Intergovernmental Oceanographic Commission
Training Course Reports
27

IOC-UNEP-SPREP
Training Course on Coral Reef Monitoring and Assessment

Rarotonga, Cook Islands,
23 February - 13 March 1994

UNESCO

IOC Training Course Reports

No.	Title	Language versions
1.	IOC Indian Ocean Region Training Course in Petroleum Monitoring Perth, 18 February-1 March 1980	English
2.	IOC Regional Training Course for Marine Science, Technicians Cape Ferguson, Queensland, 1-28 June 1980	English
3.	ROPME-IOC-UNEP Training Workshop on Oceanographic Sampling Analysis, Data handling and Care of Equipment, Doha, Qatar, 3-15 December 1983	English
4.	Stage COI d'initiation à la gestion et au traitement de l'information scientifique et technique pour l'océanologie, Brest, France, 28 novembre - 9 décembre 1983	French
5.	Curso mixto COI-OMM de formación sobre el Sistema Global Integrado de Servicios Oceánicos (SGISO), Buenos Aires, Argentina, 15-26 de octubre de 1984	Spanish
6.	UNESCO-IOC-NBO Training Course on Tidal Observations and Data Processing Tianjin, China, 27 August - 22 September 1984	English
7.	Stage COI sur la connaissance et la gestion de la zone côtière et du proche plateau continental Talence, France, 18 septembre - 4 octobre 1984	French
8.	IOC Regional Training Course on Marine Living Resources in the Western Indian Ocean Mombasa, Kenya, 27 August - 22 September 1984	English
9.	IOC-UNESCO Summer School on Oceanographic Data, Collection and Management Erdemli, Icel, Turkey, 21 September - 3 October 1987	English
10.	IOC-UNESCO Regional Training Workshop on Ocean Engineering and its Interface with Ocean Sciences in the Indian Ocean Region, Madras, India, 17 March - 5 April 1986	English
11.	IOC-UNESCO Training Course on the Use of Microcomputers for Oceanographic Data Management Bangkok, Thailand, 165 January - 3 February 1989	English
12.	IOC Advanced Training Course on Continental Shelf Structures Sediments and Mineral Resources Quezon City, Philippines, 2-13 October 1989	English
13.	IOC/IODE Training Course on GF3 Data Formatting System Obninsk, USSR, 14-24 May 1990	English
14.	IOC Training Course on Microcomputers and Management of Marine Data in Oceanographic Data Centres of Spanish-speaking Countries, Bogotá, Colombia, 21-30 October 1991	English Spanish
15.	IOC Advanced Training Course on Nearshore Sedimentation and the Evolution of Coastal Environments, Kuala Lumpur, Malaysia, 17-29 February 1992	English
16.	First IOC Training Course on the Applications of Satellite Remote Sensing to Marine Studies Caracas, Venezuela, 24-28 September 1990	English
17.	IOC-KMFRI-RECOSCIX (WIO) Regional Training Course on Microcomputer-based Marine Library Information Management, Mombasa, Kenya, 10-21 August 1992	English
18.	ROPME-IOC Regional Training Course on Management of Marine Data and Information on Microcomputers for the ROPME Region, Kuwait, 18-28 October 1992	English
19.	IOC-SOA Training Workshop on Environmental Effects on Benthic Communities Xiamen, China, 19-23 October 1992	English
20.	IOC Training Course for the Global Sea Level Observing System (GLOSS) directed to the African and South American Portuguese and Spanish-Speaking Countries São Paulo, Brazil, 1-19 February 1993	English
21.	IOC-SSTC-SOA Training Course on Marine Information Management and ASFA Tianjin, China, 19-30 October 1992	English
22.	First IOC/IOCARIBE-UNEP Training Course on Monitoring and Control of Shoreline Changes in the Caribbean Region Port-of-Spain, Trinidad and Tobago, 21-30 July 1993	English Spanish
23.	IOC/WESTPAC Training Course on Numerical Modelling of the Coastal Ocean Circulation Matsuyama, Japan, 27 September - 1 October 1993	English
24.	IOC-JODC Training Course on Oceanographic Data Management Tokyo, Japan, 28 September - 9 October 1992	English
25.	IOC-JODC Training Course on Oceanographic Data Management Tokyo, Japan, 27 September - 8 October 1993	English
26.	IOC Training Course on Ocean Flux Monitoring in the Indian Ocean. Organized with the support of the Government of Germany, Mombasa, Kenya, 15-27 November 1993	English
27.	IOC-UNEP-SPREP Training Course on Coral Reef Monitoring and Assessment, Rarotonga, Cook Islands, 23 February - 13 March 1994	English

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PREFACE

As part of the Pilot Phase Activities of the Global Ocean Observing Systems Coastal Zone Module, a training course on the standard techniques for monitoring coral reefs was undertaken in Rarotonga, Cook Islands with the support of IOC, UNEP and SPREP.

The result of this course was that 15 participants from four South Pacific nations were trained in the Manta Tow and Line Intercept techniques for the assessment of benthic communities, a Visual Census technique for the assessment of reef fish communities and the management of data collected using these methods. This report has been prepared by Mr. Angus Thompson and Mr. Ian Miller from the Australian Institute of Marine Science and Ms. Maylene Loo from the National University of Singapore. It summarizes this training initiative and provides recommendations for future courses of this nature.

The IOC, on behalf of co-sponsors, is grateful to the Cook Islands Conservation Service and the Australian Institute of Marine Science for the organization and support provided to the training course.

1. INTRODUCTION

There is widespread concern that coastal resources such as coral reefs are degrading on a global scale. Indications suggest that the causes of this degradation are linked to human activities; both directly, through pollution and over exploitation, and indirectly, through human induced climate changes. Unfortunately there is insufficient information on reef status, threats and pressures, to allow a quantification of the rates of change being imposed upon these resources throughout the world. This concern and lack of good baseline data form the catalyst from which this training course evolved.

There has been increasing pressure for action at a global level to investigate and seek solutions for environmental degradation. This came to a head, with respect to the marine environment, during the Fifteenth Session of the IOC Assembly in 1989 with the decision to initiate the development of the Global Ocean Observing System (GOOS). GOOS was subsequently cosponsored by the World Meteorological Organization (WMO), and the United Nations Environment Programme (UNEP) with the aim of allowing a co-ordinated approach to the monitoring of physical, biological and chemical parameters of the ocean.

The UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change (1990) (ref. 5) recommended to initiate coastal pilot monitoring activities, considered as an important potential contribution to the GOOS Module which addresses Monitoring of Coastal Zone Environment and its Changes. Monitoring and assessment of coral reef ecosystems was one of the proposed pilot activities. The UNEP-IOC-ASPEI-IUCN Global Task Team on the Implications of Climate Change on Coral Reef has prepared an action plan for the implementation of the project (ref. 6) and acted as an expert advisory body to both UNEP and IOC on scientific and technical aspects of the pilot activity. The Methodology Manual on Coral Reef Monitoring has been published. More than 20 countries have expressed their interest in participating in the Pilot Activity. The Task Team emphasized that the development and instigation of a long-term monitoring programme of coral reef ecosystems initially will require the training of personnel from regional areas in standardized techniques for monitoring of coral reefs. This standardization of techniques will allow coral reefs to be compared on a global scale.

The Cook Islands Conservation Service (CICS) acted on concern about the state of their coral reefs by applying to the South Pacific Regional Environment Programme (SPREP) for provision of a training course on techniques to monitor and assess the status of benthic communities and fish populations. Dr Andrew Smith (Coastal Management Officer, SPREP) approached the chairman of the UNEP-IOC-ASPEI-IUCN Global Task Team on Coral Reefs, Dr Clive Wilkinson, for assistance in formulating a training course. There was clear overlap in the request from CICS and the training responsibilities of the Task Team, therefore a proposition was put to SPREP, UNEP and IOC to fund a joint course based in the Cook Islands to train both local personnel and other participants from Fiji, Papua New Guinea and the Solomon Islands as part of the Coral Reef, Pilot Phase Monitoring Activity.

The IOC-UNEP-SPREP Training Course on Coral Reef Monitoring and Assessment was approved for funding to be held in Rarotonga, Cook Islands, 23 February - 13 March 1994. Contact was made with the Australian Centre for International Agricultural Research (ACIAR) to identify trainees who had already been trained in a visual census technique for Reef Fish Stock Assessment and who required training in the assessment of benthic communities. This action was undertaken so that the participants from Fiji, Papua New Guinea and the Solomon Islands would be able to expand their current data collection programmes to include data in the standard format to allow the global comparison of their coral reefs. This report summarizes the training course and includes recommendations for future courses.

2. OBJECTIVES

(i) to train participants from the Pacific in the standard methods adopted by UNEP-IOC-WMO-IUCN for assessing coral reef benthic communities and reef fish populations;

(ii) to emphasize the importance of constructing a database to ensure accuracy and enable basic statistical analyses;

(iii) to assess the status of reefs around Rarotonga for the Cook Island Conservation Service; and

(iv) to develop a training procedure for the global programme of monitoring coral reefs and assess the effectiveness of such a programme.

3. THE TRAINING COURSE

Participants were trained in methods developed jointly within the ASEAN-Australia Living Coastal Resources project (LCR) and the Australian Institute of Marine Science (AIMS) (UNEP/AIMS, 1993; English et. al., 1994). Resource persons were therefore drawn from these two groups of experts, Mr. Angus Thompson and Mr. Ian Miller from AIMS and Ms. Maylene Loo from the National University of Singapore and the ASEAN-Australia LCR project. A list of participants from the Cook Islands, Fiji, Papua New Guinea and the Solomon Islands is presented in Annex III. The Annex IV includes a list of trainers and instructors.

The basic course structure involved introductory lectures on each of the methods followed by a period of practical training. Topics covered included; the Line Intercept and Manta Tow techniques for assessment of the benthic community, Visual census for the assessment of reef fish populations and the management of data collected using these techniques. All lectures and discussions were held at the Penrhyn Hostel. Field work was conducted out of Ngatangiia Harbour. Annex I provides a detailed course outline. The list of training material is shown on page 5.

4. OUTCOME OF TRAINING

Experience gained during the monitoring of Southeast Asian and Australian coral reefs has indicated the need for all personnel to be trained to a high level of expertise to ensure reliability of the data collected. For each method covered in the training course, there is a level of identification skills required before the technique can be successfully adopted. The variety of backgrounds and degree of experience in the coral reef environment exhibited by the trainees greatly influenced the final competency they achieved. The level of competency reported in this section are the levels achieved by the group as a whole; it should be noted that some participants attained a higher level of competency in applying the various techniques.

4.1 MANTA TOW TECHNIQUE FOR BROADSCALE ASSESSMENT OF CORAL REEFS (ref. 1)

Following the completion of this module all participants were able to apply the manta tow technique (English et. al., 1994 ref. 1) to return useful broadscale data on live coral cover. Because the cover of soft coral was extremely low, we have no way of knowing how well the trainees could estimate this cover category. Similarly the ability to detect crown-of-thorns starfish (COTS) outbreaks could not be determined due to the absence of COTS. However the resource personnel believe that, due to the obvious nature of outbreaks, the participants would have no trouble in recording an outbreaking population of COTS if one existed.

4.2 LINE INTERCEPT TECHNIQUE FOR ASSESSMENT OF BENTHIC COMMUNITIES (ref. 1)

A solid grasp of the actual mechanics of applying the LIT was achieved by each participant

by the end of this section of training. Individual skills in the identification of benthic life forms was the limiting factor which dictated the taxonomic/structural level to which the technique could be applied. All students could pick the following life forms with a high degree of certainty and would be capable of conducting surveys recording information at this basic level; acroporid corals, non-acroporid corals, dead coral (DC), *millepora* (CME), soft coral (SC), zooanthids (ZO), other life forms (OT), algal assemblage (AA), coralline algae (CA), *halimeda* (HA), macroalgae (MA), turf algae (TA), rubble (R), sand (S), water (WA).

The next level of identification requires the determination of growth forms (e.g. branching, submassive, encrusting etc.) for live coral. These categories are some what subjective with no clear definition for the exact point at which a colony can be categorized as having a different growth form. It is this continuum which posed the main stumbling block for many of the participants. Minimal extra training should see the development of identificational skills which would allow participants to collect data at this finer resolution.

4.3 VISUAL CENSUS TECHNIQUE FOR ASSESSMENT OF REEF FISH COMMUNITIES (ref. 1)

The ability to identify target species, quickly and accurately, is critical to the implementation of the visual census technique. In recognition of this, a relatively small number of target species (20) were selected for inclusion in the training programme.

The participants gained a working knowledge of the mechanics of the visual census technique. By the completion of training observers were returning comparable estimates of absolute abundance for the target species that they could comfortably identify. Practical training was not undertaken in extensions of the basic visual census technique including length estimation (to gain biomass and size structure data for important commercial and subsistence species), and log abundance estimates of non-target species (to gain broader community level information), due to restriction of time and the limited identification skills of the majority of the participants. The use of these additional methods was discussed and their importance stressed.

4.4 DATA BASE

Participants were trained in data entry and validation using the Dbase IV™ software package. All participants were competent at this basic level of data management. Preliminary analysis of data collected was treated as a demonstration only, the results presented in a report to the Cook Island Conservation Service describing the areas surveyed during the training course.

5. CONCLUSIONS

The participants gained a working knowledge of the techniques involved in the collection of data for monitoring benthic and fish communities on coral reefs. They also developed basic skills in the entry and checking of data obtained using these techniques. This level of expertise will allow the collection of basic monitoring data to the level of broad lifeform categories and a small portion of the fish community. To increase the sensitivity of the data collected there is a need for most participants to improve their skills in identification. These skills can be developed through the participants spending time familiarizing themselves with the fish species and benthic life forms present in their local reef environments. Two participants were not qualified to scuba dive. These people are obviously not trained to a level which would enable them to carry out field monitoring. However their knowledge of the logistics and theory involved will be useful in an administrative capacity.

A major concern when using numerous observers to collect data for comparison is that any patterns in the data will be masked by varying biases between the observers. Although the participants have all learnt standard techniques any small biases they posses now will be compounded as they individually develop these basic skills. This bias will greatly detract from the benefits of using standard techniques which have been adopted to facilitate global comparisons.

For this reason it is essential that a regular training programme is developed with the objective to continually standardize the monitoring techniques of all participants submitting data to the global data base. In short, participants will now be able to collect useful data on the benthic and fish communities from their respective areas. However, to maintain reliability and enhance the resolution of this data it is critical that an ongoing regular training and standardization programme be implemented.

6. RECOMMENDATIONS

6.1 FUTURE TRAINING COURSES

There are two levels of training course that need to be undertaken; the first being an introduction to the techniques for participants from countries entering the programme for the first time, the second concentrating on participants currently trained in the basic techniques with the aim of maintaining global standards in the data collected. The following recommendations are suggested for the introductory type training course as undertaken in the Cook Islands.

The basic structure of the course as outlined in Annex II in which topics are introduced through a lecture format and skills then developed through practical application and group discussion is a good basis for future courses of this nature. Nonetheless there are several recommendations which can be made in hindsight that would improve the level of training achieved.

6.2 CONTENT AND TIMING

Courses should be specifically training orientated to allow flexibility away from the rigid protocols enforced by the collection of actual baseline data. The duration of the course will be dependant on the techniques identified for inclusion. There are three main techniques which could be included in an introductory course, these being Manta Tow, Line Intercept and Visual Census. The suggested allocation of time given for each of these techniques is that required to train participants to a level of competency that would allow the collection and management of reliable monitoring data.

6.2.1 Manta Tow (1-4 days)

The investment of time in this technique will depend on the expected application. Manta tow is useful in long-term monitoring of coral reefs at two levels; simply as a site selection tool in which case the level of training required is minimal, and secondly as a broad scale monitoring technique returning comparable data in its own right. An introductory lecture covering the uses and practicalities of the technique and limited field training can be achieved in one day. This will allow participants to use the technique for rough comparison of sites in terms of total coral cover and reef structure within their own country. To train participants to a level which will enable reliable comparisons between data collected by different observers (hence countries) will require a greater field effort to standardize the estimates returned by each observer. This should be achieved after three to four days of field comparisons.

6.2.2 Line Intercept of benthic communities (6 days) and Visual Census of reef fish populations (6 days)

Data returned by the trainees should be constantly compared with those returned by the trainer through out the field training programmes. The final day of training for each technique should aim at quantitatively assessing the competency of the trainees.

In addition to the time allocated to each technique, the first day of the course should be allocated to introductory lectures on monitoring and general orientation activities. The last to concluding the course.

6.2.3 Ratio of trainers to trainees

Diving groups should not exceed a ratio of five trainees to one trainer. Greater numbers than this result in inadequate field tuition.

6.2.4 Equipment and logistics

Field and laboratory work areas should be in close proximity and readily accessible.

UNEP/AIMS (1993) (ref. 3) and English et. al. (1994) (ref. 1) should be provided to each participant as manuals for the standard techniques adopted by the programme.

Computing facilities should include a printer and a ratio of one computer to every four participants. Software for data input should be installed on all computers.

For the days of the course devoted to Line Intercept and Visual Census, a boat capable of carrying half the complement (trainers and trainees), and enough air fills for the entire complement are required.

For manta tow two vessels capable of towing an observer at slow speed close to the reef crest are required.

A set of fish shaped cut outs (ranging from 10 cm to 80 cm with a 2 cm interval up to 40 cm and a 5 cm interval thereafter) for training of underwater fish length estimation should be constructed.

To enhance the development of identification skills, a list of fish to be included in the visual census training dives, and a poster or booklet showing the benthic life form categories should be circulated to all participants prior to the commencement of the course. In addition to the pre-course material, a comprehensive set of slides illustrating each life form category should be constructed. Randall et al. (1990) (ref. 2) and Veron (1986) (ref. 4) should be available during the course as reference guides for the identification of Reef Fish and Corals respectively.

6.2.5 Requirements of Trainees

The following requirements were circulated prior to the training course and are a reasonable set of requirements for future courses. Unfortunately several participants attending the course did not fulfil these requirements. Some additional effort should be exerted in future to ensure participants are suitable for the course.

Trainees should:

(i) be available for long-term involvement in the actual gathering of data on the status of coral reefs;

(ii) be relatively fit and qualified to scuba dive;

(iii) be able to pass on the training to others in their country;

(iv) have some understanding of computer use e.g. database operations; and

(v) be proficient in English (or other language in which training is conducted).

6.2.6 Qualifications of trainers

A specialized training team should be developed to ensure the standard format of techniques conveyed during introductory training courses and subsequent standardization courses.

The use a specialized group of trainers for all courses will minimize bias at all levels of the programme and allow for the continual upgrading of the training programmes.

Trainers should:

(i) be fully conversant with goals of the global coral reef monitoring initiative of GOOS as well as the function of coral reef monitoring at the national level;

(ii) have experience in the Manta Tow, Line Intercept and the Visual Census techniques;

(iii) be physically capable of undertaking these techniques;

(iv) have a working knowledge of Dbase and data management; and

(v) be in possession of good verbal communication skills.

6.3 DEVELOPMENT OF A CENTRAL DATABASE

It is essential that a central data base to ensure regional data integration be developed if the current level of enthusiasm in participating countries is to be maintained. Several participants attending the training course queried the procedure for data lodgement and analysis. In reply we could only allude to a theoretical, central data base. The data base should have the dual roles of being a repository for all monitoring data collected using the standard techniques and provide participating organizations with updated data reports on lodgement of data.

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4. Veron J.E.N. (1986). "Corals of Australia and the Indo-Pacific". University of Hawaii Press, Hawaii.

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6. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change, Monaco, 9-13 December 1991. IOC Reports of Meetings of Experts and Equivalent Bodies. UNESCO

ANNEX I

COURSE OUTLINE

Day 1 Wednesday 23-2-94

0800-0815	Opening prayer
0815-0830	Opening address by the Honourable Viane Tairea, Minister for Conservation
0830-0845	Introduction to the course including reasons for the workshop, goals and basic course outline
0845-1000	Introduction to sampling design *
1030-1130	Monitoring on the Great Barrier Reef and in Singapore *
1130-1230	Introduction to the manta tow technique *
1330-1600	Tour of proposed monitoring sites including group discussion on reasons for site selection

Day 2 Thursday 24-2-94

0800-0900	Organization of field equipment and participants into three working groups
0900-1600	Rotated groups through; practical exercise using the manta tow technique, identification of benthic life forms, identification of fish species

Day 3 Friday 25-2-94

0800-1200	Class divided into two groups
	Group 1 Introduction to visual census technique for reef fish *
	Group 2 Introduction to Line Intercept Technique for benthic life forms *
1300-1330	Organization of dive gear and personnel
1330-1600	Group 1 Field identification of target fish species
	Group 2 Identification dive for benthic life forms

Day 4 Saturday 26-2-94

Catch up classes for late arrivals

0800-0930	Introduction to sampling design
1000-1130	Introduction to the manta tow technique
1230-1300	Organizing personnel and dive gear
1300-1600	Practical training on using the manta tow technique

Day 5 Monday 28-2-94

0800-1200	Group 1 Theoretical exercises on the Visual Census Technique *
	Group 2 Practical training on the Line Intercept Technique *
1300-1600	Group 1 Practical training on the Visual Census Technique *
	Group 2 Discussion of data base *

Day 6 Tuesday 1-3-94

0800-1200	Group 1 Discussion on data bases. Theoretical exercises on the Visual Census Technique
	Group 2 Practical training on the Line Intercept Technique
1300-1600	Group 1 Practical training on the Visual Census Technique
	Group 2 Theoretical exercises on the Line Intercept Technique *

Day 7 Wednesday 2-3-94 and Day 8 Thursday 3-3-94

0800-1200	Group 1 Theoretical exercises on the Visual Census Technique
	Group 2 Practical training on the Line Intercept Technique
1300-1600	Group 1 Practical training on the Visual Census Technique
	Group 2 Theoretical exercises on the Line Intercept Technique

Day 9 Friday 4-3-94

0800-1200	Group 2 Introduction to visual census technique for reef fish
	Group 1 Introduction to Line Intercept Technique for benthic life forms
1300-1600	Organization of dive gear and personnel
	Group 2 Field identification of target fish species
	Group 1 Identification dive for benthic life form categories

Day 10 Monday 7-3-94 to Day 13 Thursday 10-3-94

0800-1200	Group 2 Theoretical exercises on the Visual Census Technique
	Group 1 Practical training on the Line Intercept Technique
1300-1600	Group 2 Practical training on the Visual Census Technique
	Group 1 Theoretical exercises on the Line Intercept Technique

Day 14 Friday 10-3-94

0800-1000	Group 2 input of data from previous days surveys
	Group 1 Exercise on checking data and data base management
1030-1200	Checking data and discussion of data base
1300-1530	Discussion of the results obtained by the instructors on the various reefs surveyed
	General discussion on monitoring and setting up programs in the participating nations
1530-1600	Graduation ceremony

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* **Points elaborated on in Annex II.**

ANNEX II

COURSE COMPONENTS

INTRODUCTION TO SAMPLING DESIGN

The topics covered:

(i) general introduction,
(ii) reasons for monitoring programmes,
(iii) definition of monitoring as a systematic programme of sampling over an extended time frame,
(iv) the reef as a dynamic environment and the importance of monitoring programmes that can determine impacts against natural background variability,
(v) the global initiative and reasons for standard methodologies,
(vi) the importance of question driven research,
(vii) the need to have clearly defined objectives,
(viii) the need for sound sampling design,
(ix) sources of variability in the data and sampling in a manner to reduce as many of these sources of variation as possible,
(x) the importance of adequate replication within the spatial scales in question,
(xi) site selection,
(xii) pilot studies,
(xiii) observer bias and the importance of training and standardization of observer estimates, traps for the unwary such as confounding and pseudoreplication,
(xiv) data analysis.

MONITORING ON THE GREAT BARRIER REEF

A short talk involving slides and a brief description of the monitoring programme for the Great Barrier Reef as it is currently carried out by AIMS.

MONITORING IN SINGAPORE

A short talk describing the coral reef monitoring programme currently being undertaken in Singapore by the ASEAN-Australia Living Coastal Resources project.

MANTA TOW

Introductory lecture

Based on the chapter on manta tow in UNEP/AIMS 1993 (Ref. 3). Special emphasis was given to the following points:

(i) manta tow is particularly useful for the large scale assessment of reefs and site selection for more detailed work such as LIT and VCT,
(ii) the importance of training and standardizing observer estimates with respect to each other,
(iii) safety considerations,
(iv) the need to be able to read a map or chart so that the position of manta tows can be identified to enable comparison of data from repeat surveys,
(v) correct equipment and procedure,
(vi) data recording, entry, and checking.

Slide presentation

This emphasized:

(i) the appearance of dead coral and causes of coral mortality,
(ii) *Acanthaster planci* (crown-of-thorns starfish) feeding scars,
(iii) *A. planci* and a brief overview of its biology,
(iv) live coral,
(v) soft coral.

Practical training

Because of limited vessel availability, the relatively large number of students and lack of time it was not possible to do a comprehensive field training exercise.

Students were taken out in small groups (6 to 8) and individually towed over an area of reef that had previously been surveyed by the instructor. Depending on time this usually entailed 3 to 4 manta tows. Student observations were compared to the instructors results for the area and reasons for any differences addressed.

All observers were made aware of the importance of standard methodologies and the training and standardization of observers.

Theoretical exercise

A dummy data set was created for Rarotonga, Cook Islands. This data set assumed the island had been surveyed by a series of manta tows. The format of the data was discussed as well as how the points marked on a chart of the island relate to the manta tow data. Students were then instructed on and partook in the entry of the data into the database.

LINE INTERCEPT TECHNIQUE

Introductory lecture

An introductory lecture based on the chapter on LIT in UNEP/AIMS 1993 was presented. Special emphasis was given to the following points:

(i) importance as a standard tool for the global monitoring programme,
(ii) developmental history,
(iii) advantages and disadvantages,
(iv) site selection,
(v) setting up sites taking into account prevailing conditions,
(vi) dive and boat safety,
(vii) standardization of observers,
(viii) data recording, entry, and checking.

Slide presentation

A slide demonstration was included that elaborated on the life form descriptions given in the training manual. Special emphasis was given to:

(i) identifying dead coral and possible causes as well as the phenomena of coral bleaching,
(ii) identifying acroporid corals,
(iii) identifying non-acroporid corals, hints for recognition of often confused life form categories.

Practical training

Students for line intercept were typically grouped into three. Each group responsible for laying one transect and then surveying it using LIT. The instructor also surveyed these transects and offered advice to the students *in situ* on the way through.

Theoretical exercises

In the laboratory, students entered their data into the data base. Observations made by students were compared to those obtained by the instructor for the same transects. Problems with the recording of variables and other discrepancies were discussed. Ways of overcoming consistent errors in data recording were also addressed. Students were encouraged to broaden their skill at identifying life forms using Veron (1992). In some instances the benthic identification slides were shown and classification of the various life from categories discussed.

DATA BASES

Introductory lecture

Points covered:

(i) What are data and databases?
(ii) Design philosophy of the Living Coastal Resources database,
(iii) Linear verses two dimensional arrays,
(iv) Database management - defining responsibility of each team member,
(v) importance of standardized data collection,
(vi) correct data handling procedures,
(vii) data validation.

Introduction to Dbase IV™ usage

Practical exercises

After each session of field training data management techniques were emphasized with participants entering their data into the database. This data was then checked and corrections made.

VISUAL CENSUS TECHNIQUE

Introductory lecture

Main Points covered;

(i) background of the visual census technique for assessment of fish abundance, variations of the basic technique used i.e. timed swims,
(ii) variety of transect dimensions, point counts, bommie counts and log verses absolute abundance estimates,
(iii) the ability of the technique to allow the concurrent collection of data on a number of fish species from a broad range within the community,
(iv) increased information through such methods as length estimation,
(v) importance of accurate species identification,
(vi) development of list of target species to suit objectives of the study, the local habitat, and the observers skills,
(vii) discussion of method outlined in the manual (English et. al. 1994) paying particular attention to criteria for inclusion/exclusion of fish seen within the bounds of the transect.

Practical training

The absolute abundance of fish from the list of target species were estimated along five, 50m by 5 m transects, Surveys were undertaken in pairs of divers such that each pair followed previous pairs at intervals of ten minutes. Divers in each pair swam abreast to ensure that the same fish were available for census by each diver. One trainee dived along side the trainer and was given more specific tuition during the survey. At the completion of the transects, the trainer waited for each pair to tutor them on the identification of target species.

Theoretical exercises

A list of target species was prepared comprising twenty species (from the families *Acanthuridae*, *Chaetodontidae*, *Kyphosidae*, and *Scaridae*) common on the reef slope on which the training dives were undertaken. Participants familiarized themselves with these fish species with the aid of Randell et al. (1992).

After each training survey participants entered their data into a database. Comparisons were made between observers and discrepancies in species identification and estimates of abundance discussed.

ANNEX III

LIST OF TRAINEES

Country	Trainees	Contact
Cook Islands	Ben Glassie Aitua Kuro Tauraki Raea Teina Rongo Vaitoti Tupa Vavia Vavia Wayne King * Jenny Shaw *	Cook Islands Conservation Service P.O. Box 371 Avarua Rarotonga
	Metu Koroa Ben Ponia Kory Raumea Sonny Tatuava Patricia Tuara	Ministry of Marine Resources P.O. Box 85 Avarua Rarotonga
Fiji	Apisai Sesawa Saiyasi Yabakivou	c/o Maciu Lagibalavu A/Director, Fisheries Division Ministry of Primary Industries Suva
	Bendito Tikomainiusilali	Fisheries Department Lautoka 7131 Islands
	Stanley Flavel **	Pure and Applied Science University of the South Pacific P.O. Box 168 Suva

* **Casual observers only.**
** **Trainee left course 2 days early.**

Country	Trainees	Contact
Papua New Guinea	Thomas Maniwavie	Montupore Island Research Station University of Papua New Guinea P.O. Box 320 Univrsity N.C.D. Port Moresby
	Dayvey Potuku	Department of Fisheries and Marine Resources Fisheries Research and Surveys Branch P.O. Box 337 Kavieng, N.I.P.
Solomon Islands	Rai Vui	Department of Environment and Conservation P.O. Box 6601 Boroko N.C.D. Port Moresby
	Joe Hourokou Peter Ranohai	c/o Mr. Moses Biliki Chief Environment and Conservation Officer Ministry of Natural Resources P.O. Box C24 Honiara

ANNEX IV

LIST OF TRAINERS/INSTRUCTORS

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