapi disekitar transek ditemukan sehingga perlu perhatian terhadap hama pemakan karang tersebut pada monitoring berikutnya. Kerusakan karang baru termasuk dalam kategori tingkat sedang (2) pada dua lokasi baru ini. Ada dugaan kuat bahwa pemutihan yang terjadi adalah akibat pembiusan, karena pada kedalaman (10 m) tidak ada tanda-tanda pemutihan oleh peningkatan suhu.

(iv) *Data ReefCheck 2002/2003 per Wilayah*

Berdasarkan data survai dan monitoring ReefCheck pada tahun 20002/2003, wilayah-wilayah survai di Sulawesi Tengah mempunyai persamaan serta masing-masing lokasi dan mempunyai ciri khas yang berbeda. Untuk melihat hal tersebut hasil survai ReefCheck, digabung menjadi 4 wilayah survai yang bisa dilihat dalam Tabel dan Gambar 4.8.

Tabel 4.9 Data ReefCheck 2002/2003 di Sulawesi Tengah per Wilayah

4.9.a Komposisi Substrat – ReefCheck

(Persentase)

Lokasi	HC	SC	FS	SP	OT	RC	RB	SD	SI	RKC
Tanjung Api & Tete B	39	1	1	3	3	30	20	2	0	1
Teluk Palu	26	2	8	6	5	17	29	5	1	1
Labuana	39	2	11	4	12	11	19	1	1	0
Pulau Pasoso	36	11	6	2	16	21	6	1	1	0
Rata-rata	35	4	6	4	9	20	18	2	1	1

4.9.b Jenis-jenis Ikan Indikator

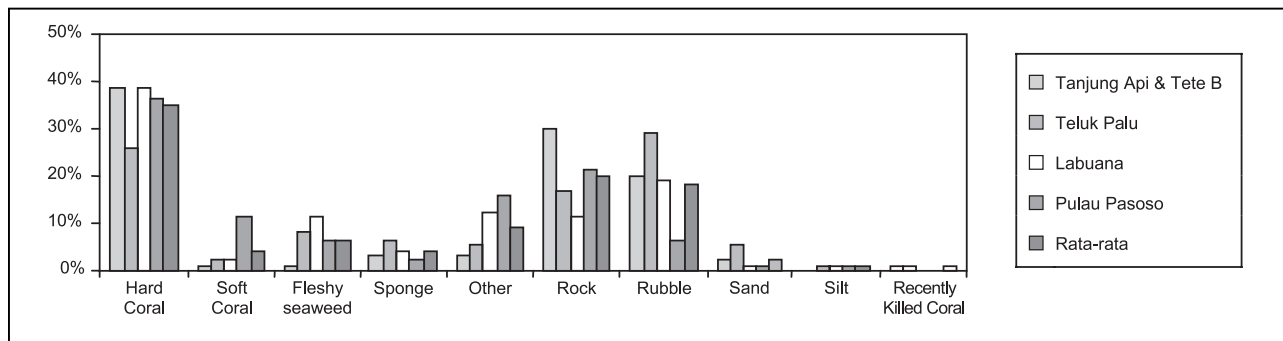
Ikan & Hewan Langka	TJ Api & Tete B	Teluk Palu	Labuana	Pasoso	Rata-rata
Ikan Kupu-kupu Chaetodontidae	18	88	43	38	47
Ikan Bibir Tebal Haemulidae	<1	4	3	1	2
Ikan Bungawara Lutjanidae	7	22	28	6	16
Kerapu Tikus Cromileptes altivelis	0	<1	0	0	<1
Kerapu Seranidae >30 cm	<1	3	3	2	2
Ikan Napoleon Cheilinus undulatus	0	0	0	0	0
Ikan Kakatua Besar Bolbometopon muricatum	2	2	1	3	2
Ikan Kakatua Lainnya Scaridae	5	12	3	5	6
Belut Moray Murenidae	0	<1	0	0	<1
Penyu	0	0	0	<1	<1
Duyung	0	1	<1	0	<1
Ikan Hiu	0	0	0	0	0

4.9.c Jenis-jenis Invertebrata Indikator

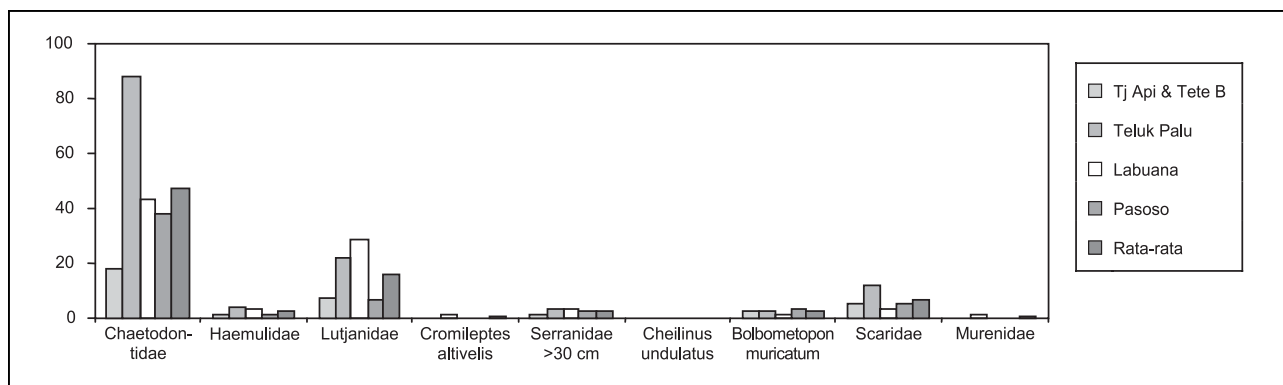
Jenis/Indikator	TJ Api & Tete B	Teluk Palu	Labuana	Pasoso	Rata-rata
Udang berbeling <i>Stenopus Hispidus</i>	<1	3	3	<1	2
Bulu Babi <i>Diadema</i> spp.	<1	5	6	<1	3
Landak laut <i>Cidaridae</i>	0	0	0	0	0
Teripang (<i>Stichopus chloronotus</i> & <i>Thelenota ananas</i>)	0	<1	<1	<1	0
Lipan laut <i>Acanthaster planci</i>	0	<1	<1	<1	0
Kima <i>Tridacnae</i>	4	1	5	2	3
Triton terompet <i>Charonia tritonis</i>	<1	<1	<1	<1	0
Udang Lobster <i>Paniliridae</i>	<1	0	<1	<1	0
Kerusakan & Sampah: (skala 0-3)					
Kerusakan baru	3	2	1	1	2
Sampah	1	1	1	1	1
Pemutihan	1	1	1	1	1

Gambar 4.9 Data ReefCheck 2002/2003 di Sulawesi Tengah per Wilayah

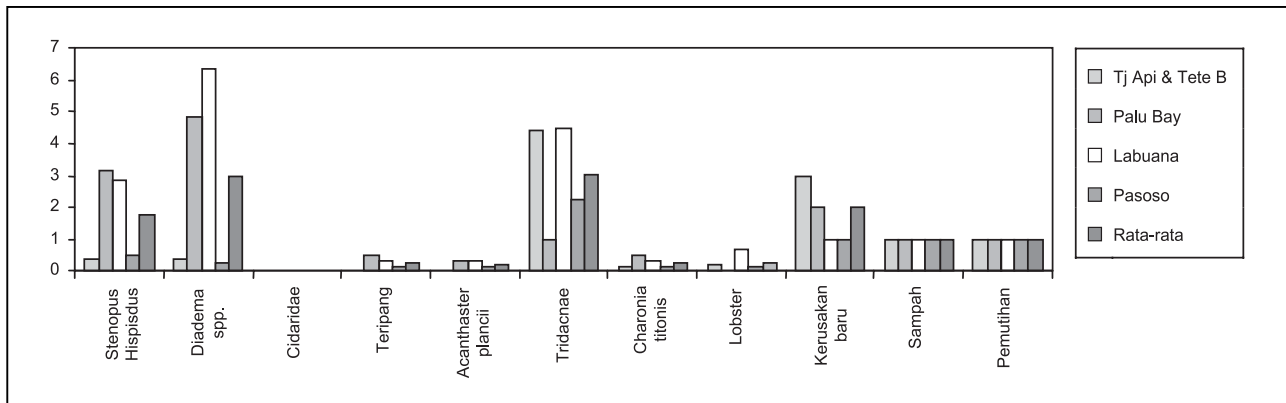
4.9.a Komposisi Substrat – ReefCheck



4.9.b Jenis-jenis Ikan Indikator



4.9.c Jenis-jenis Invertebrata Indikator



Berdasarkan Tabel dan Gambar 4.9, sampel di Tanjung Api/Tete B mempunyai penutupan baik karang keras hidup maupun karang mati dan kerusakan baru yang sangat tinggi dibandingkan dengan ikan dan invertebrata yang jauh lebih rendah kecuali khusus kima (*Tridacnae*), meskipun jumlah hewan yang dilindungi lebih tinggi dibandingkan dengan populasi pada tahun 2001-2002.

Semua lokasi mempunyai kekurangan dan kelebihan yang berbeda terhadap menghadapi faktor-faktor alam dan tekanan oleh aktivitas manusia, dan semua itu mengalami degradasi, termasuk kerusakan fisik terhadap terumbu karang, sampah, pemutihan, overfishing, illegal fishing dan lain-lain. Namun meskipun sebagian lokasi dalam kondisi yang dinilai kritis, tidak ada lokasi survai-monitoring ReefCheck yang telah rusak hingga fungsi ekologisnya telah hilang tersebut membuka peluang untuk pemulihan kembali jika tekanan terhadap ekosistem dapat diatasi.

(c) Data Survei LIT

Mayoritas data survai LIT diambil setelah pelaksanaan pelatihan LIT pada tim survai, dan mayoritas lokasi survai adalah sama dengan lokasi-lokasi survai-monitoring ReefCheck. Di lokasi-lokasi tersebut tim mengambil minimal 3 sampel dengan panjang 10 m pada setiap transek ReefCheck, baik di kedalaman 3 m maupun di 10 m.

Sebagian data LIT diambil untuk kepentingan program MCRMP maupun penilaian Kawasan Konservasi di Kepulauan Togean. Data tersebut meliputi satu atau 2 sampel dengan panjang 10 m pada setiap lokasi. Dalam rangka MCRMP data LIT hanya diambil di MCMA Kabupaten Poso pada 2 Kecamatan (Una-Una dan Walea Kepulauan) yang sudah dimekarkan menjadi 3 Kecamatan (Una-Una, Togean dan Walea Kepulauan) sedangkan di MCMA Kabupaten Donggala data yang diambil adalah hasil survai Life form yang tidak dimasukkan kedalam laporan ini.

Data LIT tercantum dalam Tabel dan Gambar 4.10 sampai 4.12 berikut.

Tabel 4.10 Data LIT khusus setiap Wilayah
4.10.a Data LIT di Kepulauan Togean

(Persentase)

Life Form (LF)	Bambu	Siatu	Taningkola 1	Taningkola 2	Kadidiri 1	Kadidiri 2	Teluk Kilat	Malenge	Kabalutan	Rata-rata
ACB	2.5	0.0	0.0	0.6	8.0	2.0	2.0	3.2	7.0	2.8
ACT	14.5	0.0	0.0	0.0	1.5	9.5	22.7	4.5	6.7	6.6
ACD ACE ACS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acropora	17.0	0.0	0.0	0.6	9.5	11.5	24.7	7.7	13.7	9.4
CB	1.5	20.0	1.5	7.3	10.9	6.4	8.5	8.8	16.6	9.1
CD	0.0	0.0	0.0	12.0	3.3	2.4	9.6	0.0	9.8	4.1
CF	1.0	0.0	0.5	0.0	0.9	0.0	0.0	0.0	0.0	0.3
CS	0.0	0.0	0.0	0.7	3.6	3.0	1.3	0.0	3.6	1.4
CM	8.3	3.0	1.2	16.1	1.7	8.4	4.3	6.2	10.3	6.6
CE	7.2	1.5	0.7	2.2	0.3	3.9	3.5	3.4	2.5	2.8
CMR	0.0	1.0	0.0	1.5	1.0	0.0	0.0	0.5	0.8	0.5
CME	0.0	1.2	0.0	0.0	17.0	0.0	0.0	9.0	3.0	3.4
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	18.0	26.7	3.9	39.8	38.7	24.1	27.2	27.9	46.6	28.1
SC	0.0	1.0	3.0	1.5	4.6	1.5	0.0	3.1	1.5	1.8
SP	13.4	4.3	6.3	6.7	3.3	7.0	7.8	7.2	2.5	6.5
ZO	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0.3
OT	2.0	2.6	3.7	3.8	10.6	14.3	10.0	6.1	2.9	6.2
Non-Alga	15.4	7.9	13.0	12.0	18.5	22.8	19.3	17.4	6.9	14.8
CA	4.0	4.7	5.0	1.1	6.0	1.2	1.5	2.0	2.8	3.1
HA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TA	0.5	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.2
MA	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.3	0.1
AA	2.8	1.0	6.4	1.0	1.5	2.5	1.0	3.5	1.4	2.3
Alga	7.3	5.7	12.4	2.1	7.5	3.7	3.5	6.0	4.5	5.9
DC	2.0	1.5	0.0	2.1	4.4	0.7	2.0	4.6	4.6	2.4
DCA	7.1	23.6	34.5	19.6	5.7	13.7	12.8	16.1	10.3	15.9
RB	27.7	31.7	17.2	17.8	15.7	18.5	4.5	20.3	12.9	18.5
Karang Mati	36.8	56.8	51.7	39.5	25.8	32.9	19.3	41.0	27.8	36.8
SA	5.5	2.9	19.0	6.0	0.0	5.0	6.0	0.0	0.5	5.0
SL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penutupan Abiotik	42.3	59.7	70.7	45.5	25.8	37.9	25.3	41.0	28.3	41.8
Karang keras	35.0	26.7	3.9	40.4	47.9	35.6	51.9	35.6	60.3	37.5
Penutupan Hidup	57.7	40.3	29.3	54.5	74.3	62.8	74.7	59.0	71.7	58.3
Jumlah LF	15	12	13	16	18	16	17	17	19	16
Jumlah LF HC	6	5	4	7	10	7	7	7	9	7
% LF HC di Kep T.	60	50	40	70	100	70	70	70	90	70
% semua LF HC	43	36	29	50	71	50	50	50	64	49

4.10.b Lokasi ReefCheck Teluk Palu

(Persentase)

Life Form (LF)	Kakafu	Kakafu	Kakafu	Talise	Talise	Talise	Kadongo	Kadongo	Kadongo	Teluk Palu
Kedalaman	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	Rata-rata
Panjang m	25	10	35	20	10	30	20	15	35	100
ACB	1.1	3.0	1.5	0.0	0.5	0.2	0.4	0.0	0.2	0.6
ACT	0.0	5.2	1.2	4.9	0.0	3.2	0.0	0.0	0.0	1.5
AC Lain-lain	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0
Acropora	1.1	8.2	2.7	4.9	0.9	3.5	0.4	0.0	0.2	2.1
CB	13.7	2.7	11.2	8.3	2.8	6.5	0.3	0.2	0.3	6.0
CD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CF	0.4	0.6	0.4	6.8	1.5	5.0	0.0	0.0	0.0	1.8
CS	17.8	0.5	14.0	5.1	0.0	3.4	1.5	0.0	0.9	6.1
CM	14.1	10.3	13.3	10.0	3.9	7.9	1.0	0.3	0.7	7.3
CE	4.6	6.9	5.1	7.4	12.9	9.2	0.5	0.0	0.3	4.9
CMR	4.2	0.0	3.3	6.8	1.0	4.8	2.6	0.4	1.7	3.3
CME	0.1	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.2	0.4
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HC Non-Acropora	54.9	21.0	47.4	44.2	22.1	36.8	8.0	0.9	4.9	29.7
SC	1.0	0.4	0.9	0.0	0.0	0.0	0.3	7.7	3.5	1.5
SP	1.1	16.1	4.4	10.8	5.3	9.0	7.9	9.3	8.5	7.3
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	2.5	3.6	2.7	2.8	2.7	2.7	2.6	0.6	1.7	2.4
Lain-lain non-alga	4.6	20.1	8.0	13.6	8.0	11.7	10.8	17.6	13.7	11.1
CA	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HA	0.2	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.1
TA	0.1	0.0	0.0	0.0	0.3	0.1	0.0	2.4	1.0	0.4
MA	0.0	0.0	0.0	0.8	0.0	0.5	0.4	0.0	0.2	0.2
AA	2.1	0.5	1.7	7.2	6.8	7.0	43.0	19.0	32.7	13.8
Alga	2.4	1.1	2.1	8.0	7.1	7.7	43.5	21.4	34.0	14.6
DC	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2
DCA	15.3	15.8	15.4	6.2	9.0	7.1	16.5	2.5	10.5	11.0
RB	9.7	24.6	13.0	4.4	18.0	8.9	7.0	0.3	4.1	8.7
Karang Mati	25.6	41.1	29.0	10.5	27.0	16.0	23.4	2.8	14.6	19.9
SA	11.5	8.2	10.7	2.9	34.9	13.5	13.3	41.2	25.3	16.5
SL	0.0	0.3	0.1	16.1	0.0	10.7	0.7	16.1	7.3	6.0
Penutupan Abiotik	37.1	49.6	39.8	29.5	61.9	40.3	37.4	60.1	47.1	42.4
Karang keras	56.0	29.2	50.0	49.1	23.0	40.4	8.4	0.9	5.2	31.9
Penutupan Hidup	62.9	50.4	60.2	70.6	38.1	59.7	62.6	39.9	52.9	57.6
Jumlah LF	18	17	19	15	14	18	17	12	17	18
Jumlah LF jenis HC	8	7	8	7	7	9	7	3	7	9
% LF HC di Teluk Palu	89	78	89	78	78	100	78	33	78	100
% semua LF HC	54	50	57	50	50	64	36	21	31	64

4.10.c Lokasi ReefCheck di Labuana

(Persentase)

Life Form (LF)	Labuana 1	Labuana 1	Labuana 1	Labuana 2	Labuana 2	Labuana 2	Labuana 3	Labuana 3	Labuana 3	Labuana
Kedalaman	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	Rata-rata
Panjang m	20	10	30	20	10	30	20	10	30	90
ACB	7.2	0.6	5.0	4.8	12.1	7.2	1.3	10.1	4.3	5.5
ACT	2.3	3.9	2.9	0.0	0.0	0.0	2.1	13.1	5.7	2.9
AC Lain-lain	4.9	0.0	3.3	4.8	0.0	3.2	3.0	0.0	2.0	2.8
Acropora	14.4	4.5	11.2	9.6	12.1	10.4	6.4	23.2	12.0	11.2
CB	6.5	3.7	5.6	11.9	1.4	8.4	7.8	1.8	5.8	6.6
CD	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.9	0.3
CF	0.0	32.8	10.9	3.5	0.0	2.3	0.0	0.0	0.0	4.4
CS	6.8	0.0	4.5	10.7	1.7	7.7	6.1	2.2	4.8	5.7
CM	24.6	2.8	17.4	3.9	21.2	9.7	8.6	1.4	6.2	11.1
CE	4.4	0.0	2.9	1.3	4.3	2.3	3.3	4.7	3.8	3.0
CMR	0.9	3.7	1.8	1.5	3.8	2.3	1.8	0.4	1.3	1.8
CME	1.7	3.6	2.3	0.0	7.0	2.3	0.0	0.0	0.0	1.6
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	44.9	46.6	45.4	32.8	39.4	35.0	28.9	10.5	22.8	34.5
SC	0.2	0.0	0.1	0.0	0.0	0.0	3.6	1.3	2.8	1.0
SP	1.4	5.4	2.8	3.8	5.6	4.4	4.5	7.3	5.4	4.2
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.7	2.5	1.3	1.8	2.3	2.0	1.7	0.6	1.3	1.5
Lain-lain non-alga	2.3	7.9	4.2	5.6	7.9	6.4	9.8	9.2	9.5	6.7
CA	6.4	1.2	4.7	5.2	1.9	4.1	0.8	0.5	0.7	3.1
HA	0.8	0.0	0.6	2.4	0.3	1.7	0.5	0.0	0.3	0.8
TA	1.1	0.0	0.7	0.3	0.0	0.2	2.1	0.0	1.4	0.8
MA	0.5	3.5	1.5	1.2	1.9	1.5	0.0	0.5	0.2	1.0
AA	6.4	9.2	7.3	10.9	3.6	8.4	7.7	0.5	5.3	7.0
Alga	15.2	13.9	14.8	20.0	7.7	15.9	11.1	1.5	7.9	12.7
DC	0.0	3.7	1.2	0.2	0.2	0.2	0.0	1.3	0.5	0.6
DCA	18.0	4.8	13.6	16.1	8.8	13.7	15.3	7.9	12.8	13.4
RB	2.3	18.6	7.7	8.7	14.0	10.5	17.2	18.3	17.6	11.9
Karang Mati	20.3	27.1	22.5	25.0	23.0	24.4	32.5	27.5	30.9	25.9
SA	0.9	0.0	0.6	4.7	7.5	5.6	11.4	28.1	16.9	7.8
SL	2.0	0.0	1.3	2.3	2.4	2.3	0.0	0.0	0.0	1.2
Penutupan Abiotik	23.2	27.1	24.4	32.0	32.9	32.3	43.8	55.6	47.8	34.9
Karang keras	59.4	51.1	56.6	42.5	51.5	45.5	35.0	33.7	34.5	45.5
Penutupan Hidup	76.8	72.9	75.6	68.0	67.1	67.7	56.2	44.4	52.2	65.1
Jumlah LF	19	15	22	20	18	21	22	17	23	23
Jumlah LF jenis HC	9	7	10	8	7	9	11	7	11	13
% LF HC di Labuana	69.2	53.8	76.9	61.5	53.8	69.2	84.6	53.8	84.6	100
% semua LF HC	64.3	50.0	71.4	57.1	50.0	64.3	78.6	50.0	78.6	93

4.10.d Lokasi ReefCheck di SMS Pulau Pasoso

(Persentase)

Life Form (LF)	Pasoso 1	Pasoso 1	Pasoso 1	Pasoso 2	Pasoso 2	Pasoso 2	Pasoso 3	Pasoso 3	Pasoso 3	Pasoso 4	Pasoso 4	Pasoso 4	Pasoso
Kedalaman	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	Rata-rata
Length m	20	10	30	20	10	30	20	10	30	20	10	30	120
ACB	3.6	3.0	3.4	6.1	0.0	4.1	13.1	2.7	9.6	0.0	0.0	0.0	4.3
ACT	0.0	0.0	0.0	4.3	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7
AC Lain-lain	0.0	0.0	0.0	1.4	0.0	0.9	1.5	0.0	1.0	0.0	0.0	0.0	0.5
Acropora	3.6	3.0	3.4	11.7	0.0	7.8	14.6	2.7	10.6	0.0	0.0	0.0	5.4
CB	9.9	14.5	11.4	7.8	22.4	12.6	9.3	6.6	8.4	9.6	2.2	7.1	9.9
CD	0.9	0.0	0.6	0.5	0.0	0.3	0.0	0.4	0.1	0.0	0.0	0.0	0.3
CF	0.0	0.7	0.2	5.6	2.3	4.5	0.0	1.5	0.5	0.0	1.9	0.6	1.5
CS	3.5	10.0	5.6	4.3	10.0	6.2	2.5	2.3	2.4	1.9	1.3	1.7	4.0
CM	7.1	1.0	5.1	6.8	0.0	4.5	5.5	15.2	8.7	6.7	12.0	8.5	6.7
CE	7.2	10.2	8.2	1.2	5.6	2.7	2.2	9.4	4.6	1.3	21.4	8.0	5.9
CMR	0.1	3.1	1.1	0.2	0.7	0.3	1.1	3.8	2.0	0.0	4.8	1.6	1.3
CME	0.5	0.4	0.5	0.9	0.0	0.6	0.0	0.3	0.1	0.0	0.4	0.1	0.3
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	29.1	39.9	32.7	27.2	41.0	31.8	20.6	39.5	26.9	19.5	44.0	27.7	29.8
SC	4.0	0.3	2.7	0.0	6.0	2.0	2.2	14.3	6.2	1.2	24.9	9.1	5.0
SP	1.0	4.8	2.2	0.3	3.7	1.4	1.0	9.3	3.7	14.3	7.2	11.9	4.8
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.1	9.1	3.1	1.7	1.8	1.7	0.6	6.7	2.6	0.0	3.7	1.2	2.2
Lain-lain non-alga	5.0	14.2	8.1	1.9	11.5	5.1	3.8	30.3	12.6	15.5	35.8	22.3	12.0
CA	0.0	1.7	0.6	0.0	1.4	0.5	0.1	1.5	0.5	0.0	2.4	0.8	0.6
HA	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.2	0.0	0.1	0.1
TA	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MA	0.0	0.6	0.2	1.8	0.0	1.2	0.2	1.1	0.5	0.0	0.7	0.2	0.5
AA	1.0	3.2	1.7	0.9	0.9	0.9	5.0	0.4	3.4	0.7	0.6	0.7	1.7
Alga	1.0	6.0	2.7	2.7	2.3	2.6	5.6	3.0	4.7	0.9	3.7	1.8	2.9
DC	0.0	3.9	1.3	0.3	0.9	0.5	0.0	1.3	0.4	0.0	2.3	0.8	0.7
DCA	8.2	9.8	8.7	20.5	4.7	15.2	40.5	11.7	30.9	15.7	8.3	13.2	17.0
RB	47.6	23.2	39.5	34.1	33.1	33.7	13.8	10.1	12.5	42.0	5.7	29.9	28.9
Karang Mati	55.8	36.9	49.5	54.8	38.7	49.4	54.3	23.1	43.9	57.7	16.3	43.9	46.7
SA	5.7	0.0	3.8	1.8	6.5	3.4	1.3	0.9	1.2	6.4	0.2	4.3	3.2
SL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0
Penutupan Abiotik	61.4	36.9	53.2	56.6	45.2	52.8	55.6	24.5	45.2	64.1	16.5	48.2	49.9
Karang keras	32.6	42.9	36.0	38.9	41.0	39.6	35.2	42.2	37.5	19.5	44.0	27.7	35.2
Penutupan Hidup	38.6	63.1	46.8	43.5	54.8	47.2	44.5	75.5	54.8	35.9	83.5	51.8	50.1
Jumlah LF	13	18	14.667	16	14	15	12.5	21	15.333	11	17	13	22
Jumlah LF jenis HC	6.5	8	7	11	5	8	4.5	9	6	4	7	5	11
% LF HC di Pasoso	59	73	64	100.0	45.5	72.7	41	82	55	36	64	45	100
% semua LF HC	46	57	50	67.9	35.7	57.1	32	64	43	29	50	36	79

4.10.e Lokasi ReefCheck di CA Tanjung Api dan Tete B

(Persentase)

Life Form (LF)	Tete B			T Api 1			T Api 2			T Api 3			T Api 4			T Api	Rata-rata
Kedalaman	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	3 m	10 m	Rata-rata	Rata-rata	
Length m	20	10	30	20	10	30	20	10	30	20	10	30	20	10	30	120	150
ACB	0.0	3.0	1.0	0.0	0.0	0.0	1.9	0.0	1.0	0.1	0.0	0.1	0.6	0.0	0.4	0.4	0.5
ACT	0.0	11.5	3.8	0.0	0.0	0.0	0.0	1.6	0.8	0.0	0.0	0.0	4.2	0.0	2.8	0.9	1.5
AC Lain-lain	0.0	4.0	1.4	0.0	0.0	0.0	9.1	4.1	6.6	0.0	0.0	0.0	1.4	2.2	1.7	2.1	1.9
Acropora	0.0	18.5	6.2	0.0	0.0	0.0	11.0	5.7	8.4	0.1	0.0	0.1	6.2	2.2	4.9	3.4	3.9
CB	4.0	5.5	4.5	19.4	12.2	17.0	0.5	3.5	2.0	7.0	3.4	5.8	8.8	17.7	11.7	9.1	8.2
CD	1.4	0.0	0.9	0.1	10.9	3.7	2.6	0.0	1.3	0.0	0.0	0.0	1.1	0.0	0.7	1.4	1.3
CF	0.0	0.0	0.0	0.0	1.8	0.6	0.0	0.0	0.0	2.6	0.0	1.7	2.9	0.0	2.0	1.1	0.9
CS	2.4	2.5	2.4	0.0	0.7	0.2	1.9	1.5	1.7	1.1	0.4	0.8	9.1	6.1	8.1	2.7	2.6
CM	17.5	14.1	16.3	1.8	4.5	2.6	18.9	12.8	15.7	0.0	0.0	0.0	3.8	5.1	4.3	5.7	7.8
CE	1.2	26.7	9.7	1.5	0.0	1.0	0.0	12.2	6.1	0.6	1.3	0.8	7.3	10.8	8.4	4.1	5.2
CMR	0.4	2.4	1.0	0.3	2.3	1.0	0.0	1.7	0.9	1.3	0.9	1.2	4.1	1.0	3.1	1.5	1.4
CME	1.6	3.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	1.0	0.4	0.0	0.2	0.3	0.7
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Acropora	28.5	54.3	36.9	23.1	32.4	26.1	23.9	31.7	27.7	12.6	8.9	11.3	37.5	40.7	38.5	25.9	28.1
SC	0.2	0.0	0.1	0.0	0.0	0.0	0.4	0.0	0.2	0.8	0.0	0.6	0.0	0.0	0.0	0.2	0.2
SP	6.6	4.3	5.9	1.8	4.4	2.7	0.0	9.5	4.8	1.2	0.8	1.1	4.4	1.4	3.4	3.0	3.6
ZO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OT	0.8	0.5	0.7	0.3	1.1	0.6	5.3	4.7	5.0	0.2	0.3	0.3	5.8	0.7	4.1	2.5	2.1
Lain-lain non-alga	7.6	4.8	6.7	2.1	5.5	3.3	5.7	14.2	10.0	2.2	1.1	2.0	10.2	2.1	7.5	5.7	5.9
CA	1.5	2.2	1.7	0.2	0.0	0.1	2.9	1.9	2.4	0.4	0.2	0.3	0.8	2.9	1.5	1.1	1.2
HA	0.9	0.0	0.6	0.0	0.4	0.3	0.2	0.0	0.1	1.2	0.0	0.8	0.0	0.0	0.0	0.3	0.4
TA	0.0	0.8	0.3	0.0	1.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
MA	0.2	0.0	0.1	0.3	6.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4
AA	4.3	4.2	4.3	1.3	1.9	1.5	4.6	4.6	4.6	1.6	1.4	1.5	4.5	1.2	3.4	2.7	3.1
Alga	6.9	7.2	7.0	1.8	10.1	4.6	7.7	6.5	7.1	3.2	1.6	2.6	5.3	4.1	4.9	4.7	5.3
DC	1.0	0.0	0.7	0.0	0.0	0.0	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
DCA	42.6	11.6	32.3	21.7	42.0	28.4	30.3	25.0	27.6	5.5	0.0	3.6	16.7	8.6	14.0	18.5	21.2
RB	10.1	1.8	7.4	44.0	7.2	31.7	19.4	16.1	17.8	76.4	88.4	80.4	24.1	42.3	30.2	40.0	33.5
Karang Mati	53.7	13.4	40.4	65.7	49.2	60.1	50.7	41.1	45.9	81.9	88.4	84.0	40.8	50.9	44.2	58.6	54.9
SA	0.9	0.0	0.6	3.0	2.8	3.0	1.0	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9
SL	2.4	1.8	2.2	4.3	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.0
Penutupan Abiotik	57.0	15.2	43.2	73.0	52.0	66.0	51.7	41.9	46.8	81.9	88.4	84.0	40.8	50.9	44.2	60.3	56.8
Karang keras	28.5	72.8	43.1	23.1	32.4	26.1	34.9	37.4	36.1	12.7	8.9	11.4	43.7	42.9	43.4	29.3	32.0
Penutupan Hidup	43.0	84.8	56.8	27.0	48.0	34.0	48.3	58.1	53.2	18.1	11.6	16.0	59.2	49.1	55.8	39.7	43.2
Jumlah LF	19	11	23	14	15	17	15	14	19	14	10	15	17	12	17	26	26
Jumlah LF jenis HC	7	9	10	5	6	7	6	7	9	6	5	7	11	6	11	13	13
% LF HC di Pasoso	54	69	77	38	46	54	46	54	69	43	50	64	85	46	85	100	100
% semua LF HC	50	64	71	36	43	50	43	50	64	43	36	50	79	43	79	93.0	93.0

Tabel 4.11 Hasil Survei LIT – Konversi pada Kode-Kode Manta Tow

(Persentase)

Lokasi	LC	DC	HC	SC	OT	RC	RB	S
Teluk Kilat	74	26	51	0	23	15	5	6
Kadidiri 1	74	26	48	5	21	10	16	0
Kadidiri 2	62	38	35	2	25	15	18	5
Taningkola 1	29	71	4	3	22	35	17	19
Taningkola 2	54	46	40	2	12	22	18	6
Siatu	40	60	26	1	13	25	32	3
Bambu	57	43	35	0	22	9	28	6
Malenge	59	41	36	3	20	21	20	0
Kabalutan	72	28	60	2	10	14	13	1
Togean Islands	58	42	37	2	19	18	19	5

LIT di Kepulauan Togean

(Persentase)

Lokasi	HC	SC	OT	RC	RB	S	Total	LC	DC
Tete B	43	1	13	33	7	3	100	57	43
Tj Api 1	26	0	8	28	32	6	100	34	66
Tj Api 2	36	1	17	28	17	1	100	54	46
Tj Api 3	11	1	4	4	80	0	100	16	84
Tj Api 4	43	0	13	14	30	0	100	56	44
Tj Api & Tete B	32	1	11	21	33	2	100	44	56
Tj Api	29	1	10	18	40	2	100	40	60

LIT di CA Tanjung Api & Tete B

(Persentase)

Site	HC	SC	OT	RC	RB	S	Total	LC	DC
Kakafu	50	1	9	16	13	11	100	60	40
Talise	41	0	19	7	9	24	100	60	40
Kadongo	5	4	44	11	4	32	100	53	47
Teluk Palu	32	2	24	11	9	22	100	58	42

LIT di Teluk Palu

Tabel 4.11 (Continued)

(Persentase)

Lokasi	HC	SC	OT	RC	RB	S	Total	LC	DC
Labuana 1	56	1	18	15	8	2	100	75	25
Labuana 2	45	0	22	14	11	8	100	67	33
Labuana 3	35	3	14	13	18	17	100	52	48
Labuana	46	1	18	14	12	9	100	65	35

LIT di Labuana

(Persentase)

Lokasi	HC	SC	OT	RC	RB	S	Total	LC	DC
Pasoso 1	36	3	8	10	40	3	100	47	53
Pasoso 2	39	2	6	16	34	3	100	47	53
Pasoso 3	38	6	11	31	13	1	100	55	45
Pasoso 4	28	9	15	14	30	4	100	52	48
Pasoso	35	5	10	18	29	3	100	50	50

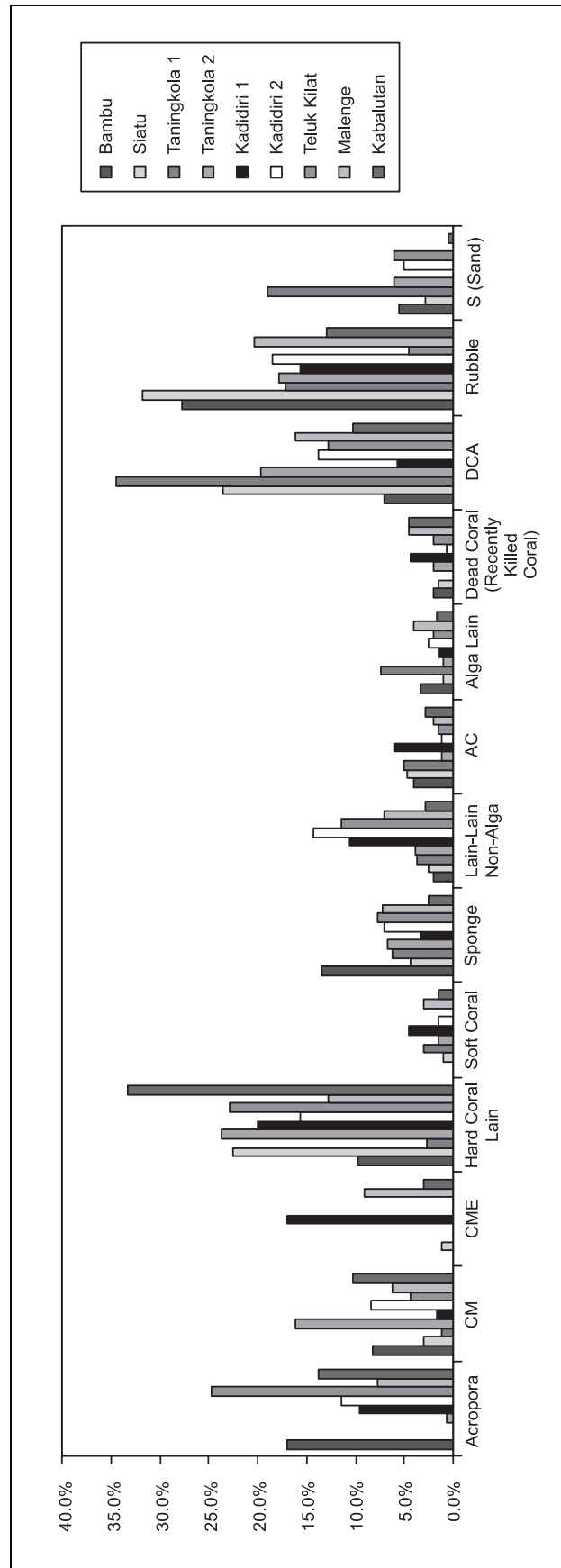
LIT Summary for Pasoso

Tabel 4.12 Kondisi Terumbu Karang pada Lokasi-lokasi Survai – LIT

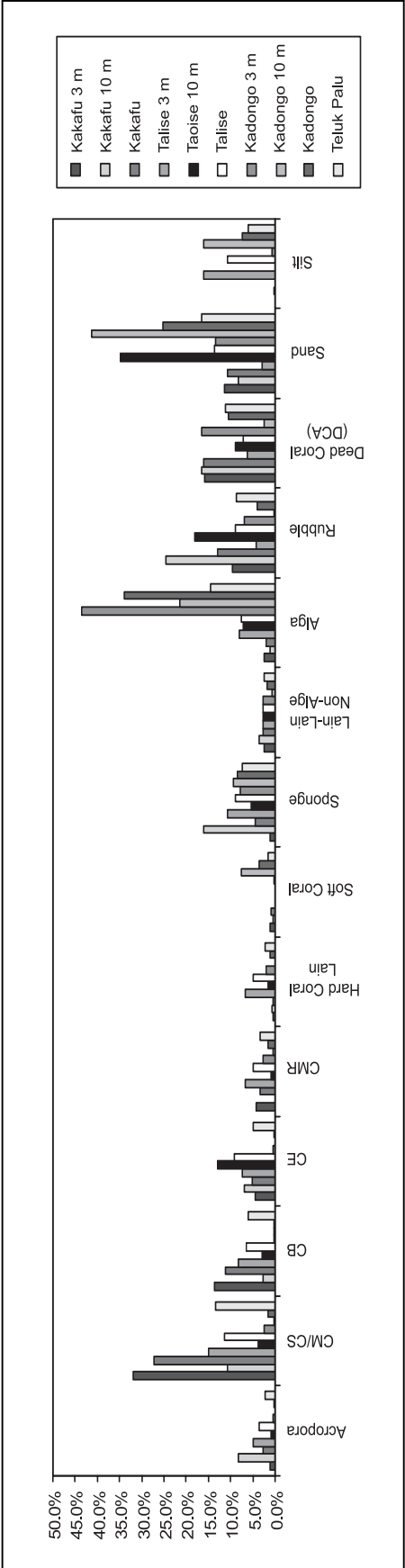
(Persentase)

Kategori	Rusak Berat	Rusak	Rata-rata	Baik	Sangat Baik	% HC	Kategori Rata-rata
Kepulauan Togean	11	11	56	22	0	42	3
Tj Api & Tete B	10	30	50	10	0	32	3
Teluk Palu	33	33	17	17	0	32	3
Labuana	0	0	50	50	0	46	3
Pasoso	0	13	87	0	0	35	3

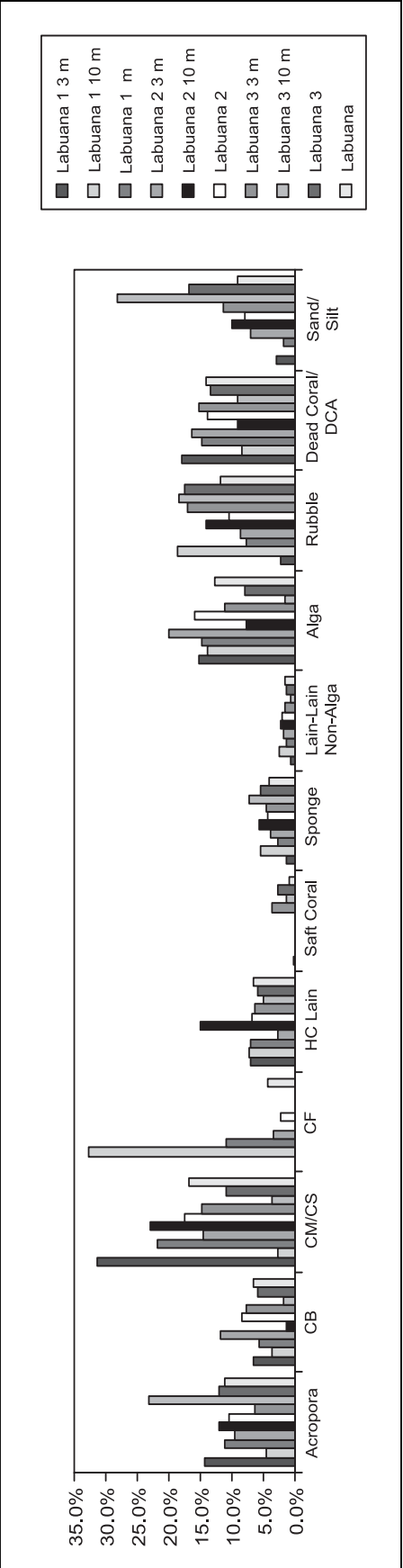
Gambar 4.10 Data LIT di Kepulauan Togean



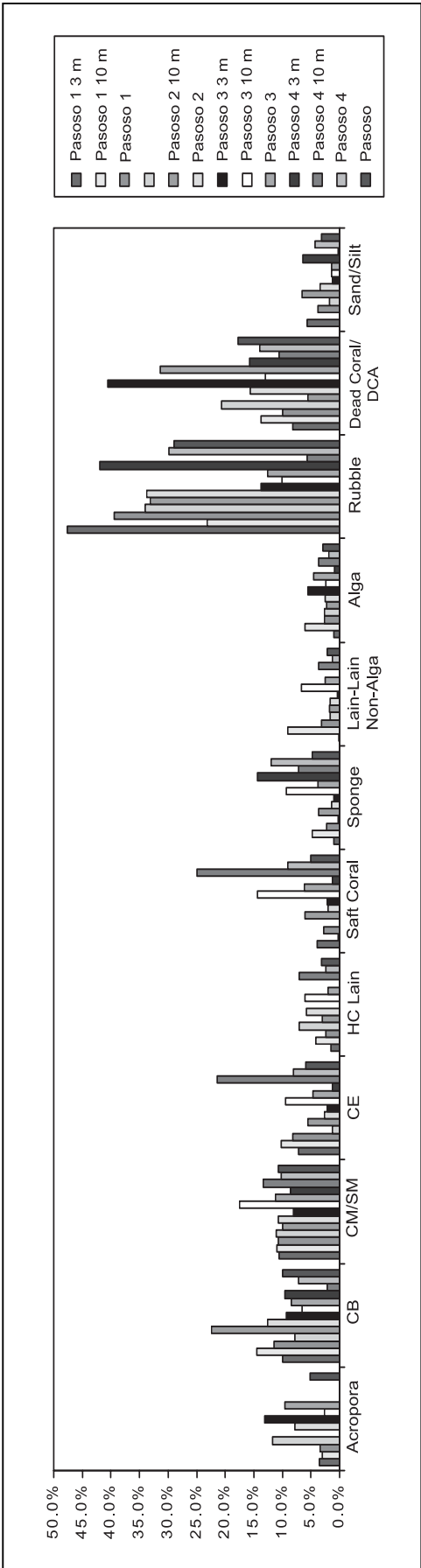
Gambar 4.11 Data LIT pada Lokasi-lokasi ReefCheck



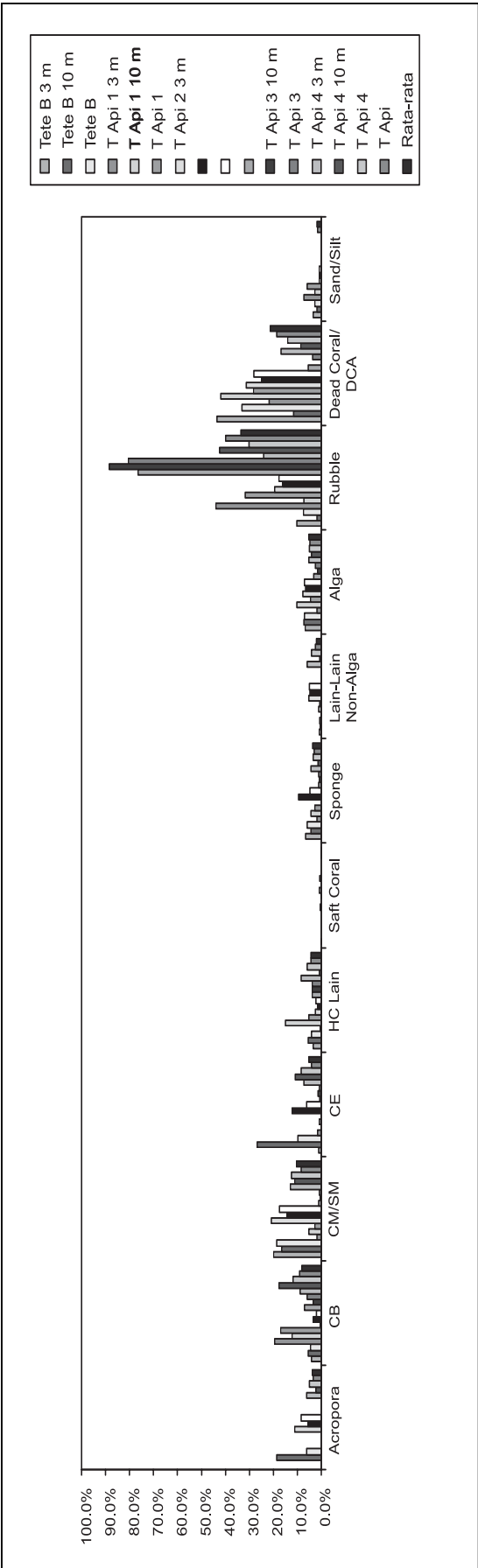
Data Lit di Teluk Palu



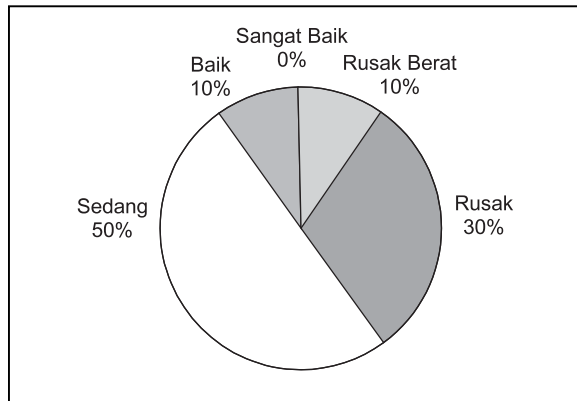
Data LIT di Labuana



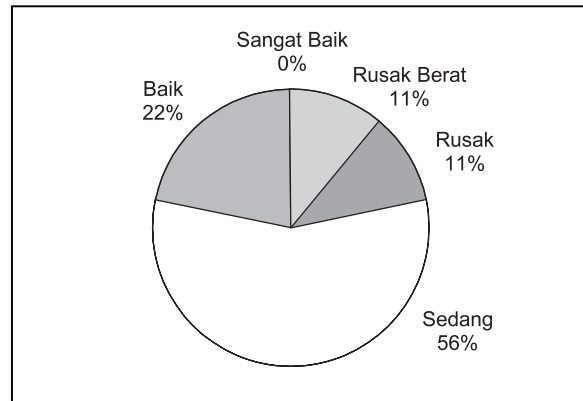
LIT Data SMS Pulau Pasoso (atas) dan CA Tanjung Api/Tete B (bawah)



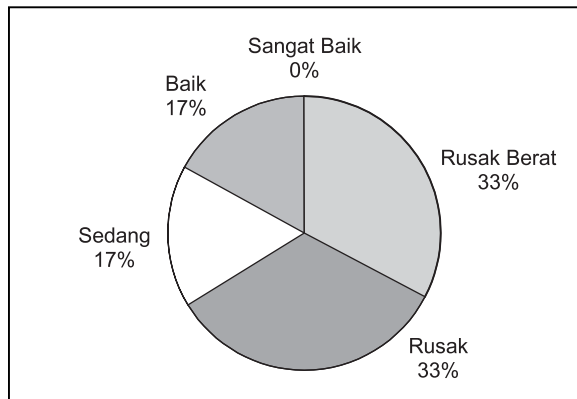
Gambar 4.12 Data LIT – Kondisi Terumbu Karang Rata-rata per Wilayah



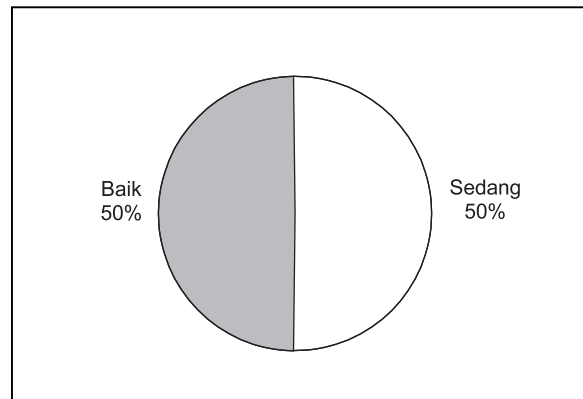
Kepulauan Togean



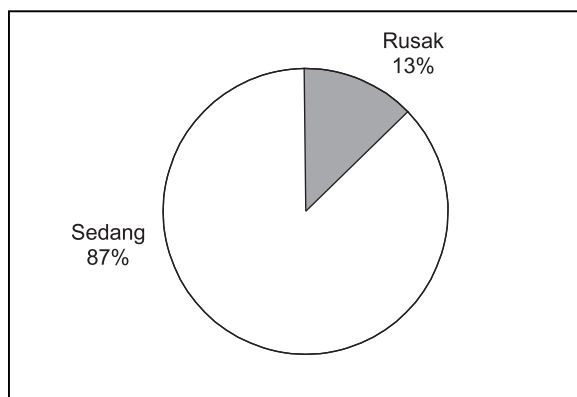
CA Tanjung Api & Tete B



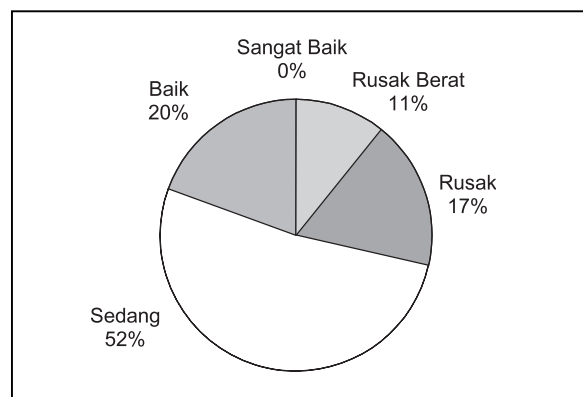
Teluk Palu



Labuana



SMS Pulau Pasoso



Rata-rata LIT di Sulawesi Tengah

Gambar dan Tabel 4.10-4.12 memperlihatkan bahwa kondisi dan komposisi terumbu karang di Sulawesi Tengah sangat beranekaragam. Namun berdasarkan data survai LIT, kondisinya yang dominan dalam kategori sedang. Lokasi yang paling baik berdasarkan survai LIT adalah Labuana, juga merupakan lokasi yang mempunyai populasi ikan dan invertebrata yang baik dibanding rata-rata diseluruh kawasan Propinsi.

Persentase Rusak dan Rusak Berat dan/atau persentase penutupan oleh pecahan karang (RB) serta karang mati (DC/DCA) termasuk dalam kategori tinggi pada sebagian wilayah, tetapi memiliki keanekaragaman yang tinggi. Survei LIT memperkuat dalam menyimpulkan bahwa ancaman dan degradasi pada ekosistem terumbu karang di Sulawesi Tengah memerlukan perhatian serius dan aksi pelestarian nyata dalam waktu dekat.

5. PERBANDINGAN ANTARA METODE DAN WILAYAH

Pada Tabel 5.2 dan Gambar 5.1 dibawah, semua data yang diambil dengan menggunakan 3 metode yaitu ReefCheck, Manta Tow dan LIT. Di konversikan pada setiap kategori substrat Manta Tow sehingga dapat dibandingkan. Sistem konversi antara kode-kode tercantum dalam Tabel 5.1 dibawah ini.

Tabel 5.1 Konversi antara Kode-Kode Manta Tow, ReefCheck dan LIT

Kode LIT	Keterangan LIT	Kode RC	Kode MT	Kode LIT	Keterangan LIT	Kode RC	Kode MT
Acropora:				Lain-lain Biotik			
ACB	Bercabang	HC	HC	SC	Karang Lunak	SC	SC
ACD	Berjari	HC	HC	SP	Sponge	SP	OT
ACS	Submasif	HC	HC	ZO	Zooanthid	OT	OT
ACE	Merayap	HC	HC	OT	Lain-lain	OT	OT
ACT	Meja	HC	HC	Algae			
Karang Keras Lainnya				HA	Halimeda	OT	OT
CE	Merayap	HC	HC	TA	Turf Algae	OT	OT
CS	Submasif	HC	HC	MA	Macro Algae	FS	OT
CM	Masif	HC	HC	CA	Coraline Algae	OT	OT
CB	Bercabang	HC	HC	AA	Algal Assemblage	FS	OT
CD	Berjari	HC	HC	Abiotic			
CF	Foliose	HC	HC				
CHL	<i>Heliopora</i> spp.	HC	HC	WA	Water (>1 m)	N/A	
CME	<i>Millepora</i> spp.	HC	HC	S	Pasir	SA	S
CMR	Karang Jamur	HC	HC	SL	Lumpur	SI	S
Karang Mati				RCK	Batu (bukan asal dari karang)	RC	OT
DC	Karang Mati putih	RKC	DC				
DCA	Karang Mati ditumbuhi	RC	DC				
R	Kerakal	RB	RB				

Berdasarkan data di Kepulauan Togean yang sangat berbeda dengan hasil Manta Tow, perlu di ketahui bahwa lokasinya berbeda. Dalam arti meskipun kebanyakan lokasi di dalam wilayah Desa yang sama, Manta Tow dilaksanakan pada "Fringing Reef" yaitu terumbu karang sekeliling pantai, sedangkan transek LIT dipasang pada terumbu karang jenis "Barrier Reef" yang terpisah dari daratan atau pulau-pulau. Menurut laporan WWF pada tahun 1989, umumnya penutupan karang keras pada terumbu karang tersebut termasuk pada kategori baik atau Sangat Baik, sehingga.

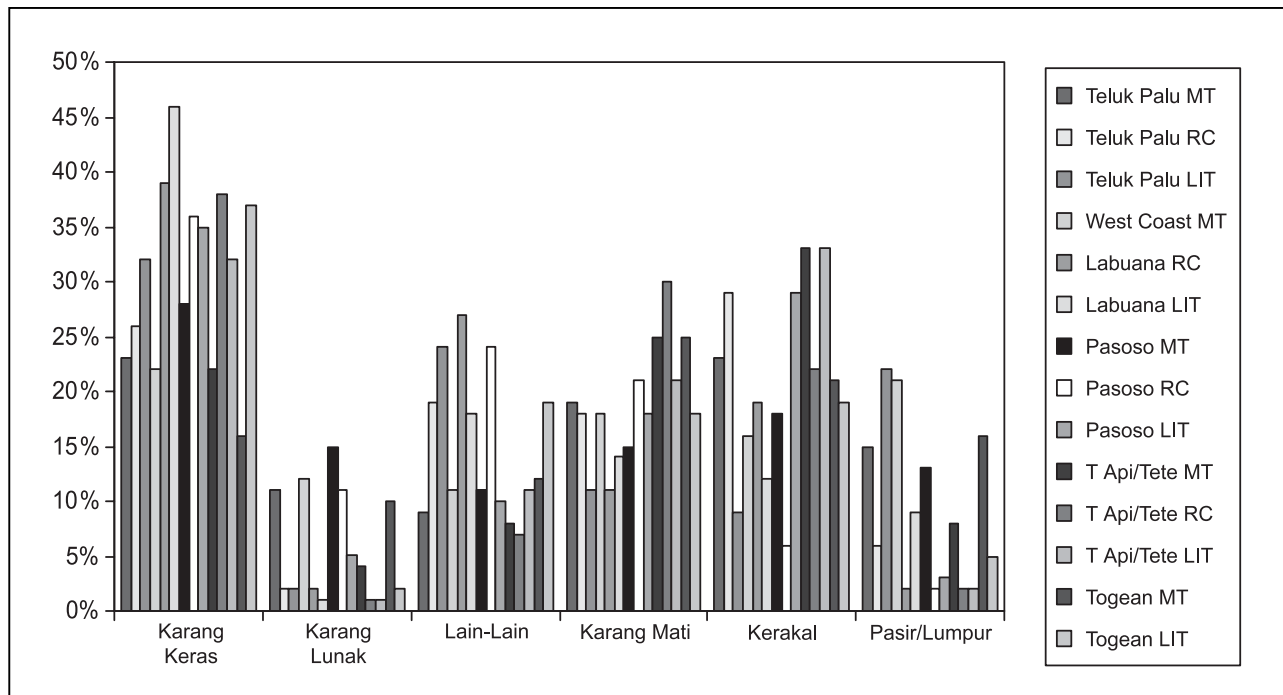
Data Lit juga merupakan indikasi adanya penurunan tajam kondisi terumbu karang di Kepulauan Togean.

Tabel 5.2 Hasil Survei & Monitoring 2002/2003

(Persentase)

Komposisi Substrat	HC	SC	OT	DC	RB	S
Teluk Palu MT	23	11	9	19	23	15
Teluk Palu RC	26	2	19	18	29	6
Teluk Palu LIT	32	2	24	11	9	22
Pantai Barat MT	22	12	11	18	16	21
Labuana RC	39	2	27	11	19	2
Labuana LIT	46	1	18	14	12	9
Pasoso MT	28	15	11	15	18	13
Pasoso RC	36	11	24	21	6	2
Pasoso LIT	35	5	10	18	29	3
T Api/Tete MT	22	4	8	25	33	8
T Api/Tete RC	38	1	7	30	22	2
T Api/Tete LIT	32	1	11	21	33	2
Togean MT*	16	10	12	25	21	16
Togean LIT*	37	2	19	18	19	5

* Lokasi-lokasi berbeda.

Gambar 5.1 Hasil Survei & Monitoring 2002/2003


6. DAFTAR SINGKATAN

Singkatan	Nama Lengkap
ADB	Asian Development Bank
BKSDA	Balai Konservasi Sumberdaya Alam
CA	Cagar Alam
COREMAP	Coral Reef Rehabilitation & Management Project
DKP	Dirigen Kelautan dan Perikanan
GCRMN	Global Coral Reef Monitoring Network
ICLARM	International Centre for Living Aquatic Resource Management (telah menjadi The World Fish Center)
IPB	Institut Pertanian Bogor
MCRMP	Marine and Coastal Resources Management Programme
SDA	Sumberdaya Alam
SMS	Suaka Marga Satwa
WRI	World Resources Institute

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- CD:
- ReefCheck headquarters, "Reef Check 2001" serta "Reef Check 2003"
- GCRMN, "C-Nav"

8. UCAPAN TERIMA KASIH

YACL ingin mengucapkan terima kasih kepada semua pihak yang telah memberikan bantuan dan dukungan dalam bentuk apapun demi kelancaran program pelestarian lingkungan. Kami ucapkan terutama kepada:

- UNEP EAS/RCU khusus pemberian dana hibah, memberikan peluang, nasehat dan bantuan lainnya sejak tahun 2000.
- Kepada pihak donor program kelautan YACL, terutama The David & Lucille Packard Foundation (2001 s/d 2004), NOAA International Coral Reef Conservation Program (2003/2004), PADI Project AWARE (2001/2002) dan mitra kerja lain dari luar negeri terutama WRI/ICLARM (2000/2001) dan The BP Conservation Programme (2003/2004).
- Mitra kerja dalam kegiatan survei bersama IPB/DKP dan dalam rangka MCRMP.
- Semua masyarakat yang telah menerima dan membantu YACL di lapangan.
- Semua lembaga dan individu yang telah memberikan informasi, materi dan nasehat termasuk COREMAP (terutama Ir Muchsin dan Ir Baharuddin di Makassar), The ReefCheck Foundation, GCRMN, Peter Feedhan dari Webinspired UK.
- Seluruh anggota tim survei YACL, baik tenaga permanen maupun anggota sementara dari masyarakat dan semua rekan-rekan yang telah memberikan dukungan secara moral maupun materil.

9. LAMPIRAN/INFORMASI TAMBAHAN

Lampiran berupa CD telah dikirim pada pihak-pihak donor. Dokumentasi serta beberapa materi tambahan seperti materi pelatihan dan survei dalam Bahasa Indonesia tersedia di YACL dan dapat diperoleh dengan mengajukan permohonan. YACL akan melayani permintaan sesuai dengan kemampuannya.

Sebagian data dokumentasi dan informasi lain tersedia di website YACL, <http://www.yacl-sulawesi.org>, dan akan ditambah apabila ada informasi atau data baru.

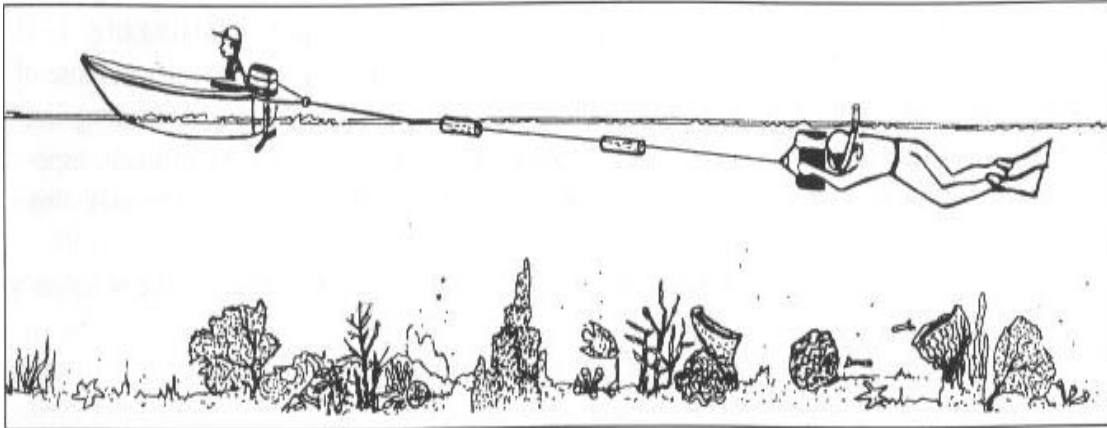
Gambaran umum dari tiga metodologi survei GCRMN yang digunakan oleh YACL dalam program bersama UNEP EAS/RCU terdapat pada lampiran. Khususnya LIT dan Manta Tow, metode lengkap terdapat dalam English et al (1997), dan khusus ReefCheck di CD yang dapat diperoleh dari Pusat ReefCheck (rcheck@ucla.edu). Singkatan metode-metode tersebut dan metode survei lainnya terdapat di Azhar et al (2002) dan CRITC (2001) antara lain.

(a) *Metode Manta Tow*

Metode Manta Tow adalah suatu metode pokok untuk survey terumbu karang “berbasis masyarakat”, yang cukup sederhana dan sudah disahkan oleh GCRMN (termasuk COREMAP dan LIPI khusus Indonesia). Metode ini dapat digunakan oleh anggota masyarakat yang bukan “Ilmuan” atau Tenaga Ahli/Pakar, karena mudah dipelajari dan dilakukan secara efisien dan profesional tanpa memiliki pengetahuan yang mendalam sebelumnya.

Manta Tow Board (Papan Manta Tow) baik satu atau dua orang Pengamat yang dilengkapi dengan peralatan snorkel ditarik dibelakang perahu kecil (misalnya Ketinting) seperti yang tampak pada gambar A.1 dibawah ini.

Gambar 1. Metode Survey Manta Tow



Manta Tow Technique

Data dicatat setiap 2 menit oleh pengamat pada formulir khusus yang terpasang di papan Manta Tow. Khusus survai yang dilakukan YACL, data pokok yang diambil adalah persentase dasar laut (rata-rata selama 2 menit) yang ditutupi masing-masing oleh 6 jenis substrat yang telah ditetapkan seperti yang tertera pada Tabel A.2. Jenis-jenis substrat tersebut terdiri dari 3 jenis benda hidup dan 3 jenis benda mati. Hasil data tersebut adalah komposisi substrat (komposisi penutupan dasar laut). Catatan tambahan lainnya berupa hewan langka yang dilihat, pengeboman, sifat atau Topografi Tubir (landai, Tebing) dll.

Tabel A.2 Jenis Dasar Laut yang Diamati pada Manta Tow

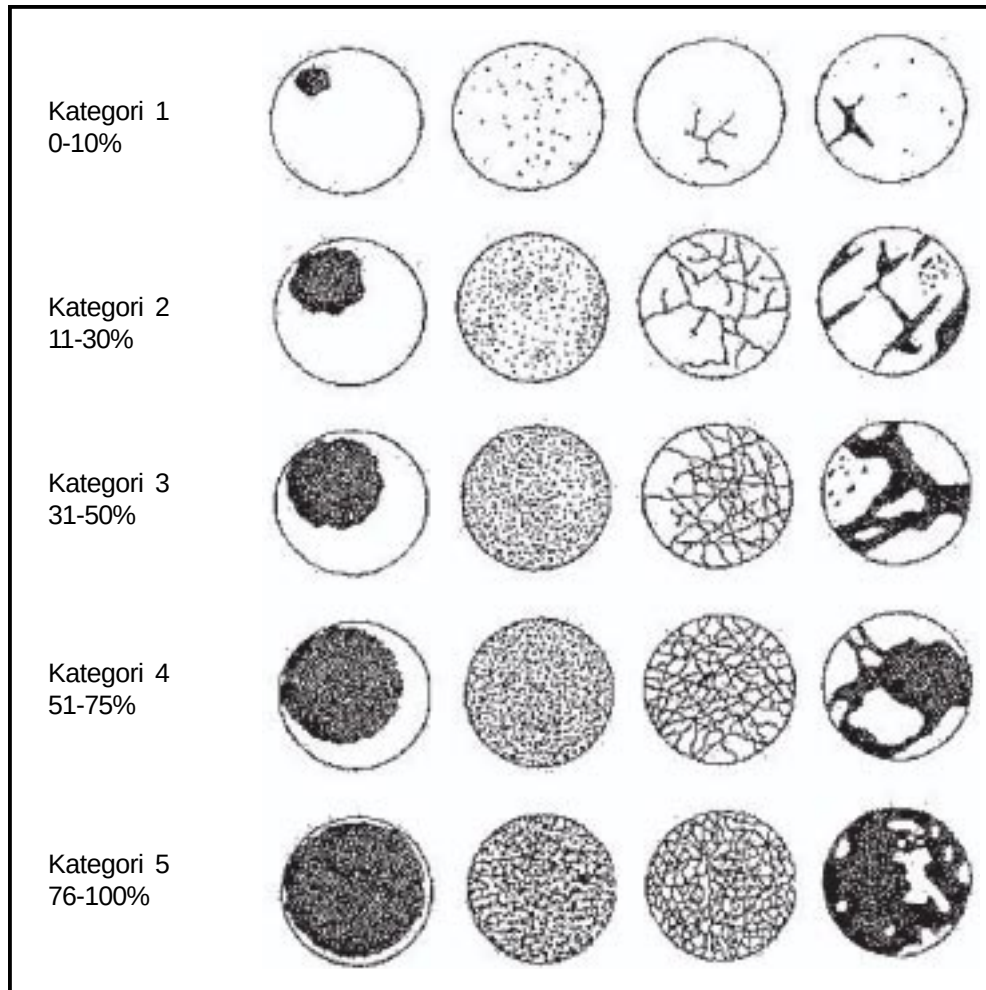
Kode Internasional	Inggeris	Indonesia	Keterangan
HC	Hard Coral	Karang Keras	Hidup
SC	Soft Coral	Karang Lunak	Hidup
RB	Rubble	Kerakal/Pecahan Karang	Mati
DC	Dead Coral/Rock	Karang Mati/Batu	Mati
S	Sand/Silt	Pasir/Lumpur	Mati
OT	Other	Lain-Lain	Hidup

Pengemudi perahu harus mengelilingi terumbu karang dengan perhatian bahwa pengamat selalu terletak di bagian tubir terumbu karang. Perahu berjalan selama dua menit, dan berhenti pada saat pengamat mencatat data. Setiap perjalanan/pengamatan selama 2 menit adalah satu "tow". Seorang observer yang berada diatas perahu bertugas untuk mengatur waktu mulai/akhir setiap tow dan mengawasi keamanan pengamat serta mencatat data yang meliputi:

1. Lokasi dan Tanggal pengambilan data serta Nama Pengamat.
2. Data GPS berupa titik awal dan titik akhir khusus setiap Tow (jika beberapa Tow tersambung, cukup jika mengambil titik paling awal dan selanjutnya titik akhir pada setiap Tow).
3. Cuaca (skala Beaufort khusus angin/ombak dan Okta khusus penutupan awan).
4. Jarak pandang Vertikal dan Horisontal (menggunakan pelampung/secchi disc).
5. Waktu mulai/selesai Tow (dalam jam: menit, beda waktu 2 menit).

Kategori Penutupan dasar laut/substrat diukur melalui metode perkiraan persentase selama setiap Tow sepanjang 2 menit, dengan menggunakan skala kategori AIMS¹/GCRMN yang tampak pada Gambar A.2 di bawah ini.

Gambar A.2 Kategori Penutupan Dasar Laut



Metode Manta Tow dapat mensurvei daerah yang cukup luas dalam waktu operasional yang relatif singkat, khusus memberikan gambaran umum tentang kondisi dan komposisi dasar laut (substrat) yang diamati.

Metode Manta Tow terutama digunakan untuk mensurvei terumbu karang, terutama "Fringing Reef" yang bersifat landai, tetapi dapat juga digunakan untuk wilayah terumbu karang lainnya seperti "Barrier Reef" atau reef yang bersifat tebing. Teknik Manta Tow sangat fleksibel dan dengan formulir serta protokol lainnya dapat digunakan untuk mensurvei kelimpahan lipan laut, kondisi atau luas areal ekosistem lamun dan sebagainya.

¹ Australian Institute for Marine Science.

Tenaga yang dibutuhkan:

- Pengemudi perahu.
- Pencatat di atas perahu yang juga bertugas mengawasi pengamat di air serta menjalani komunikasi dengan/antara pengamat di air dan pengemudi.
- 1 atau 2 orang pencatat di air.
- Jika posisi pengemudi tidak memungkinkan penglihatan yang jelas tentang bentuk tubir ke depan, maka dibutuhkan 1 pengamat tubir khusus menunjukkan jalan pada pengemudi.

Khusus menjaga kualitas data dan kenyamanan pengamat, GCRMN anjurkan untuk melakukan roling/pengantian pengamat di air apabila telah melakukan kegiatan pengamatan selama 10 atau 12 Tow, jika situasi dan jumlah pengamat terlatih memungkinkan.

Peralatan yang dibutuhkan:

- Papan Manta Tow, yang dilengkapi dengan tali sepanjang 18 m (yang sebaiknya ditandai dengan pelampung pada jarak 6 dan 12 m dari ujungnya guna memfasilitasi perkiraan jarak pandang).
- Perahu yang mampu mengikuti tubir secara pelan dan akurat.
- Masker, snorkel dan fins (sepatu bebek) bagi pengamat di air.
- Alat GPS.
- Jam/stopwatch yang dapat mengukur waktu 2 menit secara tepat.
- Formulir pencatatan data yang tahan air serta alat tulis khusus pengamat di perahu maupun di papan manta tow.
- Gambar kategori penutupan (A.2) yang dapat dipasang pada papan Manta Tow.
- Peralatan dokumentasi (tustel atau videocam) – tidak mutlak.

Pakaian pelindung (baju karet, perlindungan dari matahari dan rasa “gatal” di air) serta kebutuhan lain untuk keamanan dan kenyamanan (air minum, obat mata hari, kotak PPK dsb.)

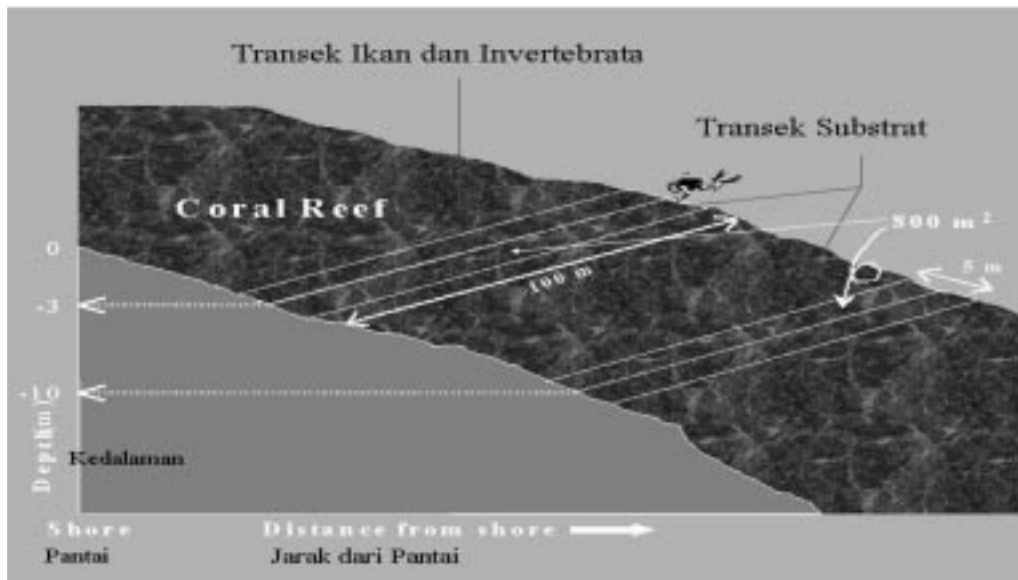
(b) Metode ReefCheck

Metode ReefCheck adalah suatu metode survai yang biasanya dilakukan dengan menggunakan peralatan SCUBA, meskipun beberapa tim mampu melaksanakannya dengan alat snorkel. Di samping pengamatan dibawah air, berupa data substrat (penutupan dasar laut) dan data biota indikator (ikan, invertebrata, hewan langka, dll) tim ReefCheck juga diwajibkan untuk mengambil data tentang lokasi Survai, berupa sejumlah indikator geografis dan sosial-ekonomi.

Metode ReefCheck telah diadopsikan oleh GCRMN sebagai pilihan pertama dalam pelaksanaan kegiatan survai dan monitoring sukarelawan, dimana masyarakat khususnya penyelam terlibat disamping tenaga-tenaga ahli. Setiap tim ReefCheck harus beroperasi dibawah pengawasan satu ahli di bidang penelitian kelautan yang telah diresmikan oleh pusat ReefCheck, yang disebutkan sebagai “Team Scientist” (TS). TS bertugas melati tim survainya dan bertanggungjawab atas kualitas data yang diambil oleh timnya. YACL mempunyai seorang TS yang telah terlibat dalam kegiatan ReefCheck sejak awalnya tahun 1997, ikut pelatihan sebagai pelatih (TOT) tahun 1998, serta mengikuti beberapa pertemuan GCRMN/ReefCheck antara 1999 dan 2003.

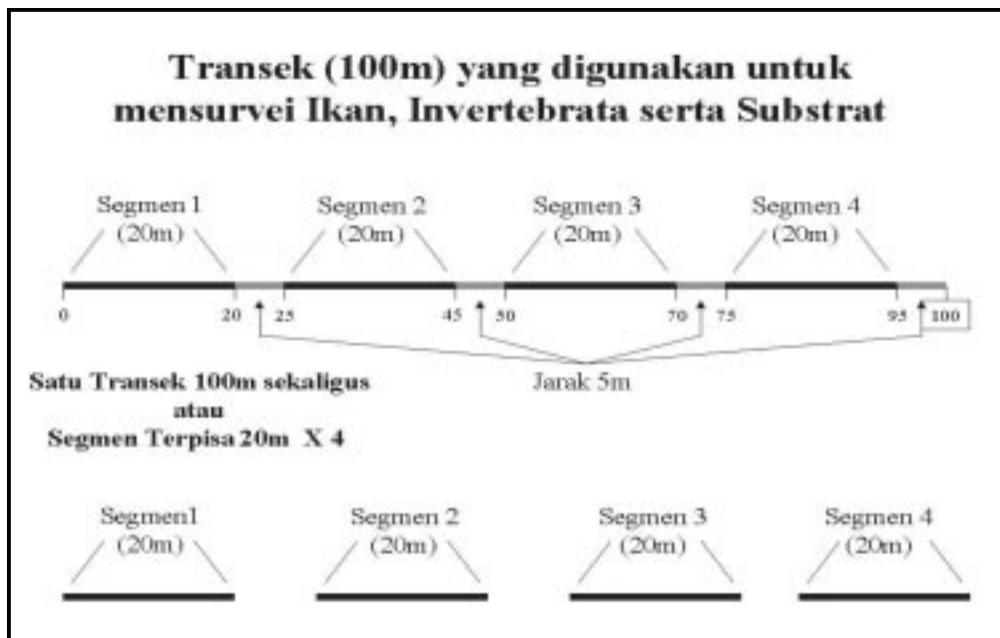
Metode ReefCheck mengambil sampel-sampel di lokasi survai, berupa dua garis sepanjang 100 m terpasang di dasar laut, dengan memakai meteran atau tali khusus, seperti pada Gambar B.1. Terumbu karang dibawah dan di setiap sebelah garis tersebut dijadikan sampel, dan diberi nama Transek. Transek-transek ReefCheck sebaiknya dipasang dengan cara yang dianggap dapat mewakili kondisi umum di wilayah survai. Setiap Transek terdiri dari 2 garis transek yang dipasang pada dua kedalaman berbeda yaitu kedalaman dangkal sekitar 3 m (batas standar >2 m dan <6 m) dan sedang, sekitar kedalaman 10 m (batas standar >6 m dan <12 m).

Gambar B.1 Transek ReefCheck



Setiap transek sepanjang 100 m terdiri dari 4 Segmen dengan panjang 20 m dan jarak 5 m antara satu segmen dan segmen berikut. Jika kondisi atau bentuk substrat (dasar laut) tidak memungkinkan untuk pemasangan 4 segmen berturut-turut, segmen tersebut dapat dipasang secara terpisah, asal kedalamannya sama dan jarak diantaranya melebihi 5 m, seperti contoh di Gambar B.2.

Gambar B.2 Garis Transek dan Segmen ReefCheck



Jika bertujuan monitoring (mensurvei ulang) pada satu lokasi, pemasangan tanda-tanda permanen sangat dianjurkan. Dengan demikian, sampel survei akan sama sehingga monitoring dapat dengan benar mengetahui tingkat perubahan dan perkembangan dari lokasi yang diamati, bukan perbedaan antara sampel pertama dan sampel kedua.

Data yang diambil dibagi tiga, yaitu data Line Transect berupa survei komposisi substrat; data Belt Transect berupa survei jenis-jenis indikator serta data Site description berupa informasi tentang lokasi secara geografis dan indikator sosio-ekonomik.

(i) *Data Line Transect*

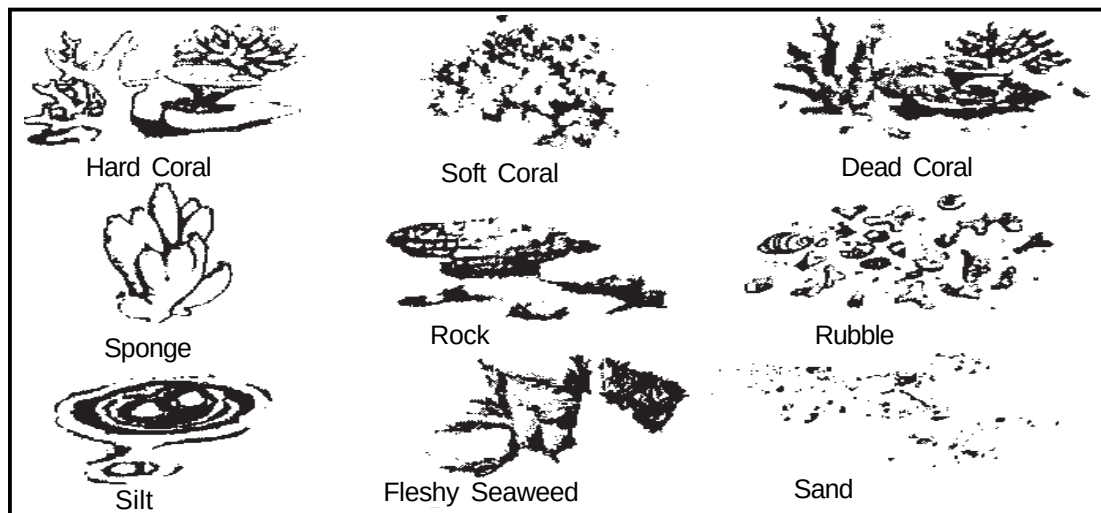
Data yang tercatat pada survei Line Transect adalah jenis substrat pada titik-titik sampel setiap 50 cm sepanjang setiap segmen. Definisi dari jenis-jenis penutupan dasar laut atau substrat yang digunakan dijelaskan dalam Tabel B.1. dan dapat dilihat secara visual pada Gambar B.3. Metode pengambilan titik dan kategori jenis dasar laut dapat dilihat pada Gambar B.4. Kegiatan ini yang biasa disebutkan “Survei karang” atau “Survei substrat”.

Tabel B.1 Jenis-jenis Substrat khusus Survei ReefCheck

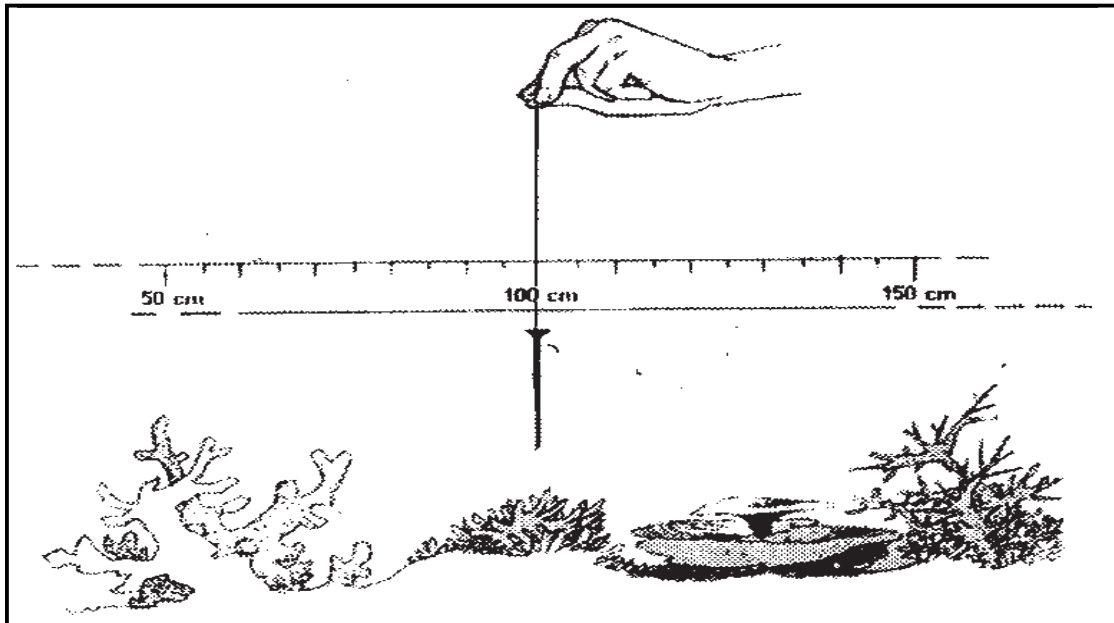
Kode Internasional	Bahasa Inggris	Bahasa Indonesia
HC	Hard Coral	Karang Keras
SC	Soft Coral	Karang Lunak
SP	Sponge	Sponge
FS ¹	Fleshy Seaweed	Ganggang
OT	Other	Lain-lain
RC	Rock/Dead CORAL >15 cm	Batu/Karang Mati >15 cm
RKC	Recently Killed Coral	Karang Baru Mati
RB	Rubble >0.5 cm and <15 cm	Kerakal >0.5 cm dan <15 cm
SD	Sand	Pasir
SI	Silt	Lumpur

¹ Telah ada perubahan pada pertengahan tahun 2003 dimana FS tidak lagi dipakai. Kode baru adalah NIA – Nutrient Indicator Alga atau Alag Indikator Nutrifikasi, dan hanya meliputi jenis-jenis alga yang dapat menandai tingkat nutrient relatif tinggi, sedangkan alga lain seperti Halimeda atau Sargassum yang merupakan bagian dari terumbu karang sehat dimasuki pada Lain-lain ataupun dapat mencatat substrat dibawahnya dengan memberikan catatan di keterangan.

Gambar B.3 Jenis-jenis Substrat khusus Survei ReefCheck



Gambar B.4 Penentuan titik sampel pada Survei Substrat

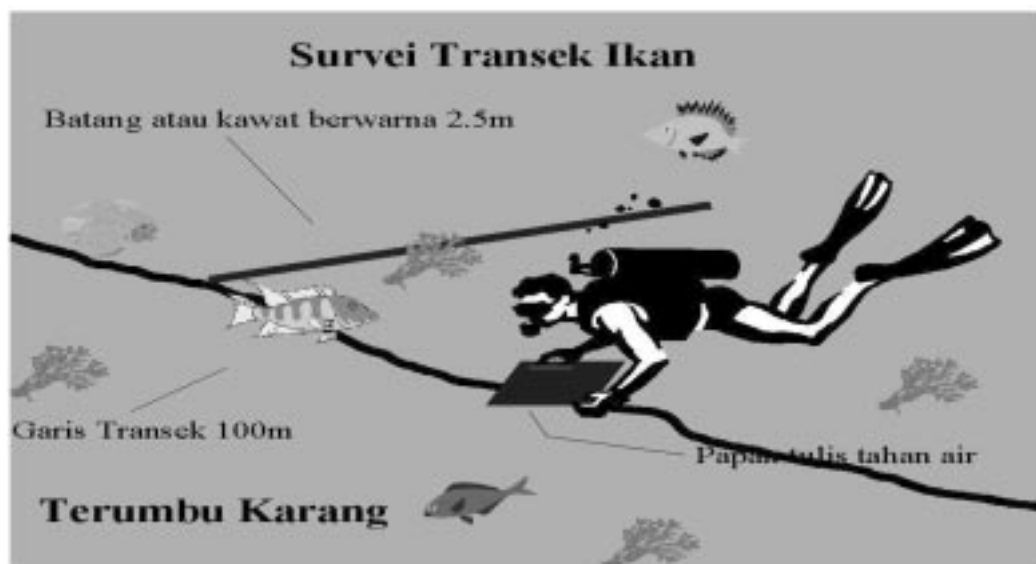


(ii) Data Belt Transect

Data Belt Transect diambil sepanjang transek dengan areal sampel selebar 5 m (2.5 m di setiap sebelah garis transek) pada setiap segmen, sehingga areal total = $5 \text{ m} \times 20 \text{ m} \times 4 = 400 \text{ m}^2$ di setiap kedalaman atau 800 m^2 per lokasi. Data jenis Ikan dan Invertebrata yang dicatat merupakan jenis indikator yang memberikan indikasi tentang kondisi wilayah dan tekanan oleh aktivitas manusia. Demikian juga data lain yang tercatat pada saat dibawah air, seperti penyakit karang, kerusakan karang, sampah dll.

Teknik pengamatan ikan dilakukan dengan menghitung jumlah ikan dari jenis-jenis indikator yang masuk dalam areal sampel, dengan pengamatan selama 3 menit per 5 m atau 12 menit per segmen. Teknik tersebut dapat dilihat pada Gambar B.5.

Gambar B.5 Teknik Pengamatan/Pengambilan Data Ikan pada Belt Transect



Jenis ikan indikator meliputi:

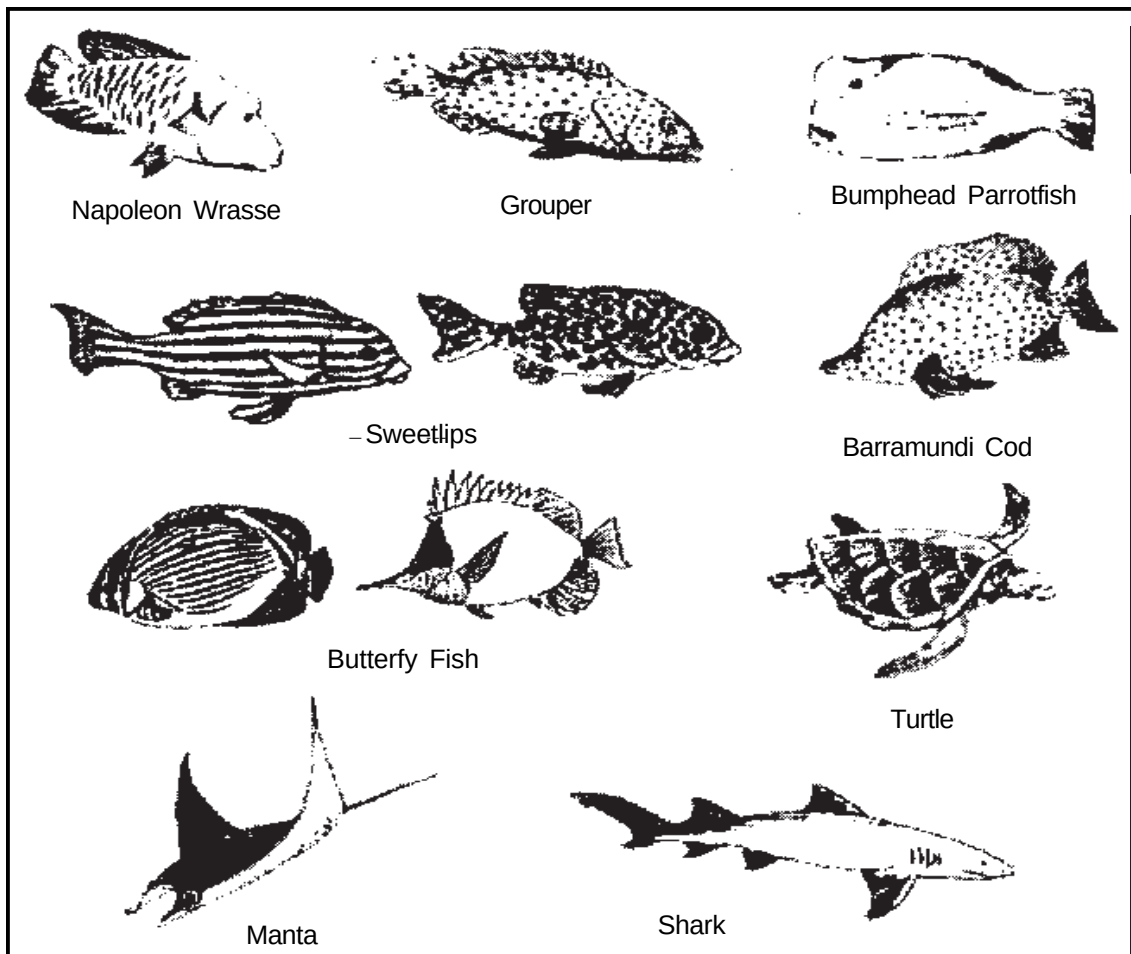
Ikan kerapu/Sunu (grouper/coral trout) >30 cm, semua jenis
 Kerapu bebek (Barramundi cod)
 Ikan Bibir Tebal (Sweetlips), semua jenis
 Ikan Napoleon)/Maming (Humphead/Napolean Wrasse)
 Ikan kakatua besar (Bumphead parrotfish)
 Ikan kakatua lain (other parrot fish) >20 cm,. semua jenis
 Ikan kupu-kupu (Butterfly fish), semua jenis
 Ikan Bungawaru (Snapper, semua jenis)
 Kompa/Belut (Moray eel)

Serranidae
Cromileptes altivelis
Haemulidae
*Cheilinus undulatus**
*Bolbometopon muricatum**
Scarridae
Chaetodontidae
Lutjanidae
Muraenidae

* Meskipun di luar areal transek, masih dicatat.

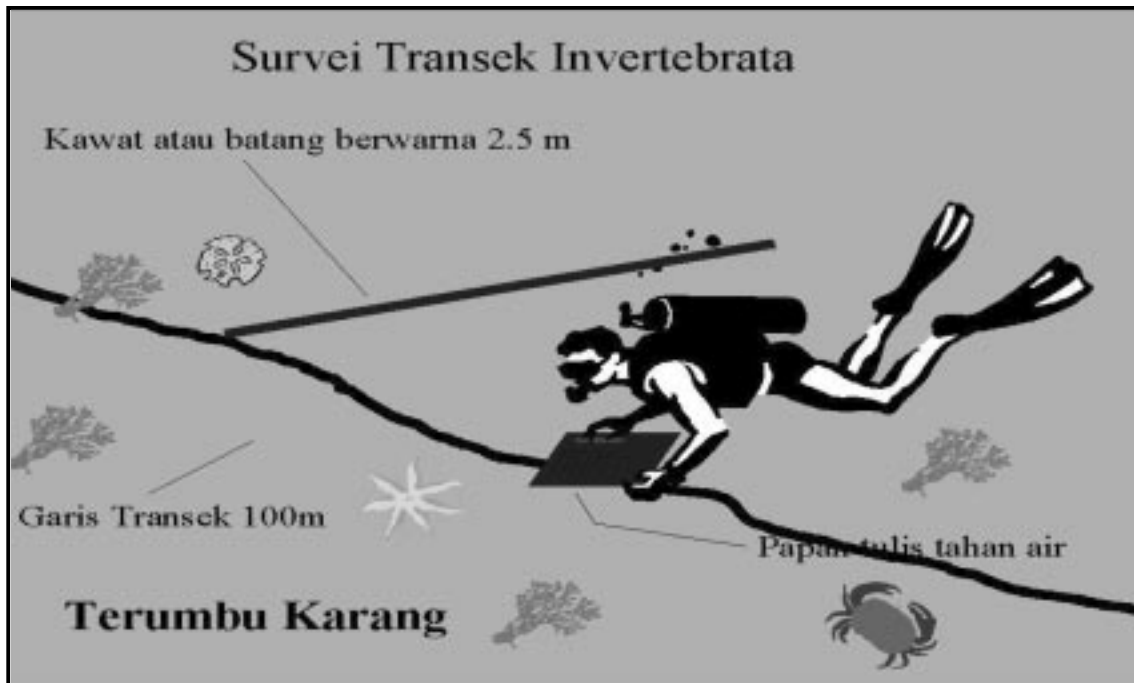
Hewan langka yang terlihat pada pengamatan juga didata, terutama ikan hiu dan pari, penyu dan duyong. Untuk lebih jelasnya sebagian jenis-jenis ikan yang diamati pada pengamatan transek ikan dapat dilihat pada Gambar B.6. dibawah ini:

Gambar B.6 Jenis-Jenis Ikan yang diamati pada Pengamatan Transek Ikan



Data invertebrata diambil pada areal sampel sama dengan khusus pengamatan ikan, tetapi tidak ditentukan batas waktu tertentu. Teknik dapat dilihat pada Gambar B.7.

Gambar B.7 Teknik Pengamatan/Pengambilan Data Invertebrata



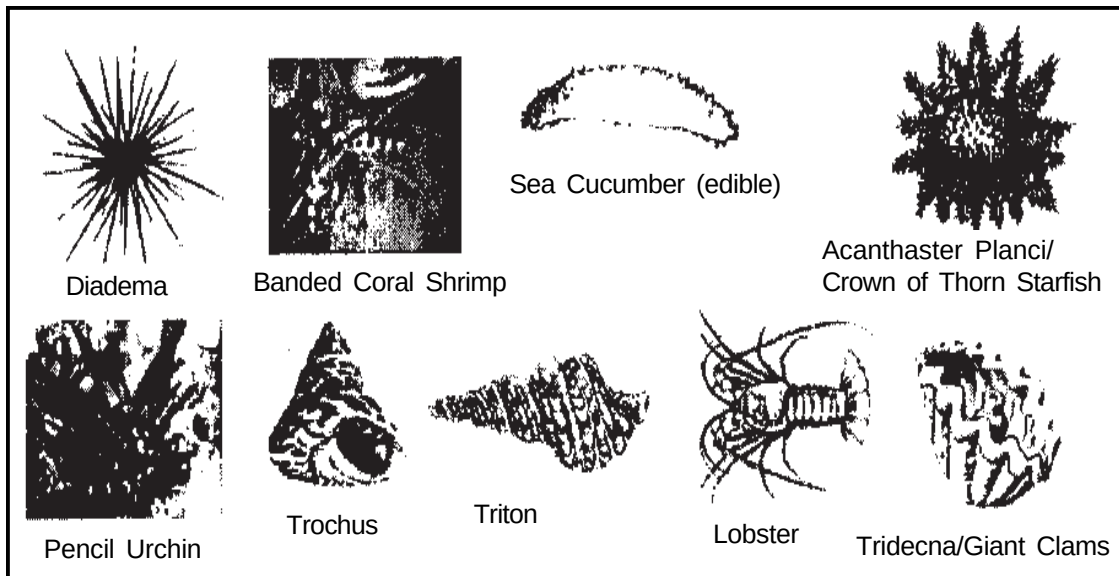
Jenis Invertebrata Indikator meliputi:

Udang Berbeling (Banded coral shrimp)
Bulu Babi (long-spined black sea urchins)
Udang lobster (lobster)
Kima (Giant clams) (ukuran dan jenis)
Landak laut (Pencil urchin)
Teripang nenas (Prickly redfish)
Teripang hitam (Greenfish)
Lipan laut (Crown of thorns starfish – COTs)
Kerang Triton Terompet (Triton shell)

Stenopus hispidus
Diadema spp.
Malacostrata/Panuliridae
Tridacna spp.
Heterocentrotus mammillatus
Thelenota ananas
Stichopus chloronotus
Acanthaster planci
Charonia tritonis

Disamping data indikator invertebrata diatas, data penunjang lain yang dicatat pada saat pengamatan meliputi sampah atau limbah rumah tangga, karang yang baru rusak akibat jangkar, bom, pemutihan terumbu karang dan penyebab lain, penyakit karang yang jelas ataupun diduga, serta kondisi apapun yang luar biasa sepanjang transek. Semua hal tersebut dicatat sesuai dengan jumlah dan tingkat kerusakannya. Sebagian jenis-jenis invertebrata yang diamati dapat dilihat pada Gambar B.8.

Gambar B.8 Jenis-Jenis Invertebrata khusus Belt Transect



Data Lokasi

Data lokasi "Site Description" (deskripsi lokasi) meliputi data fisik (termasuk koordinat Lintang Bujur yang diambil dengan GPS atau navigasi tradisional, jarak dari kota dan sungai terdekat, cuaca, badai pengrusak dsb), serta data sosial-ekonomi seperti jumlah penduduk, jenis aktivitas perikanan, aktivitas manusia lain yang berdampak pada terumbu karang, status kawasan dsb.

Sebaiknya, data primer ReefCheck ditunjang dengan data pendukung lainnya berupa dokumentasi foto dan video bawah laut di lokasi, termasuk gambar tanda-tanda permanen, gambar atau video dari keadaan sepanjang transek, panorama daratan di sekitar lokasi transek dan aktivitas tim pada kegiatan survei.

Peralatan yang dibutuhkan

- Alat selam (SCUBA) lengkap.
- Perahu (minimal untuk membantu memasang tanda dan mengukur GPS, meskipun sekaliwaktu tim penyelam dapat turun dari pantai).
- Tali transek 100 m (minimal 2 per lokasi) dan tanda-tanda ujung transek.
- Alat GPS dan jam selam/komputer yang dapat mengukur waktu 3 menit secara tepat (khusus keamanan dan Survei ikan).
- Formulir pencatatan data dan gambar jenis Indikator yang tahan air serta alat tulis.
- Peralatan dokumentasi (tustel dan/atau videocam) yang tahan air.
- Pakaian pelindung (baju karet).
- Tanda-tanda permanen (jika bertujuan memasang transek permanen).

Tenaga yang dibutuhkan

- Tim penyelam (minimal 4 orang, sebaiknya 6 orang atau lebih).
- "Team scientist" TS (Ahli siens) yang diakui oleh ReefCheck (dapat menjadi suatu penyelam atau tidak, tetapi bertanggung-jawab terhadap kualitas data).

- “Team Leader” TL (Pemimpin Tim): boleh TS = TL tetapi sebaiknya tugas dibagi pada 2 orang.
- Pengemudi perahu/pengawas di permukaan.

(c) LIT – Line Intercept Transect

LIT adalah metode GCRMN untuk menilai penutupan dasar laut atau komposisi substrat secara lebih mendetail, tetapi masih tanpa memasuki pada tingkat spesies. Metode LIT dapat dilakukan oleh seorang penyelam sendiri, meskipun demi keamanan standar PADI dan mayoritas lembaga penyelaman lain melarang penyelaman sendiri, tanpa “buddy”. LIT membutuhkan tingkat pengetahuan tentang taksonomi lebih tinggi dibanding dengan Manta Tow atau ReefCheck, tetapi yang masih dapat dijangkau oleh amatir yang berniat belajar dengan serius, bukan hanya oleh pakar ahli karang.

Cara pengambilan data adalah memasang tali meteran dengan panjang apapun (biasanya minimal 10 m) pada terumbu karang yang disurvei, dan mencatat jenis substrat dalam klasifikasi “Life Form” yang terdapat dibawahnya, dengan akurasi pencatatan pada centimeter terdekat. Klasifikasi dan Kode-Kode Life Form terdapat pada Tabel 5.1. Data LIT gampang dimasuki pada analisa statistik, tetapi untuk benar-benar mewakili suatu wilayah jumlah transek yang dibutuhkan cukup tinggi, sedangkan jumlah relatif kecil dapat memberikan indikasi yang bernilai, terutama tentang keanekaragaman hayati dalam suatu substrat.

Peralatan yang dibutuhkan

- Alat selam (SCUBA) lengkap.
- Perahu (minimal untuk membantu dalam penentuan lokasi geografis, misalnya melalui pengambilam titik GPS, meskipun sekaliwaktu tim penyelam dapat turun dari pantai).
- Tali transek (minimal 10 m) – jika memungkinkan dengan pemberat sehingga benar-benar rapat dengan substrat tanpa diikat.
- Formulir pencatatan data yang tahan air, alat tulis, jika masih diperlukan gambar Life-Form.
- Pakaian pelindung (baju karet).

Tidak mutlak

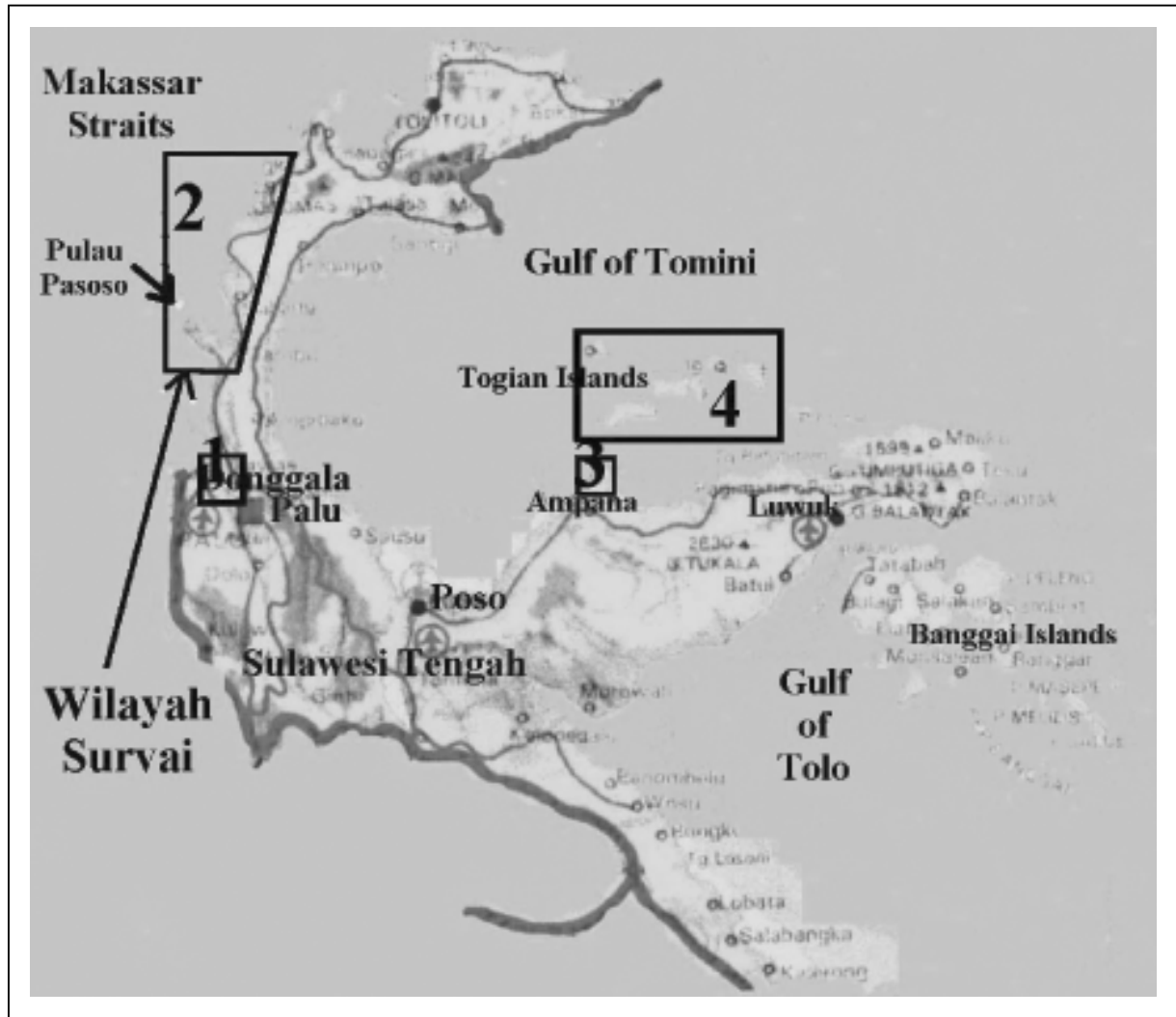
- Peralatan dokumentasi (tustel dan/atau videocam) yang tahan air.
- Tanda-tanda permanen (jika bertujuan memasang transek permanen).

Tenaga yang dibutuhkan

- Tim penyelam (minimal 2 orang) dengan minimal 1 yang terlatih.
- Pengemudi perahu/pengawas di permukaan.

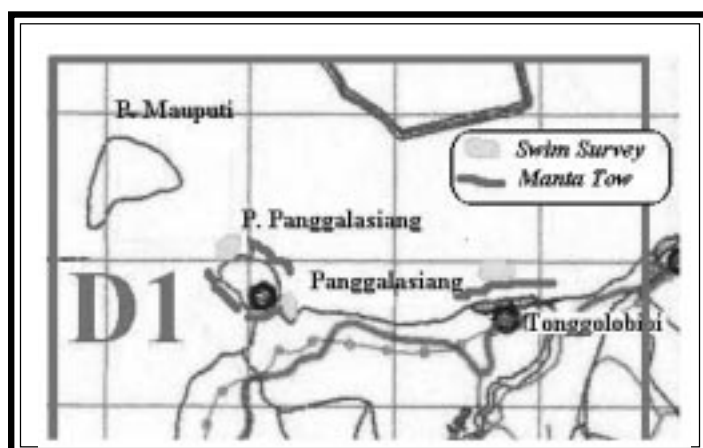
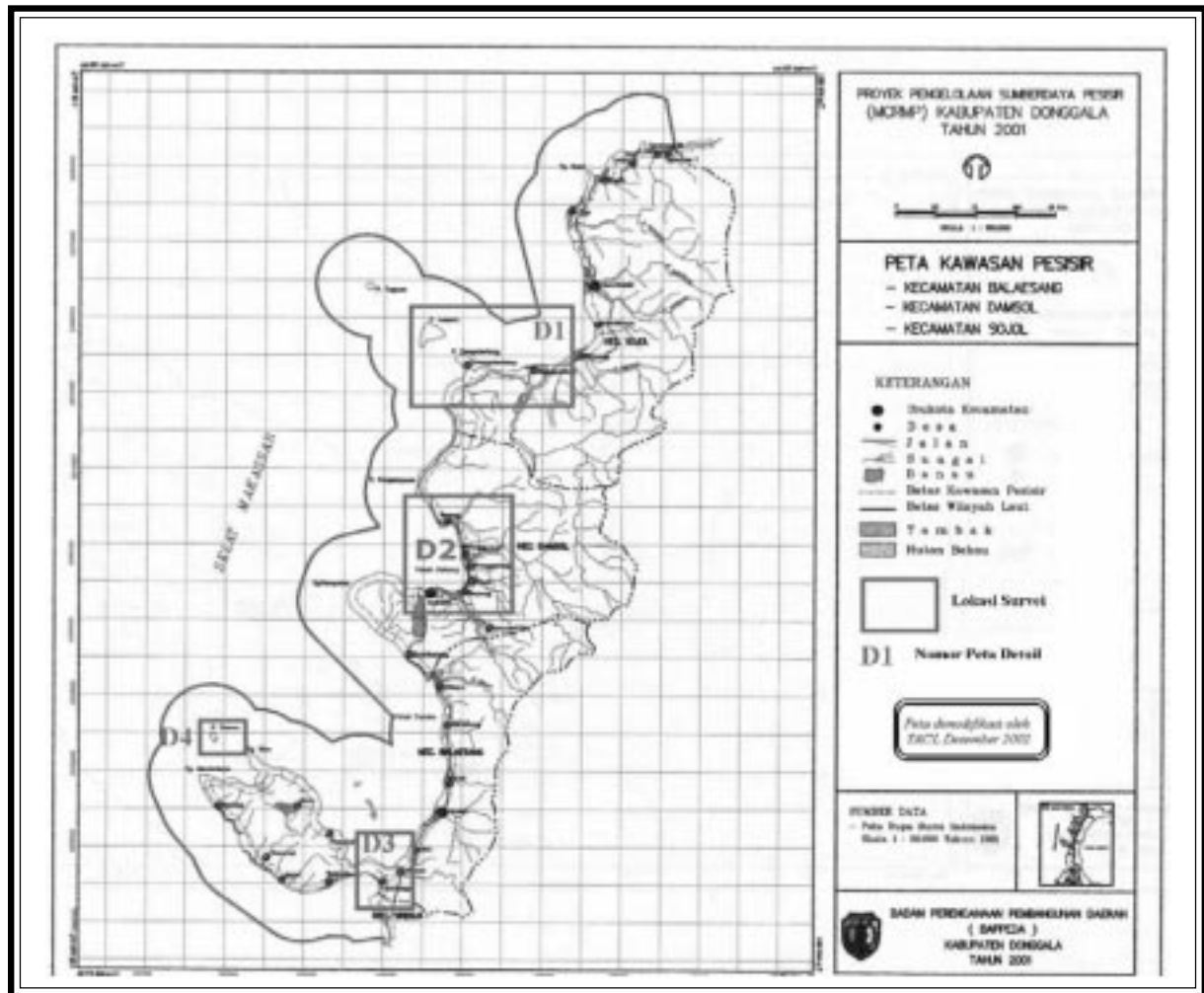
(d) *Peta-Peta Lokasi Survei:*

Peta 1 Wilayah Survei di Sulawesi Tengah



Peta-peta berikut memberikan gambaran tentang lokasi/titik survei di setiap wilayah yang didalam kotak-kotak di peta wilayah survei di atas kecuali wilayah 3, Cagar Alam Tanjung Api.

Peta 2 Survei di Selat Makassar

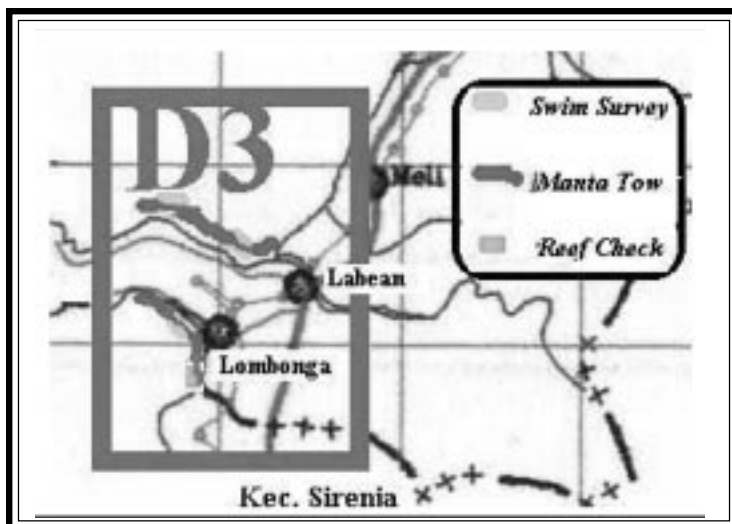


**Peta Lokasi Survei
Kecamatan Sojol**



Peta Lokasi Survai

Kecamatan Damsol

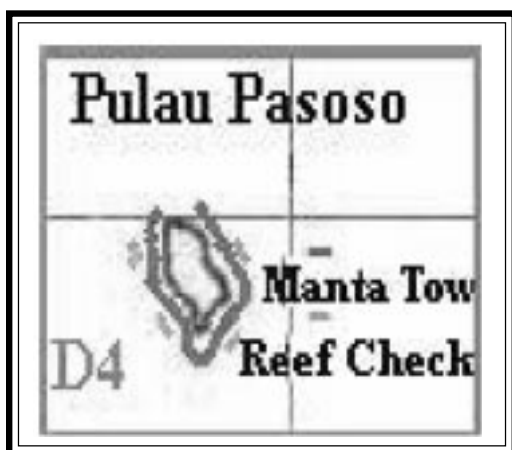


Peta Lokasi Survai

Kecamatan

Balaesang

(Lokasi LIT & ReefCheck sama)



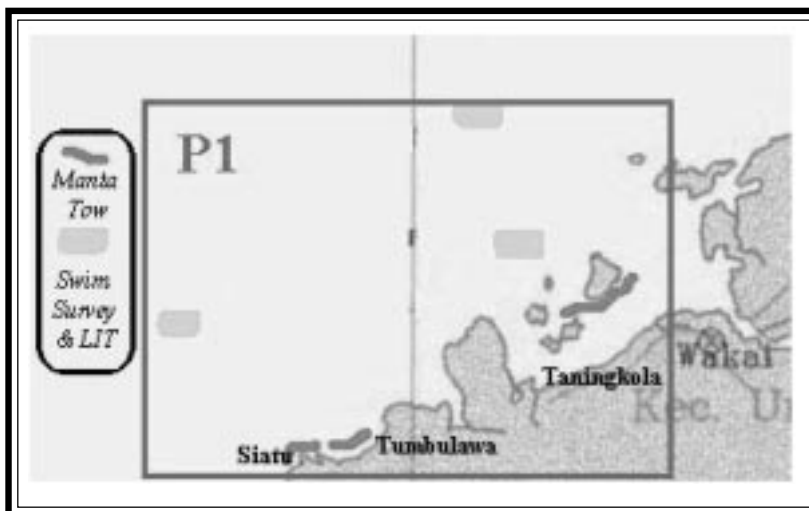
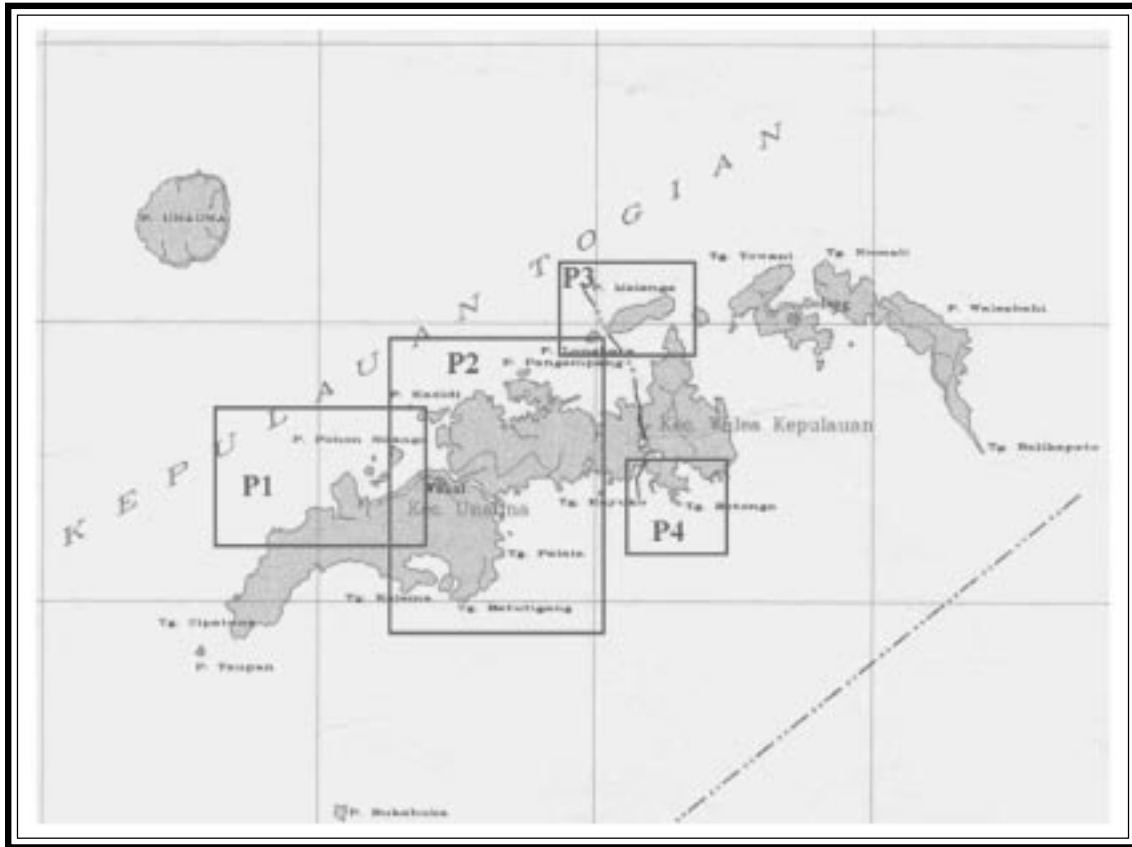
Peta lokasi Survai

di Pulau Pasoso

Kecamatan Balaesang

(Lokasi LIT & ReefCheck sama)

**Peta 3 Survai di Teluk Tomini
Kepulauan Togean**



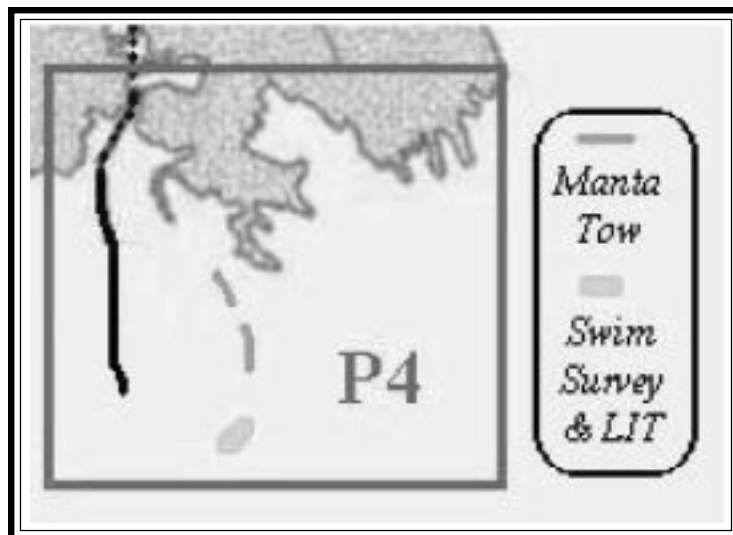
Peta Lokasi Survei
Kecamatan
Una Una (1)



Peta Lokasi Survei

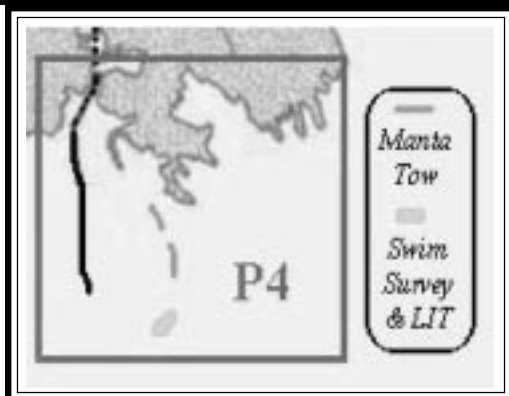
Kecamatan

Una-Una (2)



Peta Lokasi Survei Kecamatan

Walea Kepulauan (1)



Peta Lokasi Survei Kecamatan

Walea Kepulauan (2)

**Status Monitoring and Management Strategy Research of
Luhuitou Fringing Reef of the Sanya Reserve**

Implementing Institution: South China Sea Institute of Oceanology,
Chinese Academy of Sciences

Project leader: Zhang Qiaomin
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1. CAPACITY BUILDING: TRAINING WORKSHOP IN MANTA TOW, LINE INTERCEPT TRANSECT, AND CORAL REEF FISH VISUAL CENSUS SURVEY

The training course at Tropical Marine Biological Research Station in Hainan (Luhuitou of Sanya City) of the Chinese Academy of Sciences in October of 2002 was co-organized by Tropical Marine Biological Research Station in Hainan and Sanya National Coral Reef Reserve. The personnel that participated in the training course included 17 persons: 3 trainers, 3 decision makers, 6 local managers, 2 local divers, and 3 young staff of research institute (Table 1). The training course was divided into two parts: classroom lectures and field practice.

In the training course, 5 training lectures were given: (1) 'Introduction to Coral reefs' presented by Chen Gang; (2) 'Introduction to Coral Reef Monitoring and Manta Tow Survey' presented by Zhang Qiaomin; (3) 'Line Intercept Transect Survey' presented by Chen Gang; (4) 'Coral Reef Fish Visual Census Survey' presented by Huang Hui and Li Chun; (5) 'Human Activity and Natural Disturbance in Coral Reef Region' presented by Zhang Qiaomin. All 5 training lectures in electronic edition had been transferred to the Sanya National Coral Reef Reserve and the Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences for reference materials.

Two reference books used for the above coral monitoring methods were: (1) Uychiaoco A J, et al. Coral Reef Monitoring for Management, University of the Philippines Marine Science Institute, et al. 2001, 1-110, and (2) English S et al. Survey Manual for Tropical Marine Resources. 2nd edition, Australian Institute of Marine Science, 1997, 5-118.

Two motor boats were used for field practice after giving lectures, one was for snorkel manta tow and snorkel fish visual census survey and directed by assistant trainer Li Chun. Another was for scuba line intercept transect survey and directed by trainer Chen Gang. All trainees divided into two groups and took turns to join field practice in two boats. Sanya Huanqiu Diving Company provided the necessary diving equipments for field practice.

The training course achieved the desired results to spread coral reef knowledge and to increase capacity in surveying and monitoring coral reefs of local managers and local research institute staff. Some trainees, like Li Chun, a young staff of Tropical Marine Biological Research Station in Hainan, studied hard and quickly learned monitoring methods, and could play an important part in the later monitor surveying activity. Mr. He Xianghua, Deputy Director of Sanya National Coral Reef Reserve, firmly believed that their Reserve had obtained great benefits from this training course.

Table 1. Participants in Sanya coral reef monitoring training course

Organization	Name	Position	Trainer or trainee
South China Sea Institute of Oceanology, Chinese Academy of Sciences	Zhang Qiaomin	Research Professor and Project header	Trainer
	Huang Hui	Associate Professor	Trainer
	Shi Qi	Assistant Professor	Trainee and assistant trainer
Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences	Wang Hankui	Associate Professor and Deputy Director	Trainee
	Li Chun	Assistant Professor	Trainee and assistant trainer
	Hu Youmu	Assistant research staff	Trainee
Hainan Marine & Fishery Department	Chen Wenqun	Officer	Trainee
	Chen Gang	Officer	Trainer
Sanya National Coral Reef Reserve	He Xianghua	Deputy Director	Trainee
	Zhou Qiwei	Monitor	Trainee
	Li Xuefeng	Monitor	Trainee
	Zeng Yi	Monitor	Trainee
	Fu Jiefu	Monitor	Trainee
	Wang Zifu	Monitor	Trainee
	Zeng Chuizhao	Monitor	Trainee
Sanya Huanqiu Diving Company	Wang Zhan	Diver	Trainee
	Wu Shaohong	Diver	Trainee

2. SURVEY: SURVEY BENTHIC COMMUNITIES, LIVE AND DEAD CORAL COVERAGE, AND FISH AT LUHUITOU FRINGING REEF, SANYA, FOR COMPARISON TO PREVIOUS SURVEYS

A status monitoring surveying was carried out in October of 2002, including snorkel manta tow surveying in 2.5 km coastal section, snorkel fish visual census surveying in 5 x 50 m transects, scuba line intercept transect surveying in 5 x 20 m transects, scuba video in 5 x 50 m transects and nearby area for 2 hours video record, scuba photograph in 5 x 50 m transects and nearby area for 118 photos, local human activity surveying. The digital video and digital photos provided special important information for detail status assessment of Luhuitou fringing reef. We especially enjoyed the collaboration and important support of Chen Gang, Terence C.W. Fong and Dickson C.C. Wong in this monitoring surveying and related data processing.

3. DATA MANAGEMENT: DATA PROCESSING AND COMPARISON ANALYSIS

We have processed monitoring surveying data and compared them with existing survey data of 1993 and 1998 for information on trends in coral health and for determining impacts influencing coral reef degradation processes and restoration pattern. Some important results from this data processing and comparison analysis are listed below.

3.1 Change in Trend of Coral Health

Table 2 shows live coral cover of Luhuitou fringing reef at 1983, 1998, and 2002 and by different survey methods. Table 2 shows also some special data like soft coral cover in transect 2 and dead coral cover in transect 5. The mean live coral covers of reef slope changed from 60% in 1983 to 41.5% in 1998 and to 21.51% in 2002 (according to 2002 scuba video line intercept 50 m transect survey), so the general declining trends should be always existing, especially at transects 1, 4, and 5. In addition, there are some other video or photo evidences for coral decline or destruction like dead, broken or bleaching corals, corals covered by aquaculture rubbish, sediments or predator snails (*Drupella rugosa*). These phenomena occurred most often at transects 5 and 4. In transect 5 dead coral cover was as high as 22.30% (Table 2).

Table 2. Live coral cover (%) of Luhuitou fringing reef at different survey times

Source of data	Live coral cover (%) of reef slope at each transect in 1989 and 2002						Live coral cover (%) of reef flat
	1	2 ¹	3	4	5 ²	Average	
1983 field survey (Feng, 1983) ³	60						2-5
1998 diving 1 m ² quadrates survey (Zhang, 2001) ⁴	15-30	10-40	30-60	50	30-100	41.5	1-3
2002 scuba line intercept 20 m transect ⁵	10.75	22.50 (22.55)	47.00	5.00	31.75	28.26	
2002 scuba video line intercept 20 m transect survey	13.22	23.31 (28.96)	47.77	6.67 (22.30)	25.64	23.44	
2002 scuba video line intercept 50 m transect survey	10.60	25.88 (14.01)	38.37	15.51	17.17 (14.17)	21.51	
2002 snorkel manta tow survey	18.91						

3.2 Factors Affecting Coral Cover Decline and Destruction

In Sanya Coral Reef Reserve area, Luhuitou fringing reef is characterized by being nearest to Sanya City and the most highly impacted by human activities. Although the Sanya Coral Reef Reserve was established in 1990, some more coastal engineering activities around Sanya Port and some aquaculture activities along Luhuitou coast and waters have had quite big negative impacts to coral reefs of Luhuitou. In Xizhou (Dazhou) Island and Baipai Reef, located in north to Luhuitou, the hermatypic coral almost fully disappeared and cannot be restored. The destructive trend is spreading from north to south, and the transect 1 is the first to be affected. Transects 4 and 5 were affected mainly by marine aquaculture activities (part of them has stopped now).

¹ Soft coral cover (%) in brackets.

² Cover (%) in brackets for dead coral and dead coral with algae.

³ Feng Zengzhao. Summary report of scientific investigation group on modern carbonate sediments of Hainan Island and Xisha Islands of the Sedimentary Committee of the Chinese Society for Mineralogy, Petrology and Geochemistry. 1983, 1-51.

⁴ Zhang Qiaomin On biogeomorphology of Luhuitou fringing reef of Sanya City, Hainan Island, China. Chinese Science Bulletin, 2001, 46 (Supp.): 97-102.

⁵ All 4 kinds of data come from this monitoring survey in October 2002.

3.3 Status of Biodiversity of Luhuitou Fringing Reef

There are some good news from this monitoring survey. First, there is quite good live coral cover at transects 3 (38.37%) and 2 (25.88%, and soft coral cover of 14.01%). Second, an important find is the high level of biodiversity. Luhuitou fringing reef has had special importance for biodiversity in the past. It contained 117 hermatypic coral species in 1960s, more than 300 molluscan species in 1984, 296 fish species for Sanya waters in 1986, and 63 algae species in 1982-1983, by 70.4%, 43%, 52%, and 38% of all species in Hainan Island respectively. But what is the current status of biodiversity? Until this monitoring survey, there were no previous data on biodiversity in this area. In this monitoring survey, we recorded by video or photos 21 hermatypic genera (*Euphyllia*, *Lithophyllon*, *Pocillopora*, *Pocillopora*, *Hydnophora*, *Cyphastrea*, *Acropora*, *Porites*, *Diploastrea*, *Fungia*, *Platygyra*, *Galaxea*, *Pavona*, *Symphyllia*, *Montipora*, *Turbinaria*, *Favites*, *Favia*, *Goniopora*, *Psammocora*, *Pachyseris*), of which first two genera are newly recorded in Luhuitou, a hermatypic coral genus *Turbinaria*, soft corals (mainly in transect 2), sea fans, fire corals, many kinds of other invertebrates (sponges, giant clams, lobsters, sea cucumbers, sea dragons, sea lilies, brittle stars, sea stars, sea urchins, and sea snails), many kinds of fish, and seagrass and seaweed. There are some evidence from other source of data that Luhuitou fringing reef has the most hermatypic species among several coastal sections of Sanya Coral Reef Reserve. It seems that Luhuitou fringing reef has the highest biodiversity in Sanya Coral Reef Reserve and special protection value.

Figure 1. Beautiful tentacles of *Euphyllia*, a genus newly recorded in the waters of Luhuitou Fringing Reef



4. DATA MANAGEMENT: NEW DATA WAS SUBMITTED TO REEFBASE DATABASE

Data from manta tow survey, line intercept transect survey and fish visual census survey have been submitted to ReefBase database and UNEP EAS/RCU on 15 April 2003 by Email. The data included (Appendix A):

- (1) ReefBase Questionnaire on coral reef monitoring programs
- (2) Table 1 Manta Tow Data Form
- (3) Table 2 Fish Abundance Data Summary Form
- (4) Table 3 Benthic Lifeforms Data Summary Form
- (5) Figure 1 Study area and layout of monitoring survey items in Luhuitou fringing reef of Sanya City, Hainan, China
- (6) Photo 1 Scuba line intercept transects survey in Luhuitou fringing reef, Hainan, China
- (7) Photo 2 Numerous *Drupella rugosa* teeming over a colony of branching coral in Luhuitou fringing reef, Hainan, China

5. RESOURCE MANAGEMENT: ORGANIZE AND PRESENT RESULTS OF SURVEY AT A STAKEHOLDER WORKSHOP TO SANYA RESERVE MANAGERS IN WRITTEN, ELECTRONIC OR AUDIO-VISUAL FORMATS

The stakeholder workshop at Tropical Marine Biological Research Station in Hainan (Luhuitou of Sanya City) of the Chinese Academy of Sciences on 25 February of 2003 was co-organized by Tropical Marine Biological Research Station in Hainan and South China Sea Institute of Oceanology. The personnel participated in the stakeholder workshop included the Deputy Director of Sanya National Coral Reef Reserve, the Chief Manager of Sanya Huanqiu Diving Company, 1 person on behalf of village head of Luhuitou Village Committee, 4 persons from Tropical Marine Biological Research Station in Hainan and 8 persons from South China Sea Institute of Oceanology (Table 3). In the stakeholder workshop, the members of the monitoring survey team gave 3 presentations in audio-visual format about monitoring results. The project leader, Professor Zhang Qiaomin, presented the keynote address, "Status Monitoring and Management Strategy of Luhuitou Fringing Reef." Dr. Huang Hui presented "Monitoring Survey Results of Coral Reef Fish Visual Census Survey." Mr. Chen Gang, of Hainan Marine & Fishery Department presented in written form, "Monitoring Survey Results of Line Intercept Transect Survey." After the presentations, participants had a discussion and showed a high level of interesting coral reef protection and management. Wang Junjie, Deputy Director of Sanya National Coral Reef Reserve, approved of monitoring results and management suggestions.

Table 3. Participants in workshop on management strategy of Luhuitou fringing reef, Sanya

Organization	Name	Position
Sanya National Coral Reef Reserve	Wang Junjie	Deputy Director
Hainan Marine & Fishery Department	Chen Gang	Deputy Director
Sanya Huanqiu Diving Company	Lin Si	Chief Manager
Luhuitou Village Committee	Li Fujin	Deputy Director of Security Guard Team
Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences	Zhang Si	Director
	Li Jianfeng	Deputy Director
	Wang Hankui	Deputy Director
South China Sea Institute of Oceanology, Chinese Academy of Sciences	Zhang Qiaomin	Research Professor
	Huang Hui	Associate Research Professor
	Wang Zhaoding	Research Professor
	Wang Youshao	Research Professor
	Lian Jiansheng	Associate Research Professor
	Yan Yan	Doctor
	Wei Guifeng	Doctor
	Song Xingyu	Doctor

6. MANAGEMENT SUGGESTION

Prof. Zhang Qiaomin gave general results of this monitoring survey and the following 5 management suggestions in his keynote address:

- (1) Luhuitou fringing reef has had a special status of high biodiversity in the past as well as at present, and special protection value, so it should be given more attention of protection and management than before, and than other coastal sections of Sanya Coral Reef Reserve.
- (2) In Sanya Coral Reef Reserve area, Luhuitou fringing reef is characterized by being nearest to the population centre of Sanya City and the most severely impacted from human activities. Therefore, it has the most urgent need of coral reef protection and management.
- (3) It is very important to build up the partnership among stakeholders, including Sanya Coral Reef Reserve, Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences, local diving company, Luhuitou Village Committee, local government and related research institutes, for coral reef protection and management.
- (4) Some concrete protection measures to counter local impact factors should be adopted: enforcement, public education focused on persons whose activity occur often on the sea, aquaculture management, sea water quality monitoring, coral reef monitoring and research program.
- (5) Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences should play a more important role in monitoring, research, protection and management of Luhuitou fringing reef.

7. SUBMITTING OF PROGRESS REPORT AND FINAL REPORT

A progress report was submitted to UNEP on 23 December 2002 by Email, and this final report was submitted to UNEP on 29 April 2003 by Email.

8. RELEVANT PAPERS AND PUBLICATIONS

A paper titled "Biodiversity of Luhuitou Fringing Reef of Sanya and Faced Threat" (in Chinese) together with some photos will soon be published in "Science News" (in Chinese) of Chinese Academy of Sciences. A paper titled "Coral Reefs and Mangroves of Sanya Bay" (in Chinese) was presented at the 11th Work Meeting and the Workshop on Chinese Ecosystem Research Network (CERN) of Chinese Academy of Sciences, from 26 to 28 February 2003, Sanya, Hainan, and at the Workshop on Bay Ecosystem Research of South China Sea Institute of Oceanology, 24 February 2003, Sanya, Hainan.

9. EVALUATION AND ASSESSMENT ON TRAINING AND MONITORING ACTIVITIES

In general the training course and monitoring survey were successful. It was the first time in China that three standard methods, manta tow survey, fish visual census survey, and line intercept transect survey, were introduced to relevant researchers and managers and were used to monitor status of coral reef together with other methods of video and photograph record. This monitoring survey produced a set of standard data and found some new information about the status of biodiversity and coral decline and destruction that is very important for protection and management of Luhuitou fringing reef. The training course and stakeholder workshop provided an important chance for all stakeholders to learn about coral reefs and monitoring methods, and to exchange and discuss protection and management measures of coral reef. The management suggestions from this monitoring survey have been given to and approved by local managers and other stakeholders.

The training course and monitoring survey still has some problems.

1. Because water transparency was only 1.5-2.0 m in shallow waters of Luhuitou fringing reef during the survey period, transects could only be put at 0.2-1.2 m for manta tow survey, at 0.6-1.1 m for fish visual census survey, and at 1.2-2.8 m for line intercept transect survey, of water depth below the Theoretical Lowest Tide (as Chart Datum in China and 90 cm below the mean sea level), instead of at 3 m water depth contour in the original plan. This will reduce typicalness of surveying data.
2. It was the first time in China to use the above-mentioned methods for coral reef monitoring and survey, so trainers and surveyors had a lack of experience especially for identification of lifeforms of benthic community and visual assessment for coverage of benthic community, identification of dead corals. We need more time to identify further more marine animals from video and photo records.
3. A long-term monitoring program for Sanya Coral Reef Reserve is urgently needed and it seems possible both for Sanya National Coral Reef Reserve and Tropical Marine Biological Research Station in Hainan of the Chinese Academy of Sciences, but it still needs more effort from the various stakeholders.

Appendix A

The data was submitted to ReefBase and UNEP EAS/RCU on 15 April 2003 by Email. In Table 1, 1998 transect locations have been added. The list of tables and figures in Appendix A are listed below:

- (1) ReefBase Questionnaire on coral reef monitoring programs.
- (2) Table 1 Manta Tow Data Form.
- (3) Table 2 Fish Abundance Data Summary Form.
- (4) Table 3 Benthic Lifeforms Data Summary Form.
- (5) Figure 1 Study area and layout of monitoring survey items in Luhuitou fringing reef of Sanya City, Hainan, China, in 1998 and 2002.

QUESTIONNAIRE ON CORAL REEF MONITORING PROGRAMS

Please return this complete form (preferably by e-mail) to:

Kiri Peat, Worldfish Center, P.O. Box 500, GPO 10670 Penang, Malaysia

E-mail: kiripeat@hotmail.com, Phone: 604.626.1606; Fax: 604.626.530

A. Reef Monitoring Program Information

Please complete this section in its entirety.

1. *Logistical Information* – General program and contact information

Name of Program	Status Monitoring and Management Strategy Research of Luhuitou Fringing Reef of the Sanya Reserve
Website	
Coordinating Institution	South China Sea Institute of Oceanology, Chinese Academy of Sciences
Coordinator's Name	Zhang Qiaomin (Q M Zhang)
Coordinator's E-mail	qmzhang@scsio.ac.cn
Coordinator's Address	164 West Xingang Road, Guangzhou, 510301, China

2. *Geographic Extent* – What geographic scale is the program operating at? (Please state the region/country/area)

	Y/N	Name of Region/Country/Locality
Global	N	
Regional	N	
National	N	
Local	Y	Sanya City Hainan Province China

3. *Duration of Program*

Year Program was Implemented	2002
Year Program Ended/Anticipated End/Ongoing	2003

4. *Give a brief description/synopsis of the program including the objectives and/or questions addressed*

To carry out diving survey training and status monitoring/survey of Luhuitou fringing reef of the Sanya Reserve and to compare status data with existing survey data of 1993 and 1998 for getting information about coral restoration pattern and corresponding impact factors of Luhuitou fringing reef. To hold stakeholder workshop for conservation and management of Luhuitou fringing reefs for finding out suggestion of management policy and strategy of Luhuitou fringing reef to the Sanya Reserve.

5. Major Funding Source – To determine the major source of funds for reef monitoring programs

	Y/N	Source of Funds
Government	N	
Private	N	
Other	Y	UNEP EAS/RCU

6. Outputs/Outcomes from the Monitoring Program (datasets, CD-ROM, publications, etc.)

(a) Please list any publications/reports that have arisen from this program (please include e-copies or hard copies that you would like to be made available/incorporated on ReefBase)

1. Datasets in e-copy in 5 pages including: Table 1 – Manta Tow Data Form; Table 2 – Fish Abundance Data Summary Form; Table 3 – Benthic Lifeforms Data Summary Form; Figure 1 – Study area and layout of monitoring survey items in Luhuitou fringing reef of Sanya City, Hainan, China.
2. Paper “Coral Reefs and Mangroves of Sanya Bay” (in Chinese) was presented at the 11th Work Meeting and the Workshop on Chinese Ecosystem Research Network (CERN) of Chinese Academy of Sciences, 2003-02-26-28, Sanya, Hainan, and at the Workshop on Bay Ecosystem Research of South China Sea Institute of Oceanology, 2003-02-24, Sanya, Hainan.
3. Monitoring survey results (in Chinese) was presented at Workshop on Management Strategy of Luhuitou Fringing Reef, 2003-02-25, Sanya, Hainan, and a relative paper titled “Biodiversity of Luhuitou Fringing Reef of Sanya and Faced Threat” (in Chinese) together with some photos will soon published in “Science News” (in Chinese) of Chinese Academy of Sciences.

(b) Data and imagery products

Are you currently using GIS/remote sensing/aerial photographs in your program? **(Y/N) N**

Would you be willing to share your GIS/remote sensing/aerial photographs information? **(Y/N)**

B. Specific Monitoring Sites Information

Please fill out for each site. If there is common information for sections eight and nine (Information Gathered & Methods Used) please fill in once and fill in site information as many times as necessary.

Site Name	Luhuitou fringing reef of Sanya City, Hainan, China
Latitude/Longitude (or include a map with sites and site name marked on it)	18°12'38" – 18°14'00"N, 109°28'15" – 109°29'30"E
Type of Reef(s)	Fringing reef (FR)
Reef Zone	Reef slope (FS)
Depth/Depth Range	0.5-2.0 m (Nautical chart depth, taking Theoretical Lowest Tide as depth datum)
Located in MPA (Y/N)	Y
Years Surveyed (please list)	2002 October
Information Gathered Meteorological Oceanographic Biotic Corals and other sessile components Coral Diseases Coral Recruitment Octocorals Reef Fishes Mobile Invertebrates Other	Biotic Corals and other sessile components Coral Diseases Coral Recruitment Octocorals Reef Fishes Mobile Invertebrates Other
Methods Used	Snorkel manta tow survey Scuba line intercept transects survey Snorkel coral reef fish visual census survey Scuba video and photo survey

For Type of Reef: Atoll (AT), Bank (BN), Barrier (BR), Fringing (FR), Patch (PA)

For Reef Zone: Backreef slope (FS), Backreef flat (BF), Crest (CR), Forereef slope (FS), Forereef flat (FF), Reef lagoon (RL)

C. Form Completed By

Name	Zhang Qiaomin Q M Zhang
E-mail	qmzhang@scsio.ac.cn
Institution	South China Sea Institute of Oceanology, Chinese Academy of Sciences
Address	164 West Xingang Road, Guangzhou 510301, P.R. China

We would welcome photographs depicting methods used or problems encountered that can be uploaded on ReefBase.

Table 1. Manta Tow Data Form¹

Site Name: Luhuitou				Municipality & Province: Sanya, Hainan, China				
Date: 2002-10-18		Time: 02:34-05:30 PM			Timer/Mapper Shi Qi/ Shi Qi			
Method: Snorkel		Observer Terence C.W. Fong and Dickson C.C. Wong						
		Location			Estimate % substrate cover			
Tow No:	Start Time	GPS Latitude/Longitude		Depth² (m)	Hard Coral	Soft Coral	Dead Coral³	Notes
		Start	End					
1	14:37:00	18-12-47.6 18-12-47.1	109-28-32.1 109-28-33.8	1.3 (0.2)	7.5	0	18	
2	14:41:20	18-12-47.6 109-28-32.6	18-12-47.4 109-28-34.7	2.0 (0.9)	12.5	0	17.5	
3	14:46:00	18-12-47.6 109-28-34.5	18-12-47.7 109-28-36.6		12.5	0	25	
4	14:50:30	18-12-47.8 109-28-36.8	18-12-48.6 109-28-38.9	2.3 (1.2)	20	0	35	
5	14:54:20	18-12-48.4 109-28-38.9	18-12-48.8 109-28-40.8	2.0 (0.9)	17.5	0	27.5	
6	14:58:00	18-12-48.5 109-28-41.2	18-12-50.3 109-28-43.1	1.5 (0.4)	10	0	17.5	
7	15:04:50	18-12-50.5 109-28-42.9	18-12-51.3 109-28-44.8	1.8 (0.7)	35	0	30	
8	15:09:20	18-12-51.4 109-28-45.1	18-12-52.4 109-28-46.8	1.8 (0.7)	45	0	25	
9	15:13:20	18-12-52.2 109-28-46.7	18-12-52.5 109-28-48.7	(0.6) 1.7	25	0	32.5	
10	15:17:50	18-12-52.1 109-28-48.4	18-12-53.1 109-28-50.6	1.6 (0.5)	25	0	25	
11	15:22:20	18-12-53.2 109-28-50.7	18-12-54.1 109-28-52.8	1.6 (0.5)	27.5	0	22.5	
12	15:27:20	18-12-54.9 109-28-54.5	18-12-56.2 109-28-56.3	1.7 (0.6)	17.5	0	12.5	
13	15:31:10	18-12-55.7 109-28-57.0	18-12-57.7 109-28-58.3		15	0	22.5	
14	15:35:30	18-12-58.2 109-28-58.5	18-12-59.9 109-29-00.2		22.5	0	27.5	
15	15:40:50	18-12-59.9 109-29-00.2	18-13-01.5 109-29-02.1	1.9 (0.9)	37.5	0	30	
16	15:46:30	18-13-01.8 109-29-02.4	18-13-03.0 109-29-04.6		27.5	0	17.5	
17	15:51:10	18-13-03.2 109-29-05.2	18-13-04.2 109-29-07.5	1.6 (0.6)	17.5	0	20	
18	16:18:50	18-13-03.9 109-29-06.9	18-13-06.2 109-29-09.1	1.6 (0.6)	22.5	0	22.5	
19	16:23:40	18-13-06.5 109-29-09.2	18-13-08.6 109-29-11.1	1.8 (0.8)	27.5	0	20	
20	16:28:30	18-13-09.3 109-29-10.7	18-13-12.3 109-29-12.0		12.5	0	17.5	

Table 1. (continued)

Site Name: Luhuitou				Municipality & Province: Sanya, Hainan, China				
Date: 2002-10-18		Time: 02:34-05:30 PM			Timer/Mapper Shi Qi/ Shi Qi			
Method: Snorkel		Observer Terence C.W. Fong and Dickson C.C. Wong						
		Location			Estimate % substrate cover			
Tow No:	Start Time	GPS Latitude/Longitude		Depth ² (m)	Hard Coral	Soft Coral	Dead Coral ³	Notes
		Start	End					
21	16:33:30	18-13-12.7 109-29-12.9	18-13-15.5 109-29-14.1		20	0	45	
22	16:37:10	18-13-16.3 109-29-13.9	18-13-18.7 109-29-14.7	1.7 (0.7)	7.5	0	35.5	
23	16:41:10	18-13-18.8 109-29-15.4	18-13-21.5 109-29-15.8		15	0	57.5	
24	16:45:10	18-13-22.1 109-29-16.6	18-13-24.7 109-29-17.0	1.2 (0.2)	12.5	0	67.5	
25	16:49:50	18-13-25.0 109-29-17.2	18-13-27.9 109-29-16.9	1.6 (0.7)	20	0	65	
26	16:54:10	18-13-28.8 109-29-17.0	18-13-31.0 109-29-18.1		20	0	72.5	
27	16:58:30	18-13-31.5 109-29-18.1	18-13-33.2 109-29-19.4	1.8 (0.9)	17.5	0	57.5	
28	17:02:40	18-13-33.3 109-29-19.8	18-13-35.0 109-29-21.4		17.5	0	50	
29	17:06:50	18-13-36.4 109-29-20.6	18-13-38.3 109-29-19.2		7.5	0	40	
30	17:11:40	18-13-37.6 109-29-18.8	18-13-36.6 109-29-16.3		7.5	0	62.5	
31	17:16:50	18-13-36.4 109-29-15.8	18-13-35.5 109-29-13.3		12.5	0	67.5	
32	17:25:10	18-13-35.3 109-29-12.6	18-13-35.9 109-29-09.2		10	0	35.5	
Average				18.91	0	35.5		

¹ Blank data form used here is from Form 3 of "A J Uychiaoco et al. 2001. Coral Reef Monitoring for Management. University of the Philippines Marine Science Institute et al."

² The depth in brackets is nautical chart depth (surveying depth – tidal height = nautical chart depth).

³ Including dead coral with algae.

Table 2. Fish Abundance Data Summary Form¹

Site Name: Luhuitou			Municipality & Province: Sanya, Hainan, China				
Horizontal visibility (m): 1.5-2.0		Transect orientation: Southeast		Left observer: Li Chun (snorkel)			
		Transect length: 50 m		Right observer: Huang Hui (snorkel)			
Transect No.	GPS Coordinates		Depth (m) ²	Date and time			
1	18-13-22.9, 109-29-15.9		1.5 (0.6)	2002-10-16, 02:30-04:00 PM			
2	18-13-11.4, 109-29-12.0		1.5 (0.7)	2002-10-16, 04:00-04:40 PM			
3	18-13-02.3, 109-29-02.6		1.9 (0.8)	2002-10-17, 02:20-03:35 PM			
4	18-12-53.7, 109-28-51.6		2.1 (1.1)	2002-10-17, 03:35-04:40 PM			
5	18-12-47.6, 109-28-34.3		1.5 (0.7)	2002-10-17, 04:40-05:40 PM			
Family		Record number of fishes per transect ³					
		1	2	3	4	5	Average
Nemipteridae		0	0	0	2	0	0.4
Mullidae		0	0	1	0	0	0.2
Chaetodontinae		0	0	67	32	2	20.2
Pomacanthinae		6	6	29	42	1	16.8
Aplodactylidae		0	0	7	0	0	1.4
Callionymidae		0	0	1	0	0	0.2
Blenniidae		0	0	4	6	0	2
Pomacentridae		10	15	174	147	155	100.2
Serranidae		0	0	0	1	0	0.2
Labridae		1	1	6	3	1	2.4
Acanthuridae		0	0	0	1	0	0.2
Total		17	22	289	234	159	144.2

¹ Blank data form used here is from Form 5A and 5B of "A J Uychiaoco et al. 2001. Coral Reef Monitoring for Management. University of the Philippines Marine Science Institute et al."

² The depth in brackets is nautical chart depth (surveying depth – tidal height = nautical chart depth).

³ The observing width of each side is 3 m, and total observing area of each 50 m transect is 300 m² (50 m* 3 m*2 = 300 m²). All recorded fishes have size class of 1-10 cm.

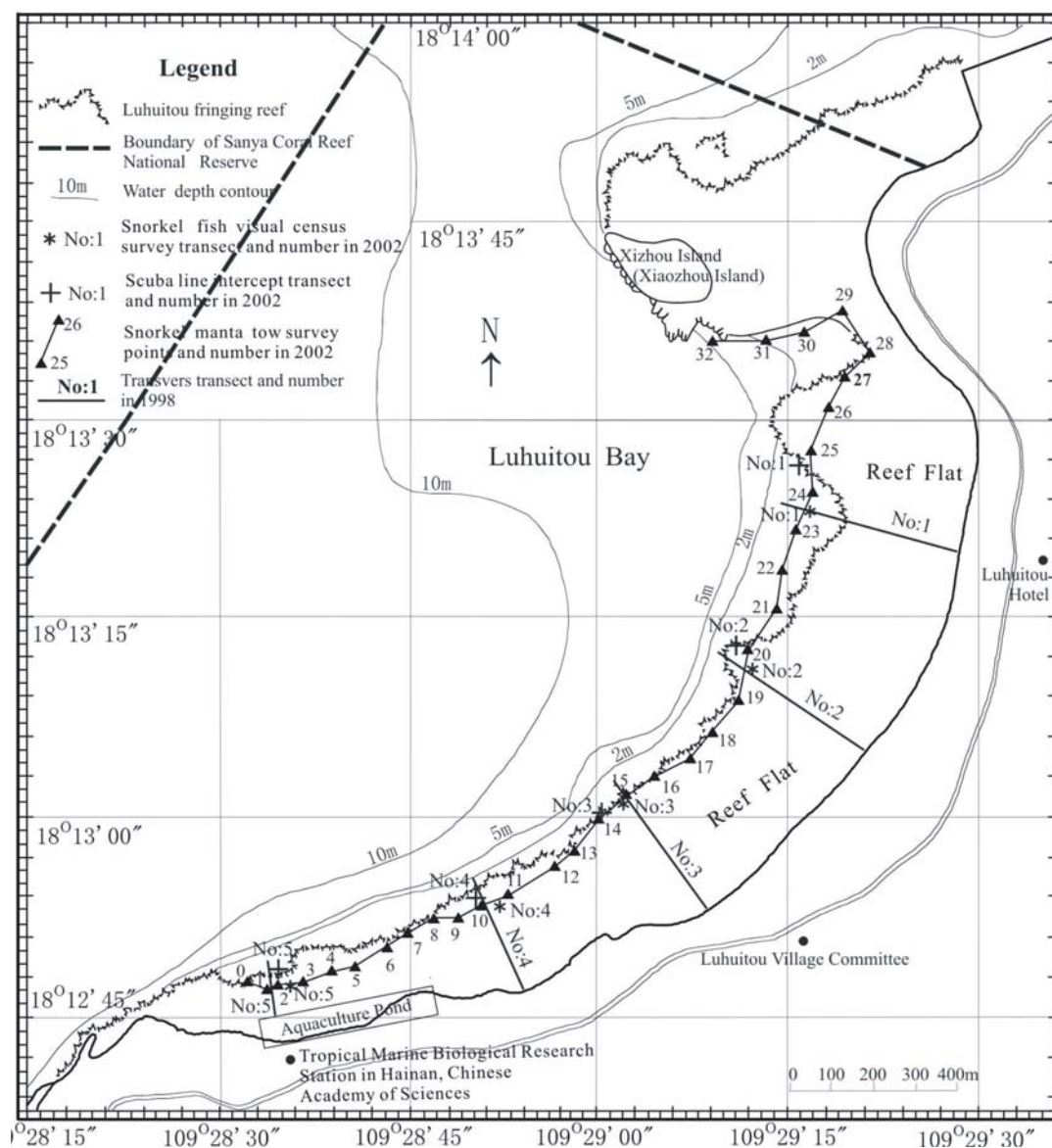
Table 3. Benthic Lifeforms Data Summary Form

Site Name: Luhuitou			Municipality & Province: Sanya, Hainan, China					
Method: Scuba 20 m Line Intercept Transect12						Transect length: 20 m		
Horizontal visibility (m): 2.0			Observer and Data Processing: Chen Gang					
Transects No.	GPS Coordinates		Depth (m) ¹³	Date and time				
1	18-13-25.4, 109-29-15.9		2.6 (1.2)	2002-10-19, 10:30-11:10 AM				
2	18-13-12.4, 109-29-10.5		4.2 (2.8)	2002-10-19, 11:20-12:00 AM				
3	18-13-01.1, 109-29-01.2		2.8 (1.4)	2002-10-19, 00:20-01:00 PM				
4	18-12-53.4, 109-28-50.7		2.5 (1.3)	2002-10-19, 03:30-04:00 PM				
5	18-12-48.2, 109-28-34.2		3.3 (2.2)	2002-10-19, 04:20-05:00 PM				
Benthic lifeforms ¹		Code ¹	Benthic lifeforms cover (%) per transect					
			1	2	3	4	5	Average
Dead Coral		DC	13.25	7.75	7.50	18.25	35.75	16.50
Dead Coral with Algae		DCA	8.25	3.95	15.25	8.0	0.00	7.09
Branching Coral		CB, ACB	0.00	2.75	32.25	1.5	25.5	12.40
Foliose Coral		CF	0.00	2.00	0.00	0.00	0.00	0.40
Massive Coral		CM	6.50	4.75	13.00	2.50	6.25	6.60
Submassive Coral		CS, ACS	1.00	8.75	0.00	1.00	0.00	2.15
Digital Coral		ACD	3.25	1.5	1.75	0.00	0.00	1.30
Millipora		CME	0.00	2.75	0.00	0.00	0.00	0.55
Soft coral		SC	0.00	22.55	0.00	0.00	0.00	4.51
Other Fauna		OT	0.00	1.75	0.00	0.00	0.00	0.35
Sand		S	47.50	18.75	6.25	40.00	7.50	24.00
Rubble		R	7.00	22.75	22.00	28.75	25.00	21.10
Rock		RCK	13.25	0.00	2.00	0.00	0.00	3.05

¹ The method, benthic lifeforms, and code refer to: "English S et al. Survey Manual for Tropical Marine Resources. 2nd edition. Australian Institute of Marine Science, 1997, 5-118."

² The depth in brackets is nautical chart depth (surveying depth – tidal height = nautical chart depth).

Figure 1 Study area and layout of monitoring survey items in Luhuitou fringing reef of Sanya City, Hainan, China, in 1998 and 2002



Annex 1

UNEP Small Grants Fund Monitoring Changes of Coral Reefs for Better Management Schemes

The United Nations Environment Programme East Asian Seas Regional Co-ordinating Unit (UNEP EAS/RCU) is co-ordinating activities concerning protection and management of coral reefs. One of the themes under this agenda is supporting activities in monitoring changes in coral reefs. As part of the support to East Asian Seas coral reef management and research institutions, UNEP EAS/RCU has established a small grants fund with the following goals:

- To carry out coral reef monitoring to detect changes in coral reef status, within the framework of the "International Coral Reef Action Network" (ICRAN) and "Establishment of an Effective Coral Reef Monitoring Network in the East Asian Seas Region" projects;
- To use the results of monitoring to strengthen the management capability of marine protected areas (MPAs)/national marine park managers in the East Asian Seas Region;
- To strengthen the capacities of institutions managing MPAs;
- To increase involvement of stakeholders in MPA management;
- To develop and implement training programmes, strategies, and tools to improve management of coral resources in MPAs;
- To act as a catalyst to leverage future funds from additional initiatives and institutions for addressing coral reef related issues; and
- To promote "best monitored and managed" MPA sites to serve as demonstration examples for other sites.

OUTLINE OF ELIGIBILITY AND GUIDELINES FOR APPLICATION

1. UNEP EAS/RCU will accept applications for projects located in the East Asian Seas region. Proponents may include government agencies, non-government organisations, community-based organisations, research/academic institutions, and private sector organisations.
2. Both monitoring and workshop activities might be included in the proposals. However all proposals must contain a specific research activity. **Proposals limited to only holding of workshops will not be allowed.** Inclusion of capacity building activities is strongly encouraged.
3. Existing projects with funding from other sources are preferred.
4. Proposals are encouraged, but not limited, to:
 - (a) Consider how they may fit into the on-going projects currently co-ordinated by UNEP EAS/RCU (e.g. ICRAN, Coral Reef Monitoring Network), and
 - (b) Implement activities within established MPAs or national marine parks.
5. Due to the modest level of funding, **salaries, purchasing of large equipment, and overhead fees will not be allowed.** However, stipends for research assistants will be taken into consideration.
6. The deadline for submission of proposals is 30 April 2002.

TYPE OF SUPPORT PROVIDED

Grants of up to US\$ 10,000 can be provided in the form of financial assistance. Projects will be supported dependent on the availability of funds for the period 1 June 2002 – 30 May 2003. Proposals will be subjected to a preliminary screening by UNEP EAS/RCU, and once completed, will be sent to a Project Review Panel consisting of 3-4 regional coral reef experts.

UNEP EAS/RCU invites the submission of proposals that should demonstrate their contribution to enhanced MPA management, under the following categories:

- Development of monitoring indicators that show changes in coral reef status;
- Application of monitoring indicators for management of MPAs;
- Involvement of stakeholders in carrying out monitoring to detect changes;
- Damage assessment and rehabilitation;
- Resource assessment of corals and associated organisms in coral reefs in the MPA;
- Development of legislation, management policies, and effective law enforcement procedures; and
- Training personnel in monitoring and managing MPAs.

FORMAT FOR PROPOSALS

Length: 5 to 7 pages (12-point font with 1" margins) exclusive of Appendices (Project leader's CV and budget). The proposal should include the following parts:

- Title of proposed project
- Proponent's full contact address and e-mail
- Abstract (or Project Summary)
- Rationale and Objectives
- Scoping/Context, i.e. existence, if any, of related research work on the topic and or relationship to other UNEP initiatives in the region or to other international programs
- Methods
- Outputs and outcomes
- Timeline of activities, including at least 1 progress report 2 months after disbursement of first instalment of project funds
- Project leader's CV (2 pages), collaborator's CV (1 page)
- Project budget in US dollars; the extent of in-kind contributions and level of matching funds from other sources, if available, should be clearly indicated in the budget.

A suggested table of contents for the proposal is attached as Annex A.

EVALUATION

Proposals will be evaluated against the following criteria:

- Originality and quality of science that underpins proposed activity, in particular, the changes in coral reef status
- Relevance to improving management of MPAs
- Capacity-building
- Well-defined outputs/products/outcomes feasible in 12 months
- Cost-sharing or availability of matching funds from proposing institution or elsewhere
- Relevance to regional needs on coral reef protection

INQUIRIES

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