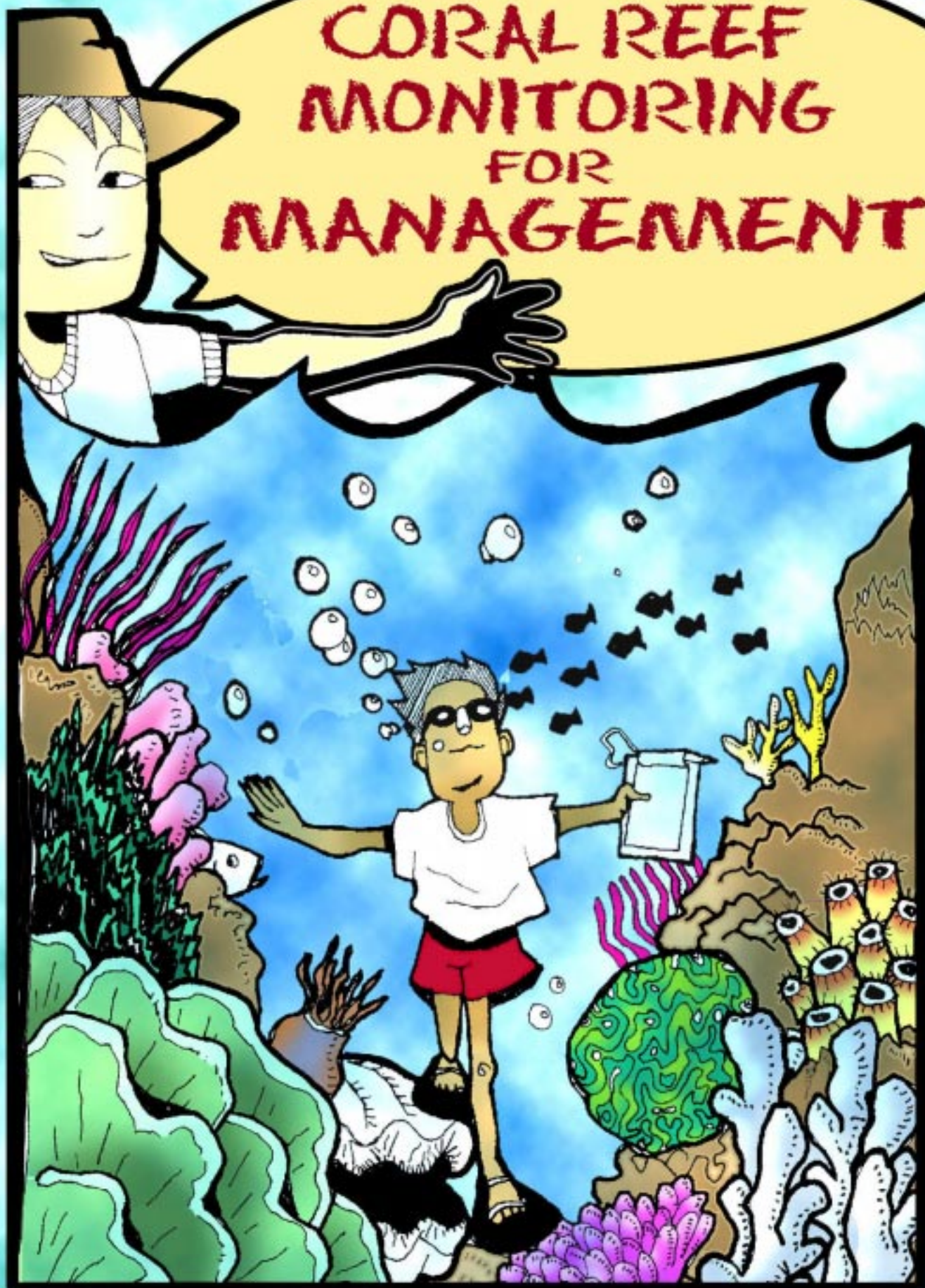


CORAL REEF MONITORING FOR MANAGEMENT



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Andre J. Uychiaoco
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UNIVERSITY OF THE PHILIPPINES, DILIMAN**



**GUIUAN DEVELOPMENT FOUNDATION, INC.
UNIVERSITY OF THE PHILIPPINES IN THE VISAYAS, TACLOBAN**



**VOLUNTARY SERVICE OVERSEAS - PHILIPPINES,
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CORAL REEF MONITORING FOR MANAGEMENT

Andre J. Uychiaoco, Stuart J. Green, Margarita T. dela Cruz, Pauly A. Gaité,
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History and Acknowledgments

Reef survey systems such as ReefCheck by Hodgson (1999), methods adapted for Earthwatch volunteers and conservation projects by White *et al.* (2000), and ReefBase's Aquanaut system by McManus *et al.* (1997) are available for SCUBA divers who wish to do coral reef monitoring with the benefit of some initial training. There are also other methods such as the Global Coral Reef Monitoring Network system described by English *et al.* (1997) for reef scientists who wish to achieve more detailed monitoring. But because there are not enough volunteer SCUBA divers and reef scientists to monitor all the world's coral reefs or even Philippine reefs, simpler methods for non-SCUBA divers were developed from the existing methods. This is a guide for communities and field level staff who are involved in project implementation in how to do low-cost, less technical surveys to evaluate the effectiveness of their coastal management efforts.

This guide began from independent efforts of M.T. dela Cruz in 1995 in Eastern Samar and S.J. Green in 1996 in Bohol to guide local fisher communities in the underwater monitoring of their marine environment and protected areas. M.T. dela Cruz of the Guiuan Development Foundation, Inc., and University of the Philippines Visayas at Tacloban was then supported by the Foundation for the Philippine Environment and assisted by M.C.G. Militante. S.J. Green was a British volunteer under the Voluntary Service Overseas (VSO) program working in the Bohol Integrated Development Foundation, Inc. In 1996, A.J. Uychiaoco of the University of the Philippines Marine Science Institute (UP-MSI) proposed a dissertation to the Department of Ecology and Evolution, State University of New York at Stony Brook to investigate the effectiveness of Philippine fish sanctuaries in restoring reef functional diversity.

Dela Cruz, Green, and Uychiaoco met and planned collaborative arrangements through the various activities of the Philippine Coral Reef Information Network (PhilReefs) in late 1996. Funding was obtained from the University of the Philippines Center for Integrative and Development Studies initially and the work began. Later on, the Coastal Resource Management Project of the United States Agency for International Development and the United Nations Development Programme Global Environment Facility-Small Grants Programme joined in 1997. In addition, resources were contributed by the UP-MSI, the Guiuan Development Foundation and the Bohol Integrated Development Foundation, Inc. Through this joint effort, the methods described up to Chapter 9 have been field tested by various teams of non-SCUBA diving local community volunteers.

Field testing and improvement of the methods resulted from the participation and assistance of many persons and groups in various locations as follows: Samar: Cathy Capanang of Guiuan Development Foundation, Inc.; Camanga Monitoring Team (especially Cornelio Macatimpag and Victor Duran) and the Duran family; Bohol: Lomboy Farmers, Fishers and Carpenters Association, Pangangan Island, Calape especially the local monitoring team composed of Zosimo Cuadrasal, Al Asunto, Boboy, and various others; Mayor Atty. Julius Caesar Herrera and Kagawad Gerardo Cuadrasal, Jr. also provided financial assistance and their time in the development of the monitoring system within Calape; Nagkahiusa Mananagat sa Cabacongan (The United Fishers of Cabacongan), Cabilao Island, Loon, especially the local monitoring team composed of Natalio Lajera, Eduardo Castiotos, Teodoro Mulato, and various others; the Municipality of Loon was fully supportive of the monitoring activities and provided counterparts and assistance to the monitoring through Mayor Cesar Tomas Lopez, M.D. and Vice-Mayor Atty. Raul Barbarona; Patricio Semante, Julie Cavero, Pedro Caet, and Victor

Orevillo from the Bohol Integrated Development Foundation, Inc.; Didi of Sea Explorers; Negros Oriental: Negros Oriental Environment and Natural Resources Management Division (especially Mercy Teves, Jose Glendo Lazarte, Annabelle Barillo, and Arsenia Cariño); St. Joseph's Fishermen's Association and Sibulan Bantay Dagat (especially Maximo and Leoncio Decipolo and sons); Cebu: University of San Carlos-Marine Biology Section (especially Jonathaniel Apurado and Joey Gatus); Gilutongan Barangay Fisheries and Aquatic Resources Management Council (especially Timoteo Menguito); Mike Ross of the Coastal Resource Management Project; Department of Environment and Natural Resources-Region VII; International Marinelife Alliance-Philippines; Sarangani: Kiamba Municipal Government (especially Venancio Banquil); Hermenigildo Cabangon, Olive Gonzales, Johnette Delegero, and Alvin Salting; Luzon: Bolinao Community-based Coastal Resource Management Project; Samahan ng Mangingisda at Magsasaka ng Balingasay; and Connie Morales of the Hayuma Foundation; and Palawan: Palawan Council for Sustainable Development Staff and U.S. Peace Corps.

Field activities that culminated in this guide were coordinated by A.J. Uychiaoco, S.J. Green, M.T. dela Cruz, H.O. Arceo, P. Gaito, and M. Teves. Writing of the guide, in addition to the main authors, was assisted by Ma. Fritzie D. Uychiaoco. Those responsible for review, editing, and various insights were: S.J. Green, A.T. White, Kai-Jens Kuhlmann, P.M. Aliño, Ma. F.D. Uychiaoco, Gregor Hodgson, C. Morales, M. Ross, Arlene Brookes (VSO), Maeve Nightingale (VSO), Karen Vidler (Philippine Rural Reconstruction Movement), Maike Waltemath (German Development Service), other participants of the VSO sponsored Marine Protected Areas Workshop and the UP-MSI sponsored MPA workshop in December 1997. Participants of the workshop to produce a source book on participatory methods for community-based coastal resource management held in September 1997, organized by the International Institute for Rural Reconstruction, also helped in refining the writing and methods.

Finally, in view of all the welcome assistance and participation in conceiving, developing an experiential basis for, and writing this reef monitoring guide, the authors assume responsibility for the result and any errors or discrepancies that remain.

Preface

Coral reefs are the focus of the methods in this guide because reefs are less accessible to monitor and evaluate than either mangroves or seagrasses. Due to their naturally high productivity and aesthetic attractiveness, coral reefs are more frequently the centerpiece of marine protected areas, as well as the target of extractive activities. Mangroves are also of high priority for management and important for the physical protection of reefs from sediments and storms but are addressed in other publications.

We must manage our coral reefs wisely so we can continue to benefit from them. We must keep track of changes on coral reefs so that we can tell whether present use and management is sustainable and where and how management can be improved. We must also be able to respond appropriately to changes on reefs from whatever cause. This guide describes ways that local communities, volunteers, and other interested parties can use to monitor and evaluate changes on their reefs for improved management. These methods should only be introduced to communities after they have already had basic environmental education, understood the value of coral reefs, and preferably have demonstrated their commitment to coral reefs (e.g. by having set up a sanctuary).

This guide describes a system to monitor and evaluate coral reefs designed for local coastal communities who have no training in SCUBA diving. However, those who wish to use these reef monitoring methods must be good snorkelers. This guide outlines the importance of monitoring reefs, the steps to gather data, to analyze trends, and to choose solutions based on the observations. The simple methods described here are not unique or original. They were adapted from the other methods developed for volunteer SCUBA divers and reef scientists (see History and Acknowledgments). This system was especially designed to collect data that are comparable to data collected by those other methods. It is hoped that the skills in monitoring and the knowledge from monitoring will help empower local communities to be more effective managers of the resources on which they depend.

This guide is intended for both development workers and members of local community monitoring teams. Notes for trainers have been incorporated in each chapter. It is emphasized that trainers must be trained in and have practiced monitoring and evaluation of coral reefs. Trainers must encourage trainees to openly discuss local and personal observations, methods, and ideas. Each trainee should have his/her personal copy of this guide to use and keep notes on. All trainees are encouraged to later become trainers!

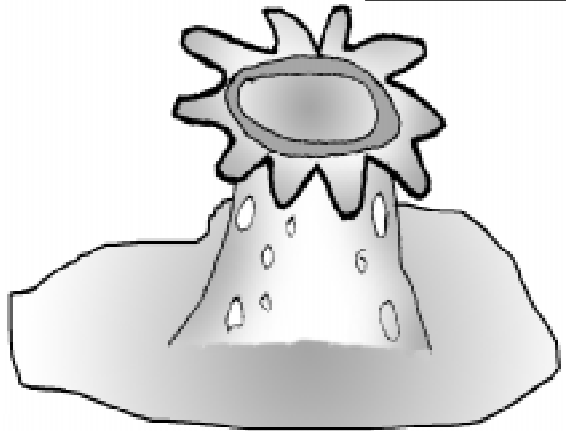
Fish and invertebrate guides are especially important. Each team should have a copy of one or more basic coral reef life guidebooks. Each team should also have at least two sets of mask and snorkel and four sets of underwater slate boards of their own. Geographic positioning systems (GPS) have also become extremely handy for determining exact locations.

This user-friendly guide is intended for field use. Read it, test it, use it, and make adaptations for successful field monitoring of coral reefs for management!

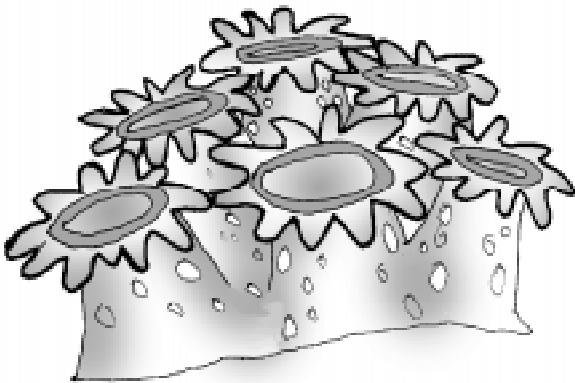
WHAT ARE CORAL REEFS?

1

Hard corals are tiny animals whose individuals consist of tubular bodies with a mouth ringed by tentacles at one end. These individuals secrete cup-shaped limestone skeletons within and around their bodies. (Soft corals have tiny particles instead so they are not as rigid.)

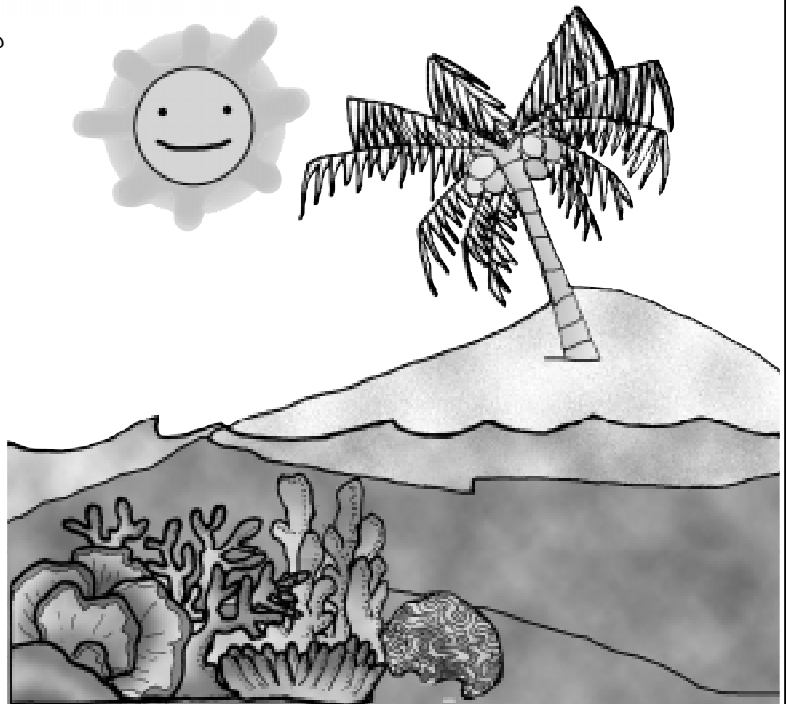


Individuals grow and divide repeatedly, forming colonies. Coralline algae cement these colonies together into hard structures known as coral reefs.

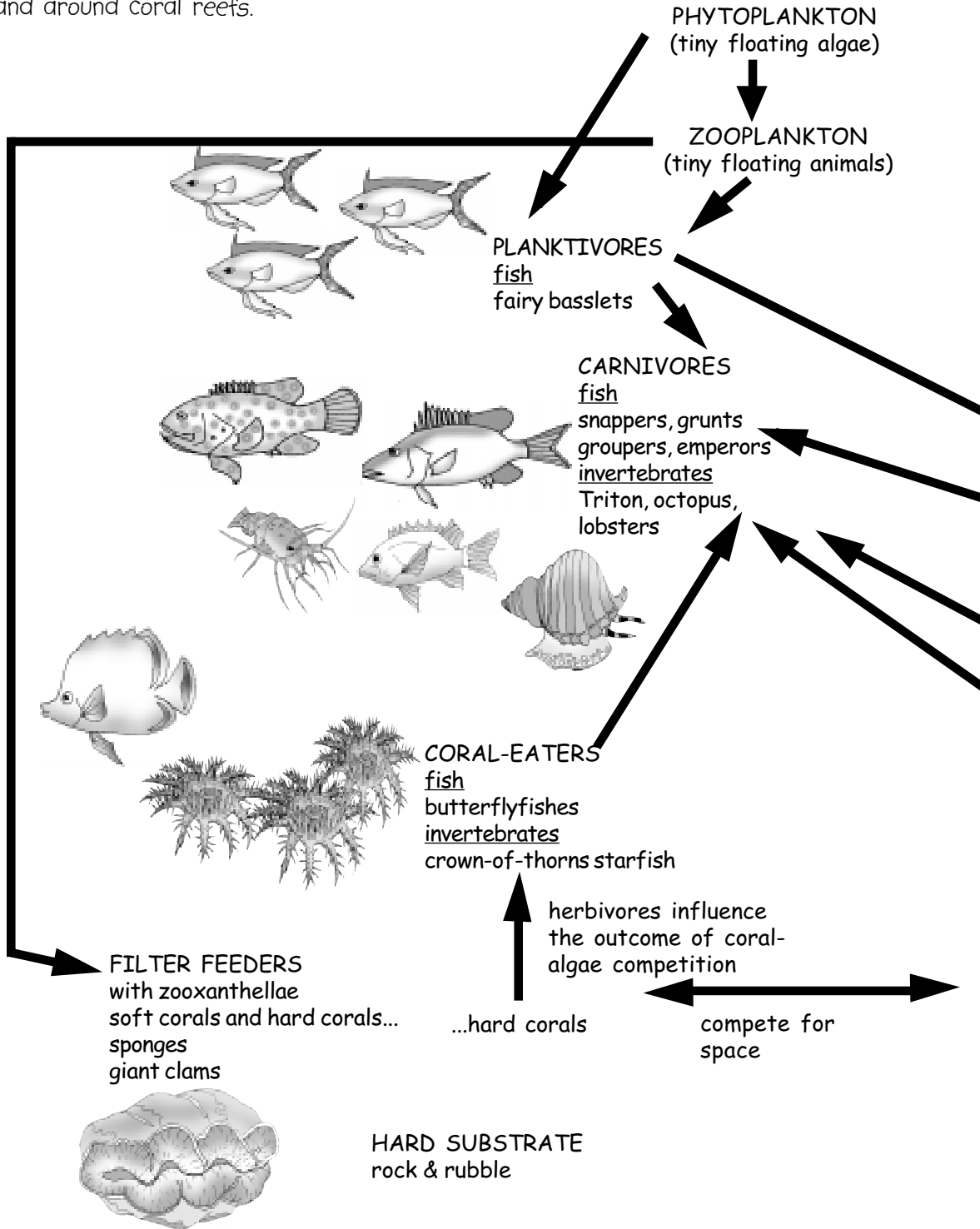


Coral reefs only develop in warm tropical climates. Corals may get suffocated by silt, so they need water movement to continuously wash their surfaces.

In addition, symbiotic algae—which photosynthesize, live within corals, and help them grow faster—also need sunlight.

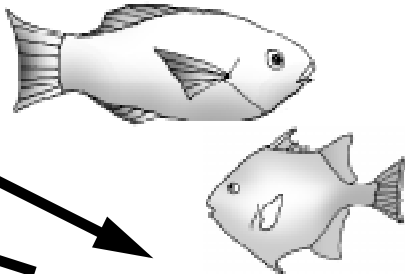
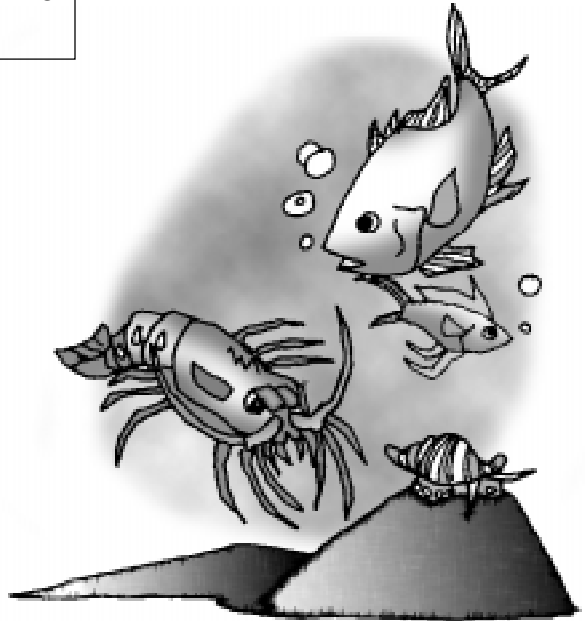


Communities of plants, algae, animals, and other living things interact with each other in and around coral reefs.



Plants, animals, and detritivores are connected to one another by this "chain" of eating and being eaten.

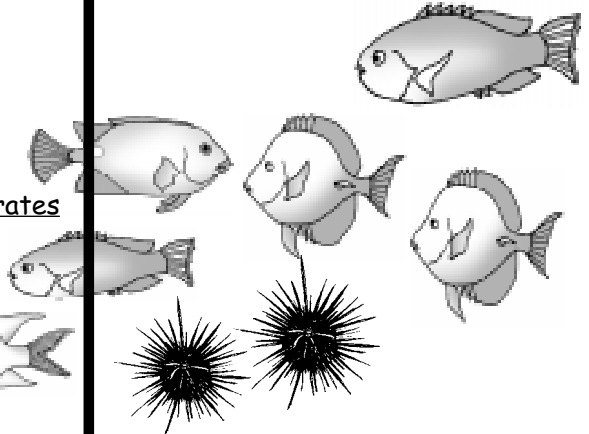
Animals eat either plants and/or other animals.



OMNIVORES
fish
 wrasses, triggerfishes
invertebrates
 gastropods, worms

HERBIVORES
fish
 parrotfishes,
 surgeonfishes,
 rabbitfishes,
 damselfishes

invertebrates
 urchins
 crabs



...with algae
 seagrasses

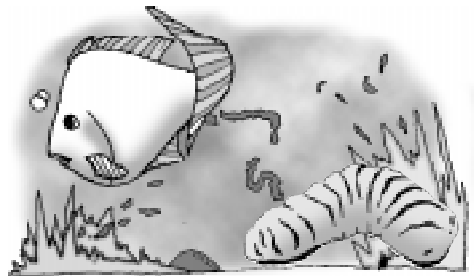
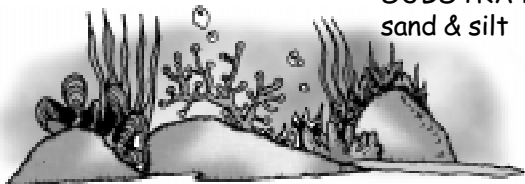
DETRITIVORES

invertebrates
 sea cucumbers,
 bivalves, sponges

Plants and algae use sunlight,
 gases, and nutrients in the
 water as food.

Detritivores break down the wastes,
 dead parts & bodies of plants, animals,
 and other living things and make them
 available as nutrients in the water.

**SOFT
 SUBSTRATE**
 sand & silt



Trainer's Tips for Chapters 1 to 4

Key Concepts:

1. Monitoring and evaluation is essential for management to be responsive to the changes in the biophysical and socioeconomic realities as an area is being managed.
2. Observations must be done in places and times that represent the variation in the places and time of interest.
3. Observe those indicators that address what you want to know.
4. The monitoring plan must be feasible.

Though there are many definitions of adaptive management, the basic idea is that management strategies are continuously improved as understanding of the system being managed improves.

It is very important that the indicators you decide to monitor are relevant to what the community wants to know. If current use is sustainable under the present management strategy, your indicators must either be stable or changing towards the direction desired (e.g. fish catch is stable or increasing). If you are evaluating management, your indicators must potentially be responsive to management.

The reef monitoring methods described here generally collect the simplest type of data with which changes can be detected. More detailed data may be collected for indicators of particular interest. Tables in the appendix outline how these methods may collect more detailed information as well as what levels of detail are collected by other monitoring systems.

If the organisms you are censusing have:

- greater movement ranges, you'll need to have your samples more spread apart
- higher abundances, you'll need lesser samples
- clustered distributions, you'll need more samples

Review Questions

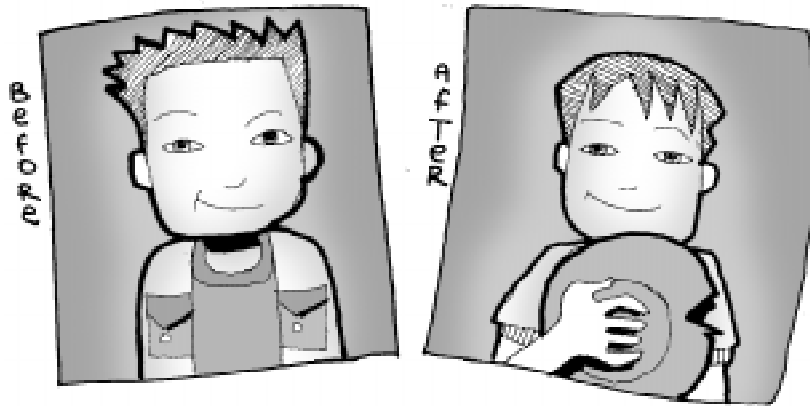
1. What use is monitoring to management?
2. What major components do we monitor?
3. Why do we observe outside protected areas too? Why do we observe at different times?
4. Why must we take several observations at each site at each time?
5. What does "representative" sampling mean?

"Representative" means a part whose characteristics are similar to the whole.

WHAT IS MONITORING?

2

Monitoring is using a standard method to observe one thing in one place over a period of time.



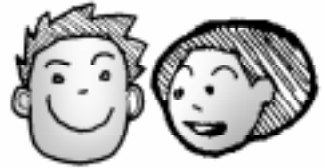
Information from monitoring is like a picture. Two pictures of a person taken at different times can be compared to see if the person has changed. Similarly, monitoring collects evidence of changes.



Trends may be deduced from a series of pictures. These trends may help predict the direction and speed of future changes.

Learning Discussion

Write/draw on this page major changes that have been observed in your coral reef area in the past 10 years. Write what you think is the cause of each change and what you think are the results of each change.



| year | cause | changes | results |
|------|-------|---------|---------|
| | | | |



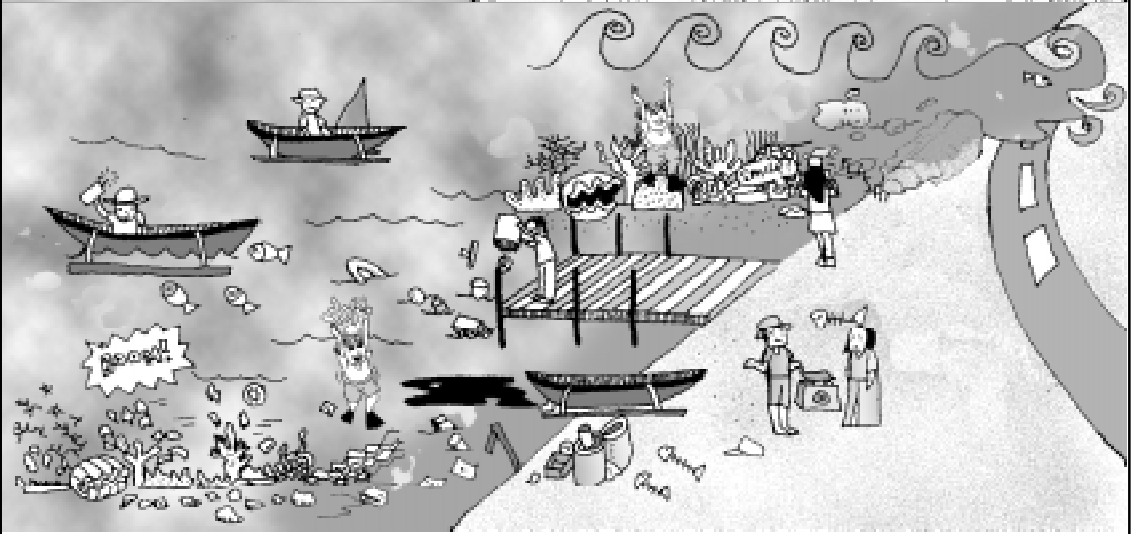
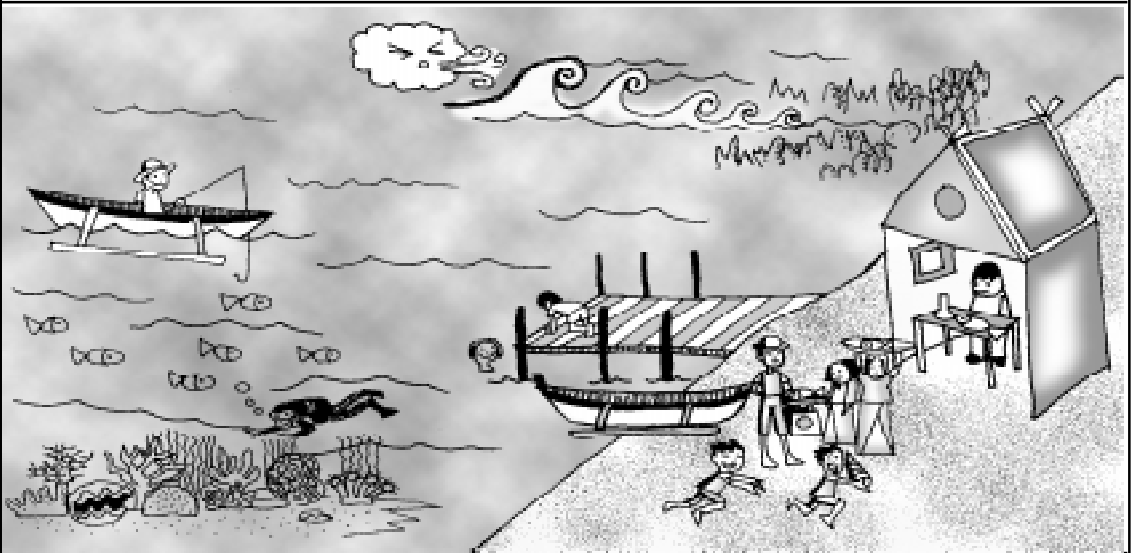
ample Data

| <i>EXAMPLE</i> year | <i>(from Hughes 1994)</i> cause | changes | results |
|------------------------|--|--|--|
| 1950s-1970s | overfishing | carnivorous, omnivorous, & herbivorous fishes decrease | less urchin predators, less competitors for algae |
| 1950s-1970s | less urchin predators, less competitors for algae | urchins increase | urchins become dominant |
| 1982-1984 | urchins hit by virus | urchins decrease | few herbivores left to control algae |
| 1983-1990s | few herbivores left to control algae | algae increase (4% cover -> 92% cover) | algae outcompete corals |
| 1985-1990s | algae outcompete corals | corals decrease (from 52% cover -> ... | |
| 1987, 1989 & 1990 | mass bleaching | corals further decrease ... -> to 3% cover) | |

WHY MONITOR REEFS?

3

Reefs give us food, income, pleasure, and protection from storms. Reefs are also a potential source of medicine.

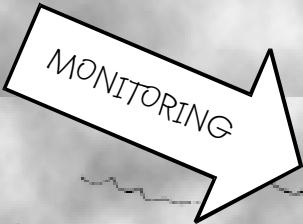


But reefs are being threatened by destructive fishing methods, overharvesting, siltation, sewage, garbage, agricultural, mining and industrial pollution, tourism-associated damage, coastal construction, and global warming.

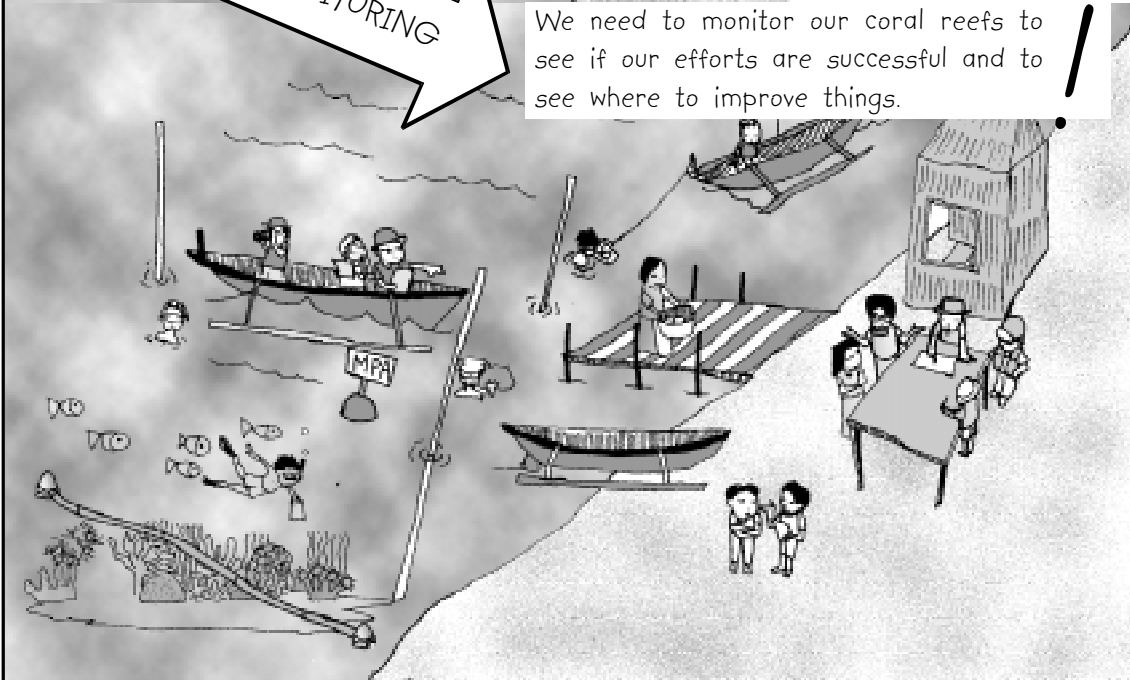
So it is important for us to manage our reefs. Many of us are helping to manage our coastal environment by establishing marine protected areas (also known as marine reserves or sanctuaries), patrolling, educating others, recycling and proper waste disposal, reforestation, and reseedling.



? How do we find out if our management efforts are effective?



We need to monitor our coral reefs to see if our efforts are successful and to see where to improve things. !



Reef scientists and volunteer SCUBA divers are keeping watch on the earth's reefs. We present here simple methods for non-SCUBA divers...to allow rural communities and development workers to see for themselves what is going on on the coral reefs under the sea.

Learning Discussion

Answer the following items.

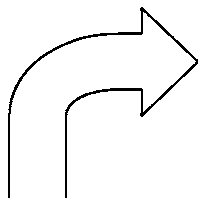


List 3 ways that reefs are useful to you.

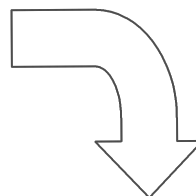
1. _____
2. _____
3. _____

Adaptive Management Cycle

List the top 3 problems of your coastal environment.



- 1.
- 2.
- 3.

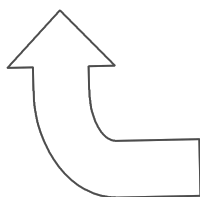


List 3 ways you can improve coastal management.

- 1.
- 2.
- 3.

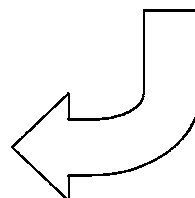
List 3 ways by which you are helping to solve these problems.

- 1.
- 2.
- 3.



List 3 effects of your efforts.

- 1.
- 2.
- 3.



DRAWING UP A MONITORING PLAN

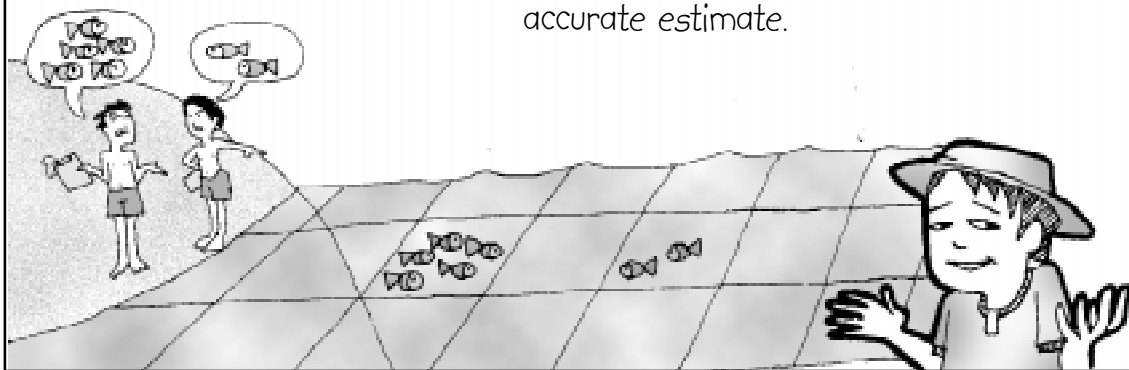
4

We cannot observe all things, everywhere and all the time.

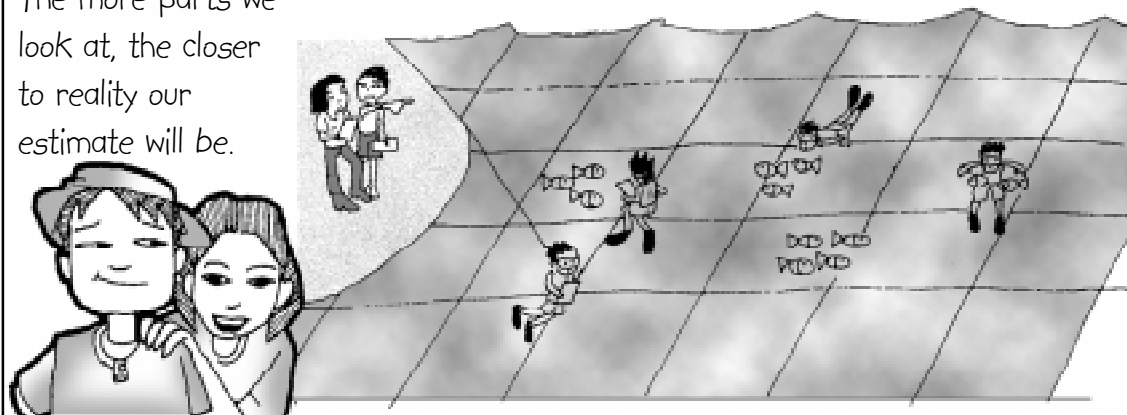


We observe parts of the whole (sampling). From this part, we infer some things about the whole.

A single observation might not give us an accurate estimate.



The more parts we look at, the closer to reality our estimate will be.



Complementing the indigenous knowledge of fishers with scientific knowledge and information from monitoring can give us a very representative picture of what is happening.

Be clear about what you want to know, then select a few things to observe in several places through time.

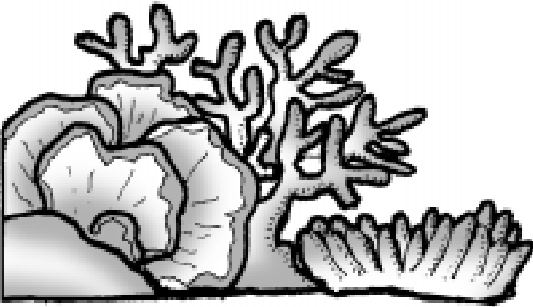
**NEEDS/
INTERESTS**

Observe the things of interest that are likely to change due to poor or good management.

Legend: **-** causes decrease
+ causes increase
+ - may cause increase or decrease **-**

**CHANGE
MAINLY DUE
TO**

CORALS



- ☆ home of fish & many other species
- ☆ tourist attraction
- ☆ storm protection

- destructive fishing
- siltation
- pollution
- coastal construction
- storms
- global warming

ALGAE



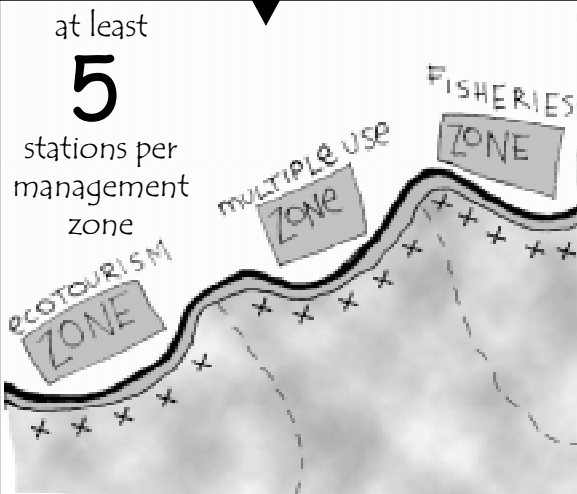
- ☆ competitor of corals
- ☆ food for fish and invertebrates
- ☆ some live in the bodies of and produce food for corals and other invertebrates

- +** pollution
- +** overfishing **-**
- +** EPIDEMICS **-**

(algae are normal on reefs; but certain stresses may cause algae to be unusually rare or unusually abundant)

⊛ Observe in different kinds of places: inside and outside the management zone or use zone (e.g. inside and outside the marine protected area (MPA)). Try to observe at 5 stations within each management zone

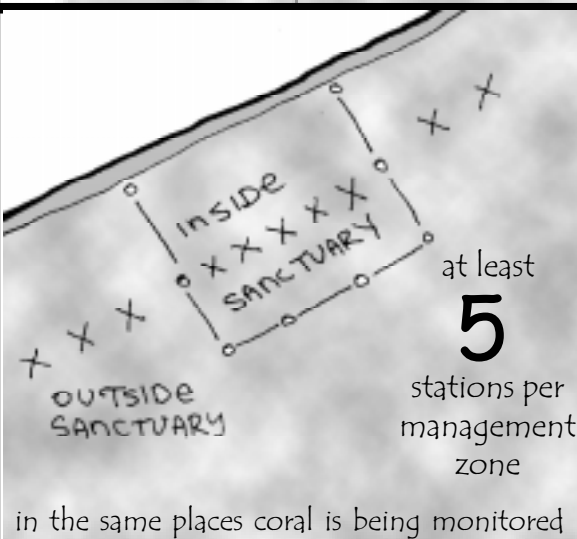
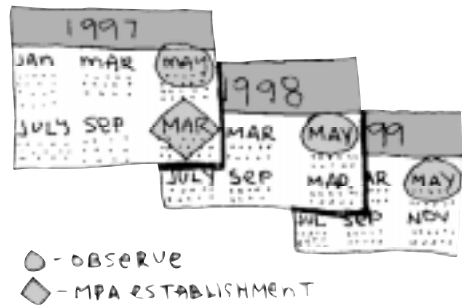
WHERE



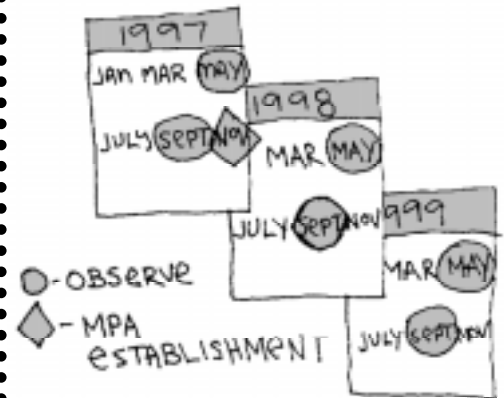
⊛ Observe before, and every year after establishment of the management actions, during each season. Things that don't change much can be observed less frequently.

WHEN

Before and every year after management

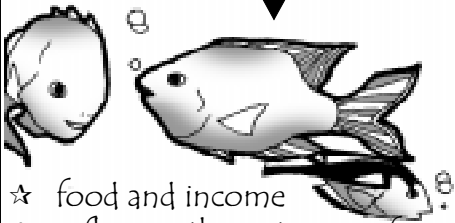


Before and every year after management. Ideally, once per season.



NEEDS/ INTERESTS

FISHES



- ☆ food and income
- ☆ influence the outcome of competition between algae and corals

CHANGE MAINLY DUE TO

- ⊖ destructive and overfishing
- ⊕ sanctuaries
- ⊕ change in corals ⊖
- ⊕ patrolling and enforcement

INVERTEBRATES



- ☆ food and income
- ☆ influence the outcome of competition between algae and corals

- ⊕ sanctuaries
- ⊕ reseeded
- ⊖ overfishing
- ⊕ EPIDEMICS ⊖
- ⊕ change in corals ⊖

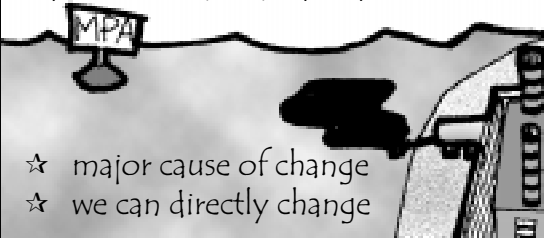
CATCH



- ☆ food and income

- ⊕ sanctuaries
- ⊕ change in fish and invertebrates ⊖
- ⊕ patrolling and enforcement

OTHER HUMAN ACTIVITIES



- ☆ major cause of change
- ☆ we can directly change

- ⊖ upland deforestation
- ⊕ education
- ⊖ shoreline development
- ⊕ legislation and enforcement

NATURAL DISTURBANCES



- ☆ major cause of change
- ☆ we are not able to change

- ⊕ global climate ⊖
(e.g. El Niño)

- ⊖ PATHOGENS

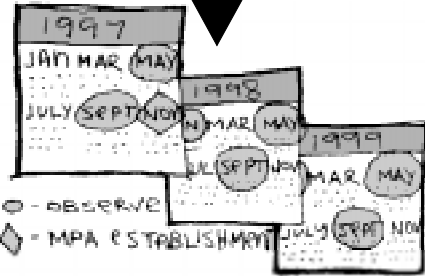
WHERE

at least
5
stations per
management
zone



in the same places coral is being monitored

WHEN

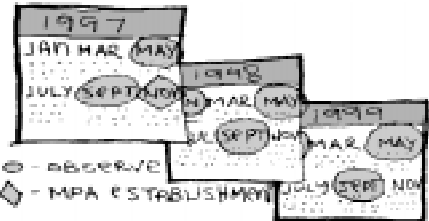


Before and every year after management. Ideally, once per season.



at least
5
stations per
management
zone

in the same places coral is being monitored



Before and every year after management. Ideally, once per season.



where local fishers are fishing and in local waters

WHO



15 fishers or 10% of fisher population, whichever is greater



types used once every 1 or 2 weeks



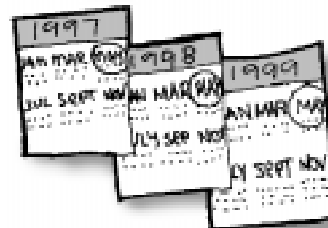
entire area of interest (e.g. within barangay/ municipality / region / province)



AT LEAST once a year
BETTER if monthly or quarterly



entire area of interest (e.g. within barangay/ municipality / region / province)



once a year

1

Meet with the community and the people who are important in decision-making.



Be clear about what you want to know.

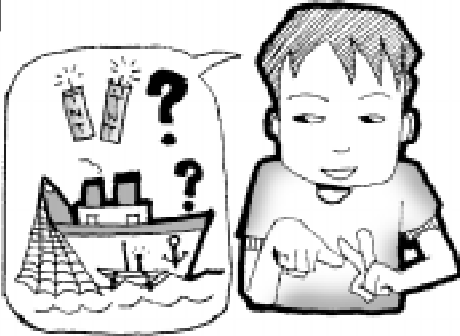
2

Determine whether monitoring can help in solving the problem or concern.



3

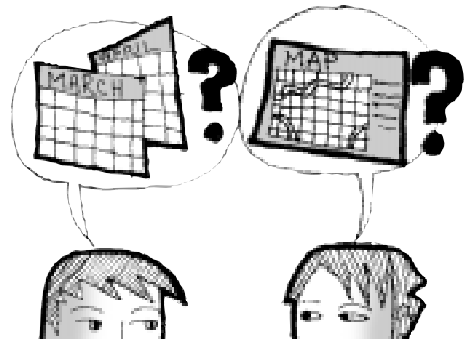
Use the Data Checklist Form.



Select a few things that can be used as an indicator or to directly answer your question.

4

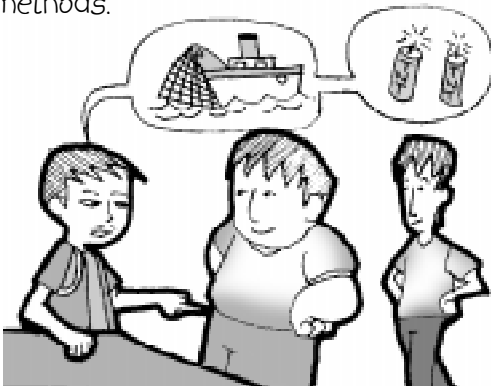
Discuss what may cause changes in your indicators.



Agree on where and how often these indicators need to be monitored.

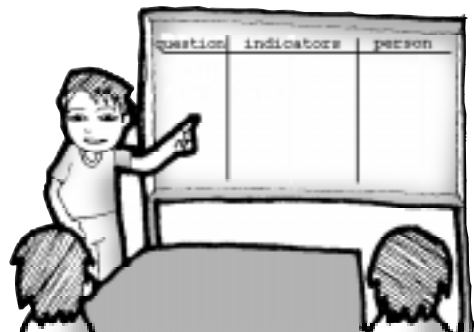
5

Decide what monitoring method the group will implement and make sure everyone understands how to do the methods.

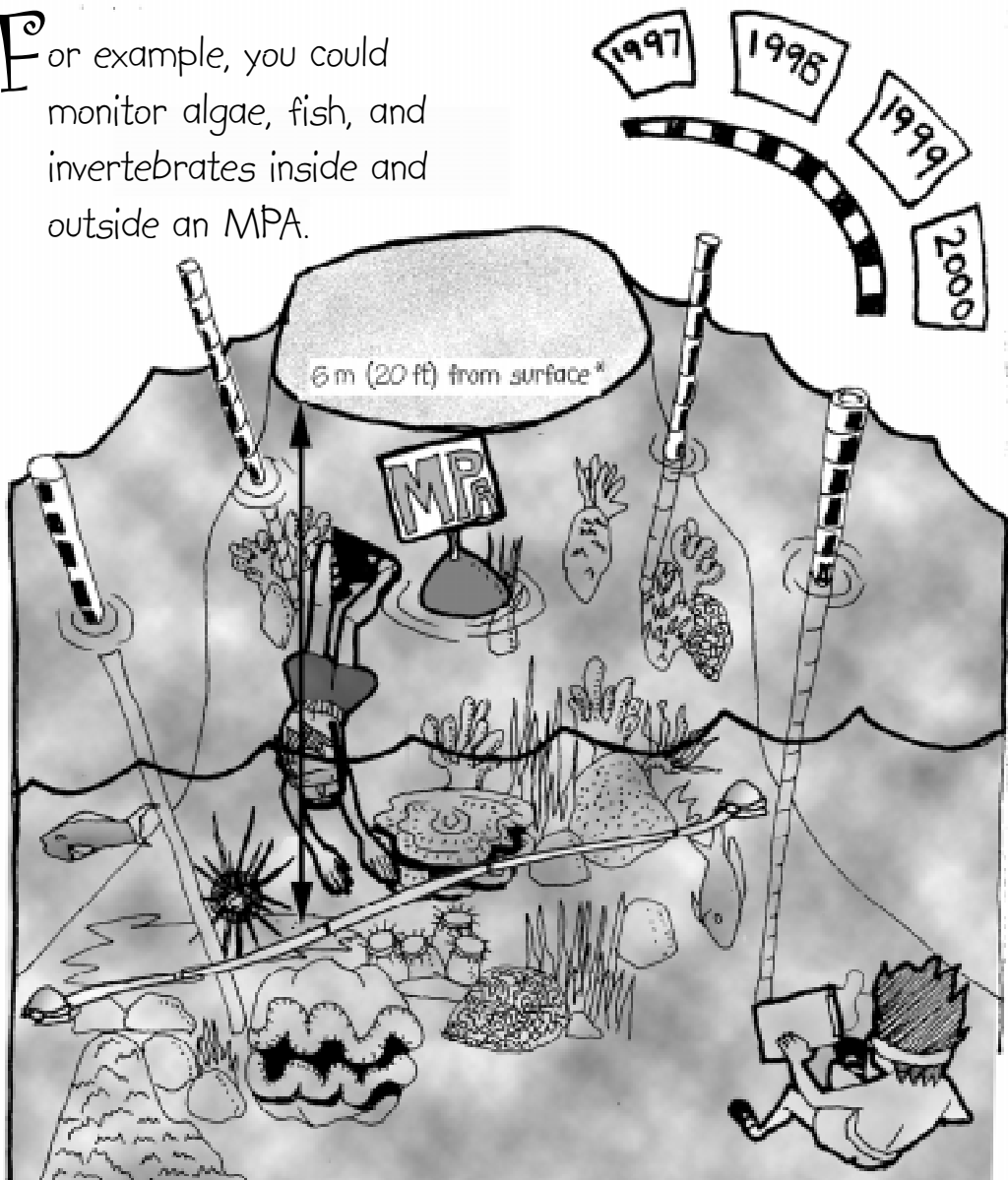


6

List the things needed and assign one person to take responsibility for monitoring each indicator.



For example, you could monitor algae, fish, and invertebrates inside and outside an MPA.



* Depth at which each transect is laid parallel to the shore or depth contour: 6 meters (20 feet) [also at 13 m (40 ft) if divers are available]. Transect can also be laid going down the slope if interested in change through depth

MONITOR EVERY YEAR

during the dry season,
the northeast monsoon

and the southwest monsoon
...so that changes from season to season
can be noted

(Corals may be monitored only once a year since they change
very slowly)



Sample Checklist

Form 1 can be used to determine what data should be collected when monitoring.

| DATA CHECKLIST FORM | | | | | | | Form 1 | |
|------------------------------------|---------------------------------------|--|--------------------------|--|---------------------------|--|------------------------------------|--|
| Question, issue or problem | Possible indicator(s) | What may cause change | Where to monitor | When to monitor | Monitoring method | Materials needed | Person(s) assigned | Target dates & # days needed |
| Overfishing Poaching in MPA | fish sizes & abundance | changes in fishing effort; natural disturbances; changes in coral cover; management practices | inside & outside the MPA | northeast monsoon, southwest monsoon, summer | fish visual census | 50-m rope marked at 5-m intervals; mask & snorkel, slates w/ pencils; boat & gasoline; data sheets | MPA monitoring team | 1st weekend of January; 1st weekend of May; 1st weekend of September (2-3 days per session) |
| | invertebrate abundance | same as above | same as above | same as above | invertebrate census | same as above | same as above | same as above |
| | fishing effort; catch per unit effort | increase in fishing effort; management practices like MPA enforcement | whole village | at least once a week | fish catch monitoring | data sheets & pencils; logbook or notebook; fish identification materials, resource map; weighing scale; calculator | MPA monitoring team; women's group | every Wednesday: collection/ submission of data forms 4th Saturday of the month: data summarization |
| Habitat Degradation | coral cover | destructive fishing practices; natural disturbances; management practices like MPA enforcement | inside & outside the MPA | once a year | manta tow, snorkel survey | 50-m rope marked at 5-m intervals; mask & snorkel, slates w/ pencils; boat & gasoline; data sheets, watch, geographic positioning system (GPS) | MPA monitoring team | 1st weekend of May; 1-2 days |

★ OBSERVING CORALS and ALGAE:

MANTA TOW, SNORKEL SURVEY, and POINT-INTERCEPT TRANSECT

5



A. Manta Tow

Definition

A manta tow survey is the observation of an underwater area of good visibility by a snorkeler who is being pulled by a small boat.

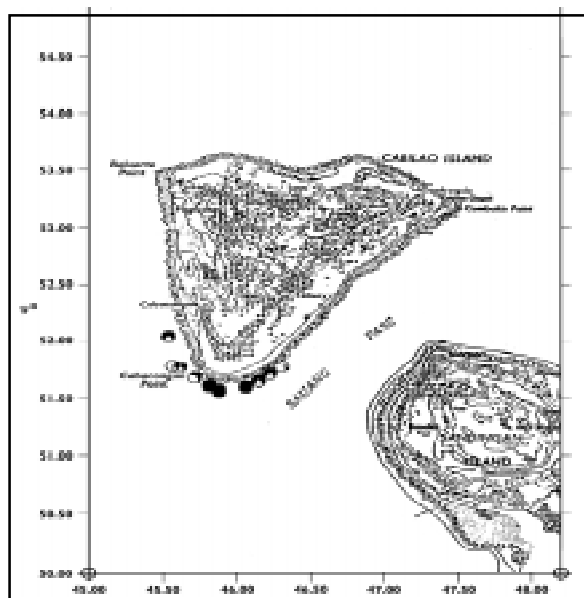
Purpose

Manta tows are used to get a general idea of the various types and amounts of habitat types and large obvious things in an area. This information may be used:

- ✓ to help in the selection of sites and numbers of samples for closer observation
- ✓ for comparison with local perceptions of the coastal area.
- ✓ in the detection of large-scale changes (e.g. due to storms or mass siltation)

Requirements

- Small boat and fuel
- Mask and snorkel
- Manta board
- Map of the area
- Watch preferably showing the seconds
- 17-m rope (approx. 10 mm in diameter marked at 6-m and 12-m from one end)
- Geographic positioning system (GPS) or compass

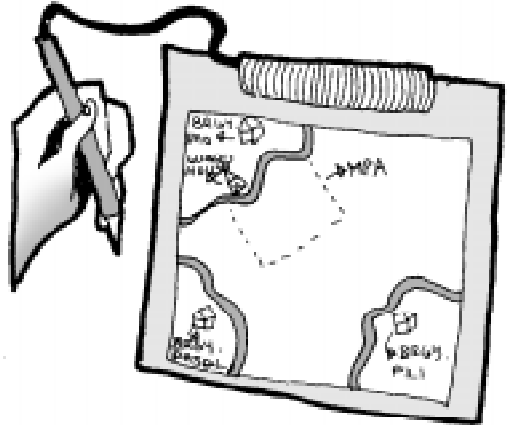


1

Copy a map of the area to be surveyed onto a slate.

**2**

Mark features (landmarks and boundaries) and zones (uses and protection) on the map.

**3**

Plan and mark the tow survey path (usually along the reef perimeter or selected depth contour) on the map.

**4**

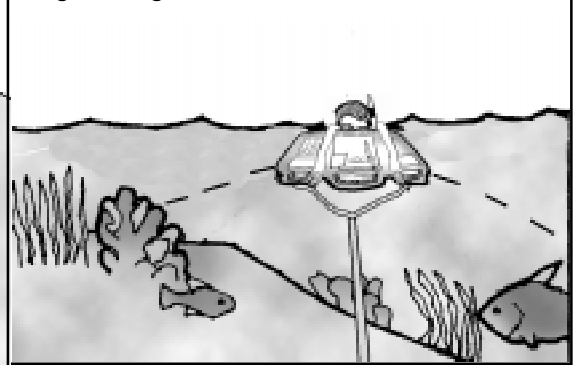
Choose 3 to 5 items (e.g. live hard coral, dead coral, soft coral, and sand/silt) to estimate.

**5**

Attach a manta board to the boat using the rope.

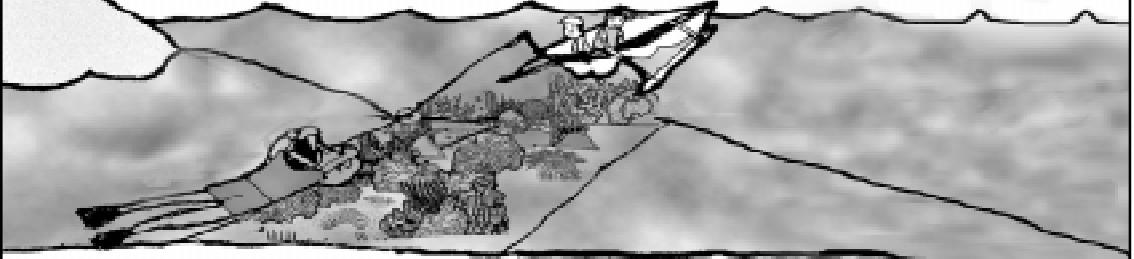
**6**

When the observer (snorkeler) is ready and gives the "OK" signal, tow the snorkeler parallel and over the reef edge along the area to be surveyed.



7

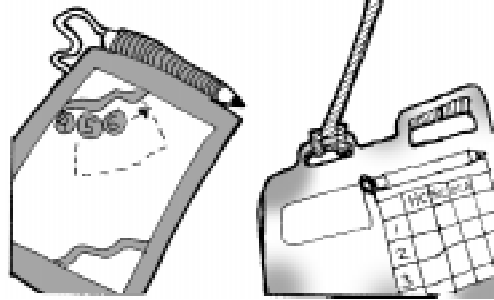
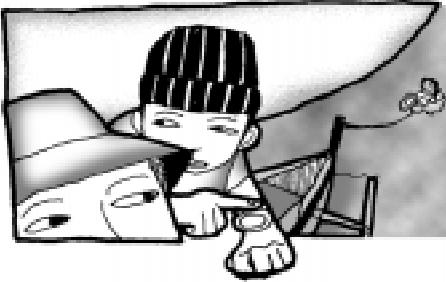
During each tow, the observer estimates the approximate percentage cover of the items chosen in step 4. Percentages of the various items don't always have to add up to 100%. (The area viewed is up to 10 m wide depending on depth and water clarity.)



Meanwhile, a person keeping watch of the time or 'timer' on the boat looks out for the observer's safety and directional signals and relays these to the driver.

8

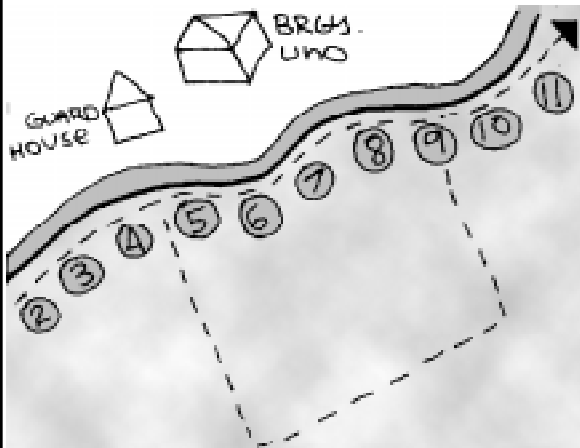
After 2 minutes of towing (around 100 to 150 m), the timer should inform the driver and the observer to pause and take notes (e.g. by tugging on the rope or using a whistle).



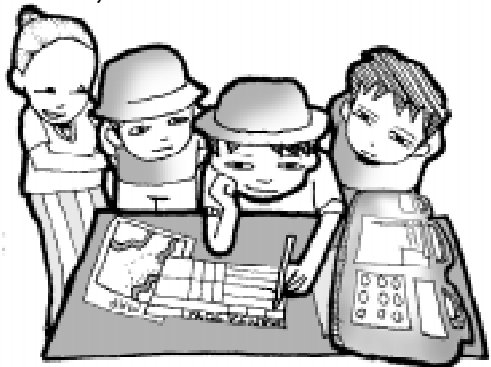
The observer then records onto the board the tow number and his/her observations of the last 2-minute tow while the driver or the timer marks the tow number at their current position on the map. One's current position on a map may be estimated by using a GPS, by using landmarks, and/or by triangulation with the help of a compass.

9

Repeat steps 6 to 8 until the entire planned tow path has been surveyed.






**10**

Copy the data onto the Data Form 3 and enclose a copy of the map (with tow numbers and path marked) with the raw data.



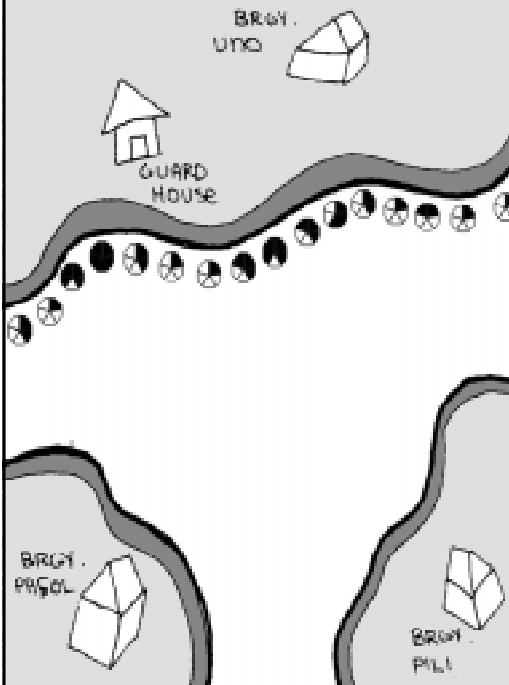
11

Convert the various percentage estimates of coral cover into its score on the five-point scale below:

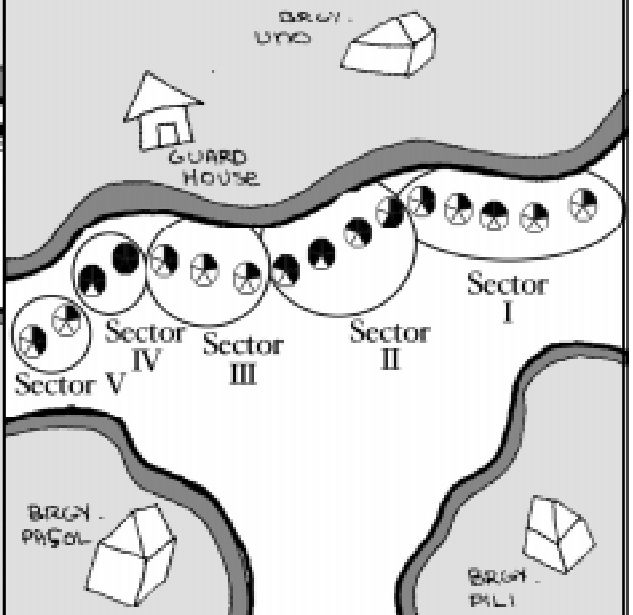
| Score | %Cover | Symbol |
|-------|---------|---|
| 1 | 0-10% |  |
| 2 | 11-30% |  |
| 3 | 31-50% |  |
| 4 | 51-75% |  |
| 5 | 76-100% |  |

12

Plot scores on the map. Put the live hard coral scores for each tow segment on the corresponding position of the tow segment on the manta tow map.

**13**

Use scores to group tow segment areas into sectors. Draw a circle around each set of continuous and similar hard coral scores on the map. You may also use the other scores (soft coral, dead coral, etc.) and observations to help group areas into sectors.

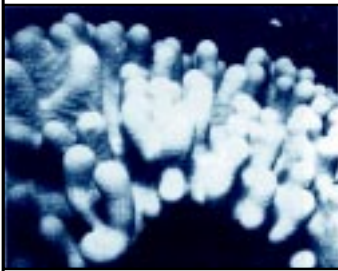


Tips:

Practice snorkelling, distinguishing, and estimating hard, soft, and dead coral in one spot before towing.



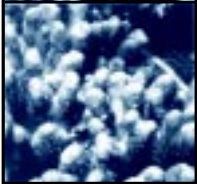
HARD
coral
(HC)



SOFT
coral
(SC)

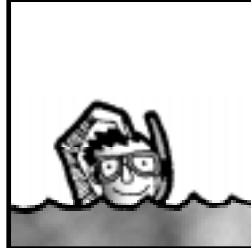


DEAD
coral
(DC)



DEAD coral
with algae
(DCA)

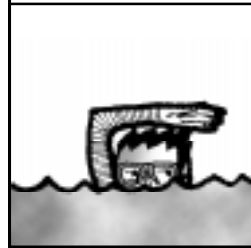
Agree on HAND SIGNALS



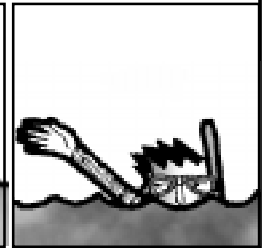
OK /
start tow



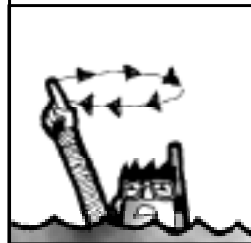
STOP
towing



LEFT



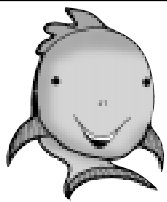
RIGHT



FASTER



SLOWER



STRENGTH

Large areas can be observed in a short time.

1

Method can only be used in areas of good visibility & during calm sea conditions.

LIMITATIONS

2

Measurements are only approximate.



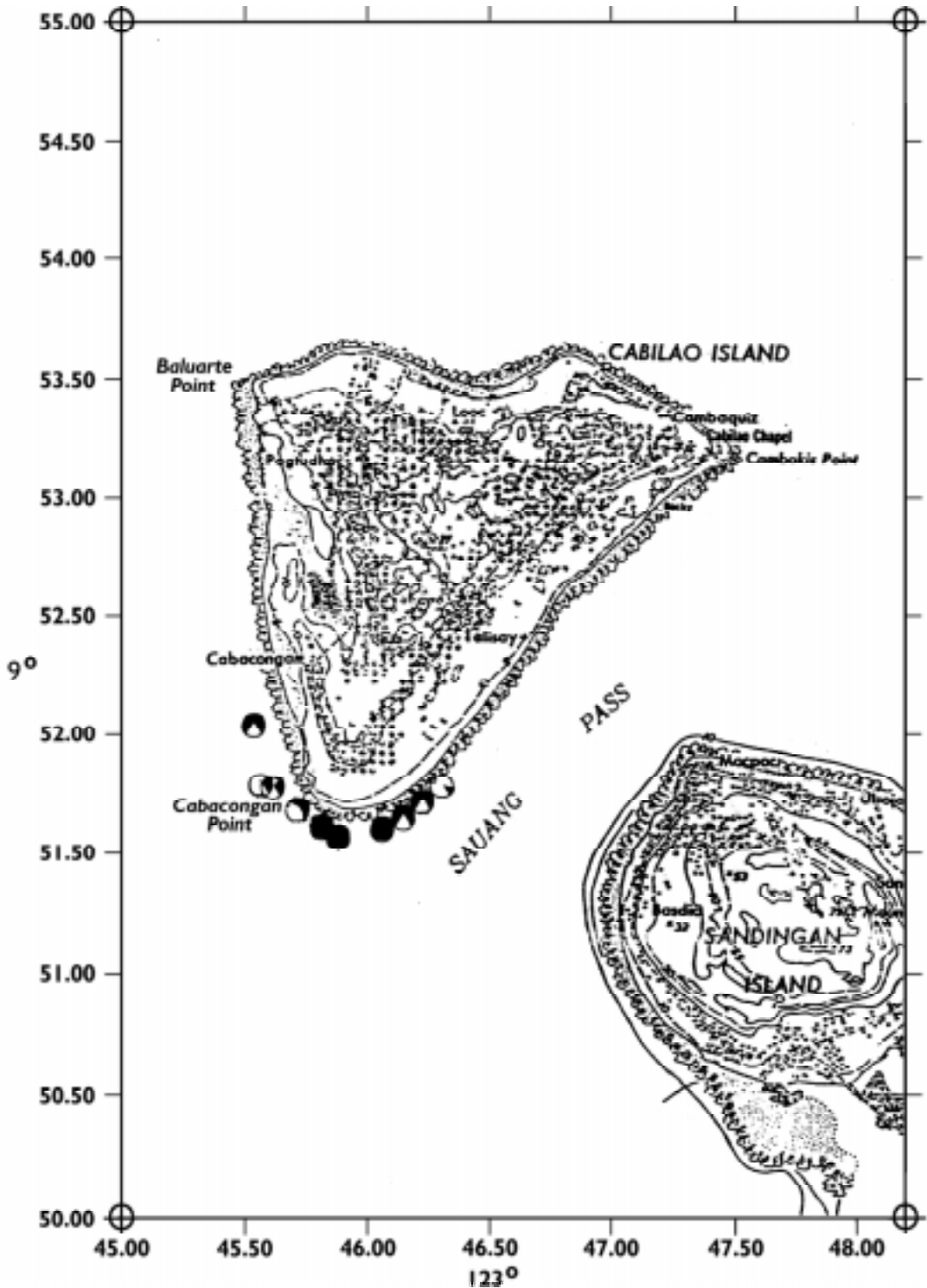
3

Can be tiring.

| MANTA TOW DATA FORM | | | | | | | | | | Form 3 |
|-----------------------------------|------------|--|------------------------|--------------------|----------------------------|--------------------------------------|------------|-------------|----------------------------|--|
| Site Name: CABACONGAN | | | | No.: | | Municipality & Province: LOON, BOHOL | | | | |
| Date (month/day/year): 04/26/1999 | | | | Time: 4:00-5:00 PM | | Observer: Andre/Paulyn | | | Timer/Mapper: Paulyn/Andre | |
| Tow No. | Start Time | Location | | | Estimate % substrate cover | | | | | Notes (e.g. crown-of-thorns starfish, <i>Diadema</i> urchins, algae, etc.) |
| | | Latitude & Longitude/Compass Bearing/Landmarks | | Depth (m) | Hard Coral | Soft Coral | Dead Coral | DC w/ Algae | Sand/Silt | |
| Start | End | | | | | | | | | |
| 1 | 16:07:25 | 9°51.873 123°46.484 | 9°51.793 123°46.404 | | 10 | 5 | 0 | | 30 | Observer: AU |
| 2 | 16:10:00 | 9°51.792 123°46.404 | 9°51.722 123°46.330 | | 70 | 0 | 0 | | 5 | Observer: AU |
| 3 | 16:12:50 | 9°51.717 123°46.327 | 9°51.655 123°46.240 | | 70 | 0 | 0 | | 0 | Observer: AU |
| 4 | | 9°51.649 123°46.241 | 9°51.606 123°46.167 | | 85 | 0 | 0 | | 0 | Observer: AU |
| 5 | | | 9°51.570 123°46.063 | | | | | | | none |
| 6 | 16:26:35 | 9°51.570 123°46.063 | | | 85 | 0 | 0 | | 0 | Observer: PAG |
| 7 | 16:29:00 | 9°51.566 123°45.997 | 9°51.612 123°45.907 | | 80 | 0 | 0 | | 5 | Observer: PAG |
| 8 | 16:32:00 | 9°51.617 123°45.895 | 9°51.683 123°45.801 | | 35 | 0 | 0 | | 0 | Observer: PAG |
| 9 | 16:34:30 | 9°51.692 123°45.791 | 9°51.780 123°45.747 | | 30 | 5 | 0 | | 0 | Observer: PAG |
| 10 | 16:37:00 | 9°51.790 123°45.743 | | | 30 | 0 | 0 | 50 | 0 | Observer: PAG |
| 11 | 16:40:15 | 9°51.932 123°45.712 | 9°51.932 123°45.712 | | 60 | 0 | 0 | 20 | <1 | Observer: PAG |

Sample output map

Hard coral cover plotted on the map for Cabacongan Point, Loon, Bohol from the manta tow results



B. Snorkel Survey (for Snorkelers)



Definition

Snorkel survey is a method used by a snorkeler for estimating the relative abundance of living and non-living things on the reef bottom observed within a defined area.

Purpose

The snorkel survey estimates the abundance of hard corals, dead corals, algae, and various reef substrates which may reflect the health of the reef.

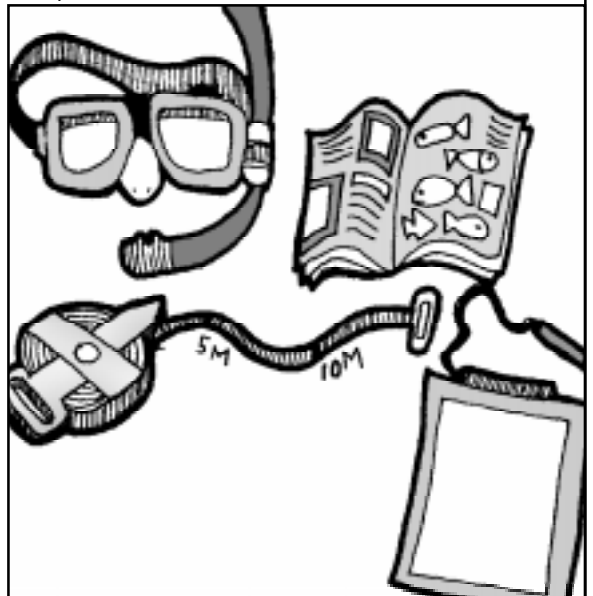
Requirements

- Picture book of the plant and animal types to be quantified (laminated guides would also be useful for training)
- Mask and snorkel
- 50-m transect line (marked every 5 m)
- Underwater slates with attached pencil

Optional

- Fins
- Life jacket

Look for the various lifeforms in the field and practice identifying other examples of those lifeforms in a given area prior to doing the actual assessments

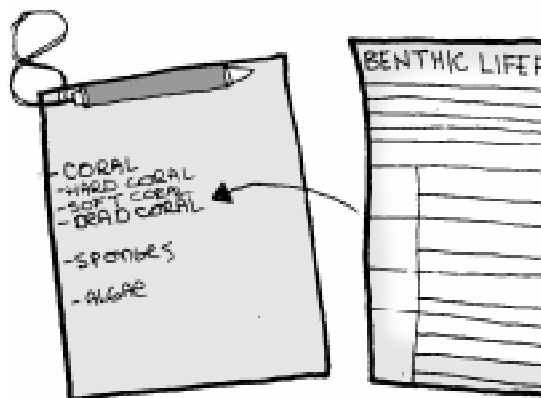


1

Select representative sampling stations to be surveyed/monitored based on the manta tow results.

**2**

Copy the Data Form 4A (with the selected benthic lifeform types) onto the plastic slates used for writing underwater.

**3**

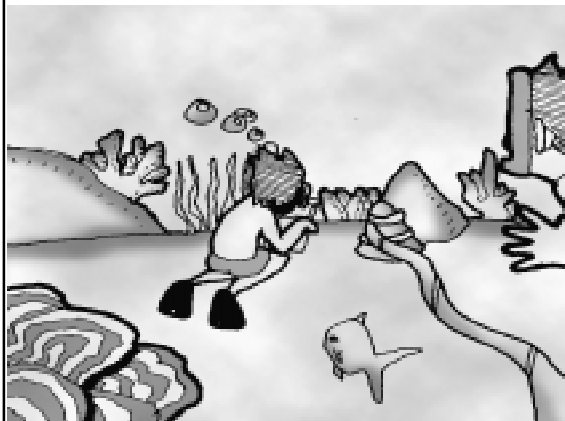
Lay the transect line on a constant depth contour. Record the depth.

**4**

Starting at one end of the transect line, the snorkeler swims over the transect estimating the % cover of each benthic lifeform within 2½ m on either side of the transect until the 5-m mark. The estimates of each 5x5 m quadrat should total 100%.

**5**

Similarly record each 5-m interval until the entire 50-m transect line has been observed.

**6**

Add the 10 readings for the transect and divide by 10.

| | | TOTAL |
|----|---|-------|
| HC | 23+42+35 +40+14+16+ 24+27+32 +30 | 283 |

7

Classify the various transects according to your purpose for data summarization. For example:

- * reef zones or types (e.g. reef flat, reef slope, fringing reef, offshore reef, etc.),
- * time of sampling (e.g. year 1/dry season, year 1/wet season, year 2/dry season, etc.)
- * management or use zones (e.g. sanctuary, fishing grounds), and/or
- * intensity of impacts (e.g. high pollution, medium pollution, low pollution)

List the transects by groups along the upper portion of the Summary Form.

9

From the data sheets per transect copy the percentages of each type of lifeform to the Summary Form.

| TRANSECT | 1 | 2 | 8 | 9 | 10 | |
|------------------|----------|-----|-----|-----|----|--|
| TYPES/ GROUPS | SUBTOTAL | | | | | |
| HC | 15% | 6% | 5% | 10% | | |
| SC | 58% | 10% | 22% | 76% | | |
| DC | | | | | | |

11

Standardize sub-total by sample size. Divide the total percentages by the number of transects actually observed. Write this on the column for averages.

| TRANSECT | 1 | 2 | 8 | 9 | 10 | TOTAL | AVERAGE |
|------------------|----------|-----|-----|-----|----|-------|---------|
| TYPES/ GROUPS | SUBTOTAL | | | | | | |
| SOFT CORAL | 15% | 6% | 5% | 10% | | 36 | 9% |
| HARD CORAL | 58% | 10% | 22% | 76% | | 166 | 41.5% |

Example:

$$\frac{43\% + 8\% + 20\% + 32\% + 17\%}{5 \text{ transects}} = 24\%$$

8

List the benthic lifeforms (by groups) along the left side of the Summary Form.

| DATA SUMMARY FORM | | | | | | | | | | |
|-------------------|---------|---|---|---|----|--------|---|---|---|---|
| TRANSECT# | OUTSIDE | | | | | INSIDE | | | | |
| | 1 | 2 | 8 | 9 | 10 | 4 | 5 | 6 | 7 | 8 |
| TYPES/ GROUPS | | | | | | | | | | |
| HC | | | | | | | | | | |
| SC | | | | | | | | | | |
| DC | | | | | | | | | | |
| DCA | | | | | | | | | | |
| TA | | | | | | | | | | |
| MA | | | | | | | | | | |
| CA | | | | | | | | | | |
| SC | | | | | | | | | | |

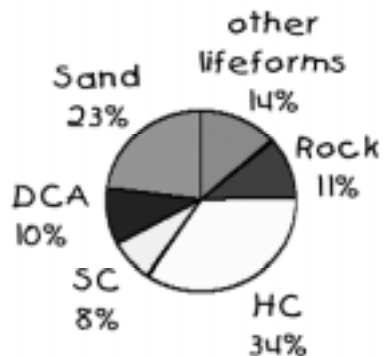
10

Sum sub-totals for each benthic lifeform for each transect group.

| SECT | 1 | 2 | 8 | 9 | 10 | TOTAL |
|------------------|----------|-----|-----|-----|----|-------|
| TYPES/ GROUPS | SUBTOTAL | | | | | |
| HC | 15% | 6% | 5% | 10% | | 36 |
| SC | 58% | 10% | 22% | 76% | | 166 |
| DC | | | | | | |

12

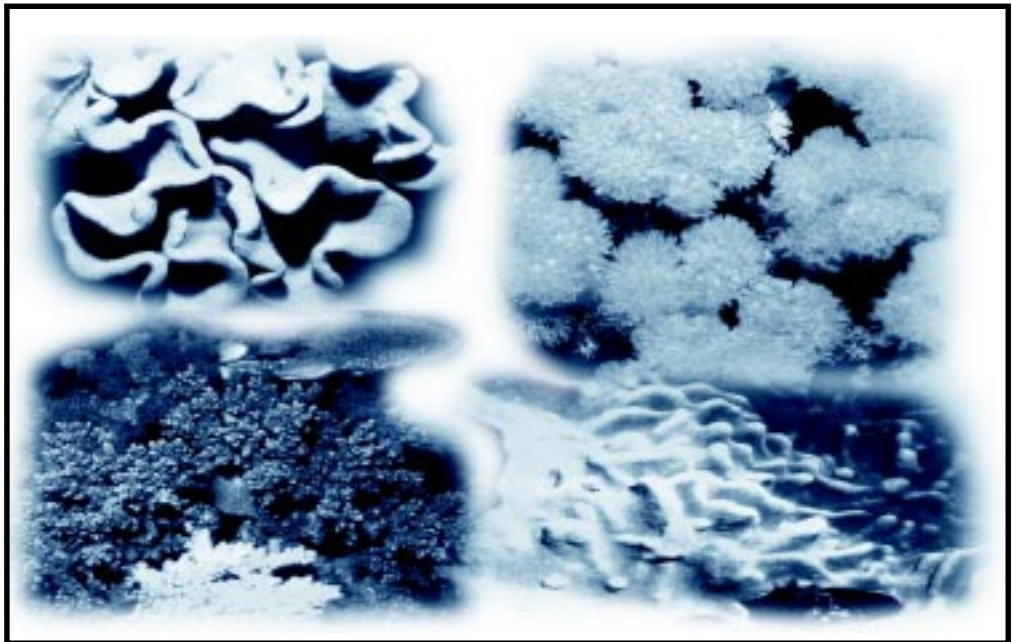
Draw pie charts for the average percentages of each transect group on the Benthos Form 4D Graph.



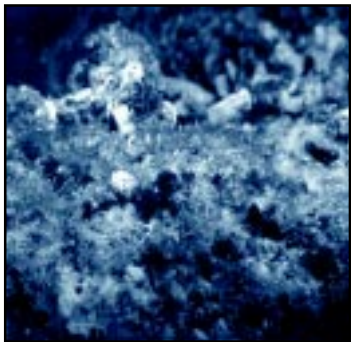
Common Benthic Lifeforms



Hard Coral
(HC)



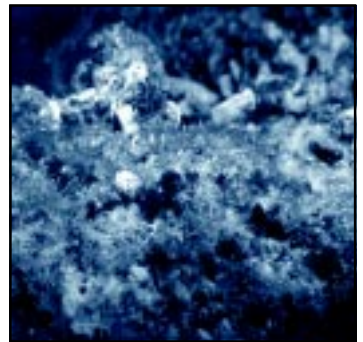
Soft Coral
(SC)



Turf Algae
(tiny filaments)



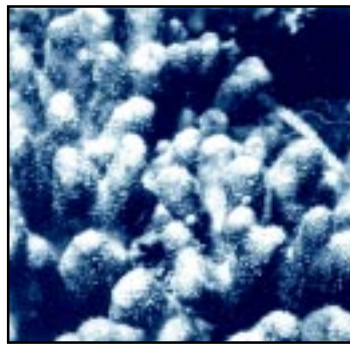
Dead Coral
(white with no living tissue)



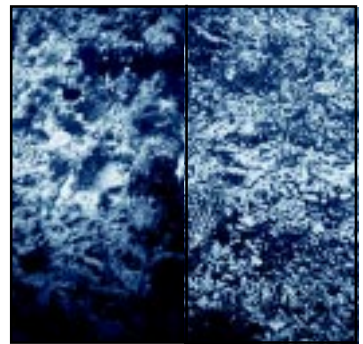
Sand/Silt



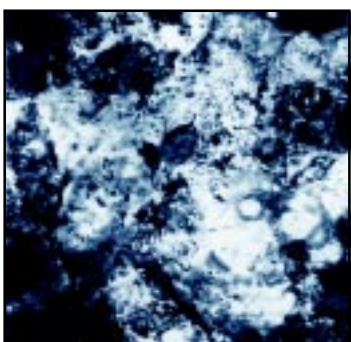
Macroalgae
(can be picked up with fingers)



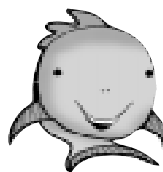
Dead Coral with Algae
(corallites still visible)



Rock/Rubble
(rubble: coral fragments)



Coralline Algae
(hard, pink or reddish crusts)



STRENGTH

The lifeform categories do not require knowledge of coral taxonomy.

LIMITATIONS



- 1 Sometimes there is confusion as to how to categorize some lifeforms (do standardization exercises with your trainer)
- 2 Without sufficient replication, it may be difficult to obtain precise information on changes through time.

C. Point-intercept Transect (for SCUBA divers)



Definition

Benthos point-intercept transect is a method used by SCUBA divers for estimating the relative abundance of living and non-living things on the reef bottom observed within a defined area.

Purpose

The point-intercept transect is used to more precisely estimate the abundance of hard corals, dead corals, algae, and various reef substrates which may reflect the health of the reef.

Requirements

- Picture book of the plant and animal types to be quantified
 - SCUBA diving gear
 - 50-m transect line (marked every 0.25 m)
 - Underwater slates with attached pencil
 - Properly-certified SCUBA divers
- Optional
- Boat (depending on where the survey site is)



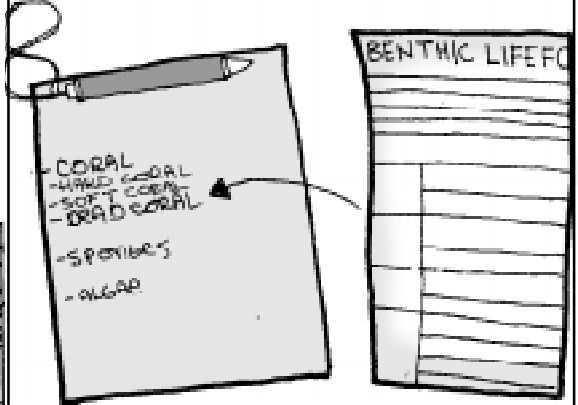
1

Select representative sampling stations to be surveyed/monitored based on the manta tow results.



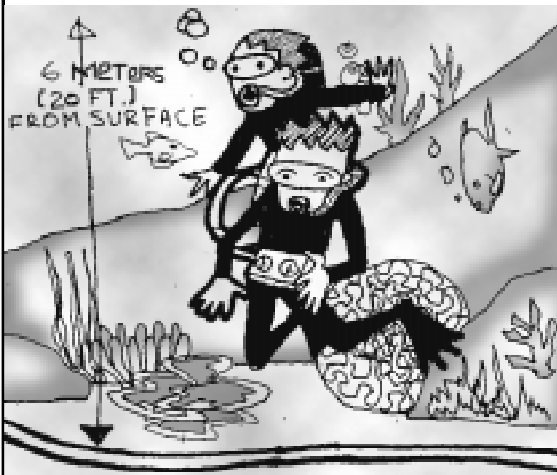
2

Copy the Data Form (with the selected benthic lifeform types) onto the plastic slates used for writing underwater.



3

Lay the transect line on a constant depth contour. Record the depth.



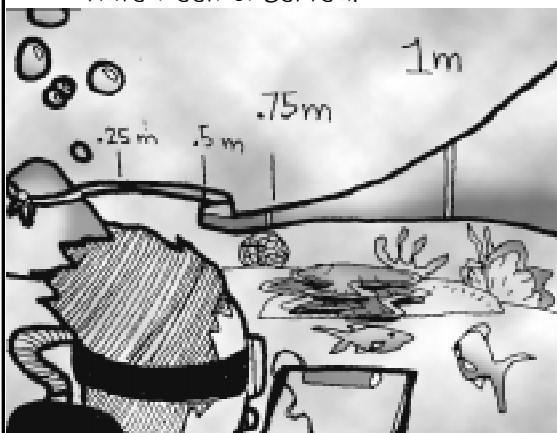
4

Starting at one end of the transect line, the observer identifies and tallies on the data form the benthic lifeform directly underneath each 0.25 m interval along the transect line.



5

Similarly, record the other stations in turn until all the planned stations have been observed.



6

Total the number of points under which each lifeform was observed and divide this by the total number of points observed to derive your estimate of percentage cover.

| LIFEFORMS | | |
|-----------|-----------------|---------------------|
| HC | LIVE HARD CORAL | - |
| SC | SOFT CORAL | - - - |

Example:

$$\frac{30 \text{ soft coral points}}{200 \text{ observed points}} = 15\% \text{ soft coral}$$

7

Classify the various transects according to your purpose for data summarization. For example:

- * reef zones or types (e.g. reef flat, reef slope, fringing reef, offshore reef, etc.),
- * time of sampling (e.g. year 1/dry season, year 1/wet season, year 2/dry season, etc.)
- * management or use zones (e.g. sanctuary, fishing grounds), and/or
- * intensity of impacts (e.g. high pollution, medium pollution, low pollution)

List the transects by groups along the upper portion of the Summary Form.

9

From the data forms per transect copy the percentages of each type of lifeform to the Summary Form.

| TRANSECT | 1 | 2 | 8 | 9 | 10 |
|------------------|----------|-----|-----|-----|----|
| TYPES/ GROUPS | SUBTOTAL | | | | |
| HC | 15% | 6% | 5% | 10% | |
| SC | 58% | 10% | 22% | 76% | |
| DC | | | | | |

11

Standardize sub-total by sample size. Divide the total percentages by the number of transects actually observed. Write this on the column for averages.

| TRANSECT | 1 | 2 | 8 | 9 | 10 | TOTAL | AVERAGE |
|------------------|----------|-----|-----|-----|----|-------|---------|
| TYPES/ GROUPS | SUBTOTAL | | | | | | |
| SOFT CORAL | 15% | 6% | 5% | 10% | | 36 | 9% |
| HARD CORAL | 58% | 10% | 22% | 76% | | 166 | 41.5% |

Example:

$$\frac{15\% + 6\% + 5\% + 10\%}{4 \text{ transects}} = 9\%$$

8

List the benthic lifeforms (by groups) along the left side of the Summary Form.

| DATA SUMMARY FORM | | | | | | | | | |
|-------------------|---------|---|---|----|--------|---|---|---|---|
| TRANSECT# | OUTSIDE | | | | INSIDE | | | | |
| | 1 | 2 | 8 | 10 | 4 | 5 | 6 | 7 | 8 |
| TYPE & GROUPS | | | | | | | | | |
| HC | | | | | | | | | |
| SC | | | | | | | | | |
| DC | | | | | | | | | |
| DCA | | | | | | | | | |
| TA | | | | | | | | | |
| MA | | | | | | | | | |
| CA | | | | | | | | | |
| TV | | | | | | | | | |

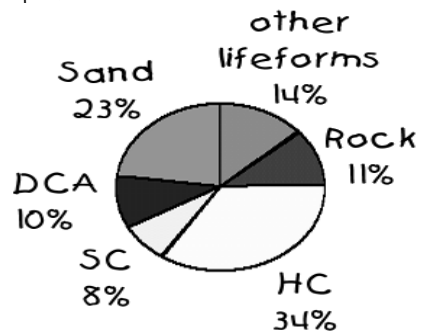
10

Sum sub-totals for each benthic lifeform for each transect group.

| SECT | 1 | 2 | 8 | 9 | 10 | TOTAL |
|------------------|----------|-----|-----|-----|----|-------|
| TYPES/ GROUPS | SUBTOTAL | | | | | |
| HC | 15% | 6% | 5% | 10% | | 36 |
| SC | 58% | 10% | 22% | 76% | | 166 |
| DC | | | | | | |

12

Draw pie charts for the average percentages of each transect group on the Benthos Form 4D Graph.





Sample Data Form 4A showing results of a 50-m transect using the snorkel survey method

| BENTHIC LIFEFORMS & INVERTEBRATES DATA FORM | | | | | | | Form 4A | | |
|--|-----------------------------------|--------------------|--|---|--|------------------------------|---|-----------------------------|---------------|
| Site Name: Gilutongan Marine Sanctuary | | | | Municipality & Province: Cordova, Cebu | | | | | |
| Transect No.: 1 Scuba: Snorkel: <input checked="" type="checkbox"/> | | | Coordinates: 10°12.701' N, 123°59.301' E | | | | | | |
| Date (mo/dy/yr): 11/4/99 | | | | Benthos observer: R. Amolo | | | Invertebrates observer: A. Diola | | |
| Horizontal water visibility (m): | | | | Depth (m): 3.5 m | | Reef zone: fore slope | | Topography: moderate | Slope: |
| Habitat notes: | | | | | | | | | |
| BENTHIC LIFEFORMS | | | Tally number of points or est. % occupied by each lifeform e.g. HLL-HLL-HLL or 12%+34%+22%+... | | | | Total Count | % Cover | |
| coral | HC live hard coral | 25 10 | 15 8 | 8 5 | 17 10 | 18 23 | 139 | 13.9% | |
| | SC soft coral | 0 10 | 0 15 | 0 5 | 5 0 | 0 0 | 35 | 3.5% | |
| dead coral | DC white dead coral | 0 0 | 3 0 | 0 0 | 0 5 | 0 0 | 8 | 0.8% | |
| | DCA dead coral w/ algae | 0 6 | 0 0 | 2 0 | 0 3 | 0 0 | 11 | 1.1% | |
| other animals | SP sponges | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 | 0% | |
| | OT other animals | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 | 0% | |
| plants | TA turf algae | 46 43 | 32 2 | 40 35 | 34 39 | 49 47 | 367 | 36.7% | |
| | MA fleshy macroalgae | 14 8 | 15 20 | 10 5 | 10 10 | 8 5 | 105 | 10.5% | |
| | CA coralline algae | 0 3 | 0 5 | 0 0 | 4 0 | 0 0 | 12 | 1.2% | |
| | SG seagrass | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 | 0% | |
| non-living | R rubble | 0 0 | 0 0 | 0 20 | 0 15 | 0 15 | 50 | 5% | |
| | RCK rock | 0 5 | 10 5 | 0 5 | 0 3 | 5 0 | 33 | 3.3% | |
| | S / SI sand/silt | 15 15 | 25 45 | 40 25 | 30 15 | 20 10 | 240 | 24% | |
| TOTAL | | | | | | | 1000 | 100% | |
| INVERTEBRATES | | # within 5-m width | | | Causes of coral damage: | | | | |
| <i>Diadema</i> urchins; <i>tuyom</i> | | 45 | | | Put x if found on corals. Circle the box of the dominant cause <input type="checkbox"/> sediment <input type="checkbox"/> seaweed overgrowth <input type="checkbox"/> blasting patterns <input type="checkbox"/> coral-eating snails <input checked="" type="checkbox"/> anchor damage <input type="checkbox"/> crown-of-thorns starfish <input type="checkbox"/> other breakage <input type="checkbox"/> plastics <input type="checkbox"/> bleaching <input type="checkbox"/> other trash <input type="checkbox"/> black band disease <input type="checkbox"/> other causes (specify): _____ <input type="checkbox"/> white band disease _____ <input type="checkbox"/> other coral disease _____ | | | | |
| Pencil urchin | | 0 | | | | | | | |
| Crown-of-thorns starfish; <i>dap-ag</i> | | 0 | | | | | | | |
| Giant clam; <i>taklobo</i> | | 0 | | | | | | | |
| Triton shell; <i>tambuli</i> | | 0 | | | | | | | |
| Lobster; <i>banagan</i> | | 0 | | | | | | | |
| Sea cucumber; <i>balat</i> | | 0 | | | | | | | |
| Banded coral shrimp | | 0 | | | | | | | |
| others | | 0 | | | | | | | |

DATA SUMMARY FORM

Form 4C

| | | | | | | | | | | | | | | | | | | | | | | |
|---|-------|-------|-------|-------|------------------|---|-------|-----|-------|---|-------------|------------------|-------|--|-------|-------|--------------|-------------|---|--|--|--|
| Site Name: Gilutongan Marine Sanctuary | | | | | | | | | | Municipality & Province: CORDOVA, CEBU | | | | | | | | | | | | |
| Zone/Sector: | | | | | Outside | | | | | Inside | | | | | | | | | | | | |
| Month & year: | | | | | November 1999 | | | | | November 1999 | | | | | | | | | | | | |
| Transect #: | | | | | 1 | 2 | 3 | 9 | 10 | | | | | | 4 | 5 | 6 | 7 | 8 | | | |
| Types/groups | | | | | Sub-total | | | | | Total | Avg. | Sub-total | | | | | Total | Avg. | | | | |
| Live hard coral | 44.0% | 28.0% | 56.5% | 41.0% | 15.3% | | 184.8 | 37% | 65.0% | 58.5% | 24.1% | 42.5% | 38.5% | | 228.6 | 45.7% | | | | | | |
| Soft coral | 0.0% | 0.0% | 0.0% | 0.0% | 0.5% | | 0.5 | 0% | 0.5% | 0.0% | 0.0% | 0.5% | 0.0% | | 1.0 | 0.2% | | | | | | |
| White dead coral | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | 0.0 | 0% | 0.0% | 0.0% | 4.0% | 6.5% | 1.0% | | 11.5 | 2.3% | | | | | | |
| Dead coral with algae | 4.0% | 5.0% | 9.0% | 7.0% | 2.6% | | 27.6 | 6% | 9.0% | 12.0% | 13.6% | 18.0% | 12.0% | | 64.6 | 12.9% | | | | | | |
| Sponges | 0.0% | 0.0% | 0.0% | 0.5% | 0.5% | | 1.0 | 0% | 2.0% | 1.0% | 1.5% | 2.0% | 1.0% | | 7.5 | 1.5% | | | | | | |
| Other animals | 0.0% | 0.0% | 0.0% | 0.0% | 0.5% | | 0.5 | 0% | 1.0% | 0.0% | 1.5% | 0.0% | 0.5% | | 3.0 | 0.6% | | | | | | |
| Turf algae | 0.0% | 0.0% | 7.5% | 0.0% | 0.0% | | 7.5 | 2% | 0.0% | 0.0% | 0.0% | 0.0% | 0.5% | | 0.5 | 0.1% | | | | | | |
| Fleshy macroalgae | 11.5% | 27.5% | 0.0% | 0.0% | 0.5% | | 39.5 | 8% | 0.0% | 0.0% | 0.0% | 0.5% | 0.0% | | 0.5 | 0.1% | | | | | | |
| Coralline algae | 0.5% | 0.0% | 0.0% | 0.0% | 0.5% | | 1.0 | 0% | 0.0% | 0.0% | 0.5% | 0.0% | 0.0% | | 0.5 | 0.1% | | | | | | |
| Seagrass | 0.0% | 0.0% | 0.0% | 0.0% | 2.6% | | 2.6 | 1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | 0.0 | 0.0% | | | | | | |
| Rubble | 6.0% | 9.5% | 6.5% | 5.0% | 0.5% | | 27.5 | 6% | 9.5% | 9.5% | 17.1% | 9.5% | 14.0% | | 59.6 | 11.9% | | | | | | |
| Rock | 14.5% | 15.0% | 9.5% | 4.0% | 6.6% | | 49.6 | 10% | 8.0% | 7.0% | 5.5% | 3.0% | 2.0% | | 25.5 | 5.1% | | | | | | |
| Sand/Silt | 19.5% | 15.0% | 11.0% | 42.5% | 69.9% | | 157.9 | 32% | 5.0% | 12.0% | 32.2% | 17.5% | 30.5% | | 97.2 | 19.4% | | | | | | |
| INVERTEBRATES | | | | | | | | | | | | | | | | | | | | | | |
| Diadema | 7 | 21 | 2 | 5 | 3 | | 38 | 7.6 | ? | 92 | 6 | 6 | ? | | 104 | 35 | | | | | | |
| Sea cucumber | 1 | 0 | 1 | 2 | 2 | | 6 | 1.2 | ? | 0 | 2 | 1 | ? | | 3 | 1 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |

Sample summary data showing the results of 10 50-m transects using the point-intercept method

BENTHOS GRAPHING FORM

Form 4D

Site Name: *Gilutongan Marine Sanctuary, Cordova, Cebu*

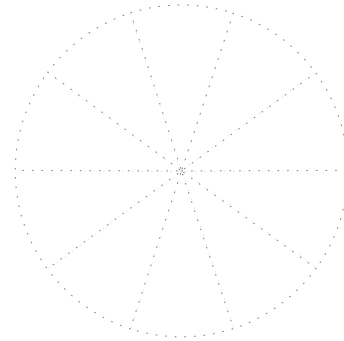
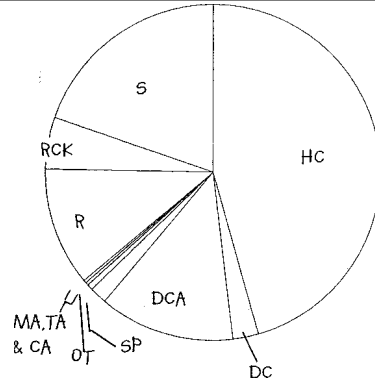
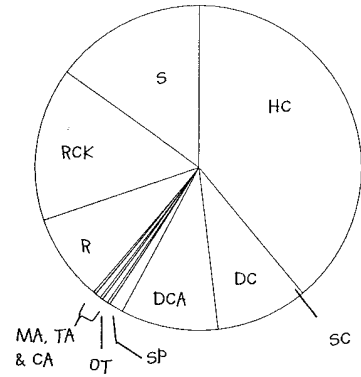
Municipality & Province: *CORDOVA, CEBU*

Month & year: *MARCH 1999*

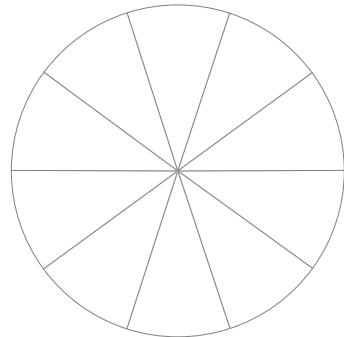
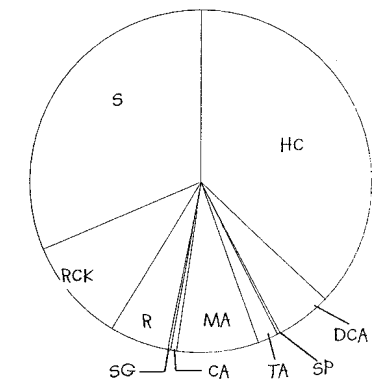
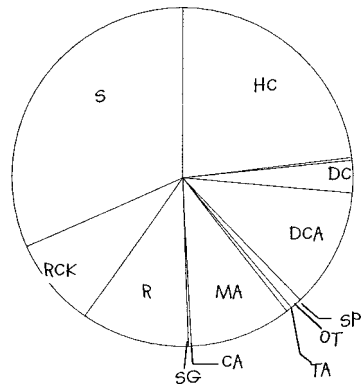
NOVEMBER 1999

Zone/Sector

INSIDE



OUTSIDE



See explanation of acronyms on Form 4A, p. 34.

Sample graphs showing the results of 10 transects at Gilutongan Marine Sanctuary, Cordova, Cebu

Learning Laboratory

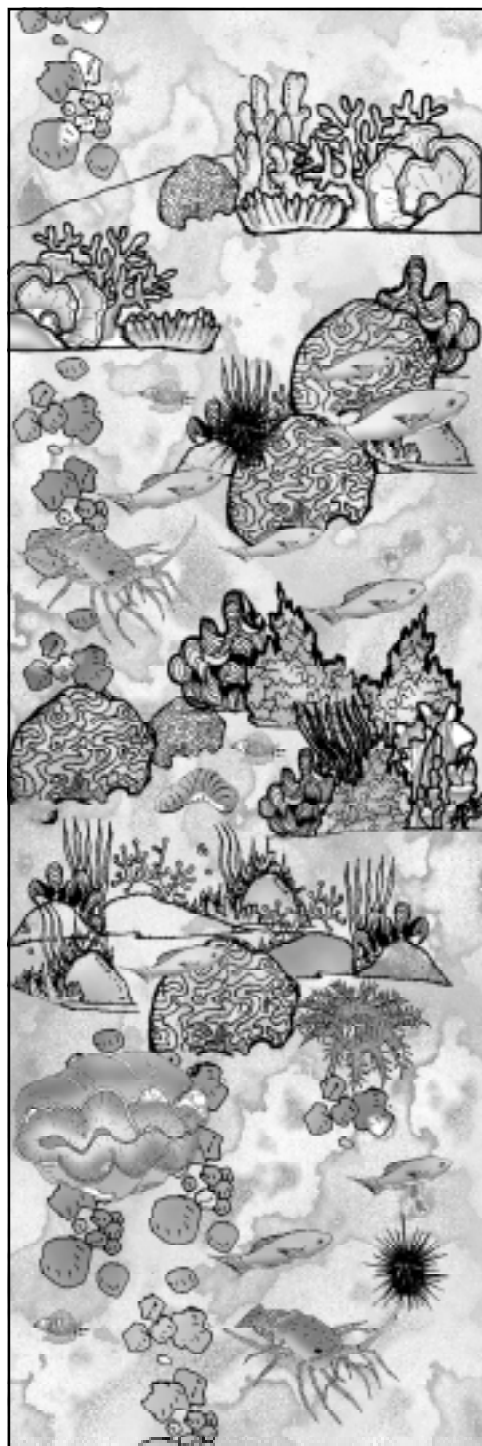
Using the sample pictures below, estimate the percentage of the area covered by each of the various things found within the transects. Use a ruler as your sample transect line to practice snorkel survey or point-intercept transect. Don't use a ruler/transect if practicing manta tow.



TRANSECT A



TRANSECT B



Trainer's Tips for Chapter 5

The method of estimating benthic cover while snorkeling described in the handbook is an untested hybrid of the manta tow developed and regularly used by the Australian Institute of Marine Science and the systematic snorkel developed and tested by White *et al.* (2000) with Earthwatch volunteers and other survey groups.

Transects are to be laid at a constant depth (except when one's particular interest is to have a cross-sectional sample through depths—even then it would be preferable to collect separate samples at different fixed depths). A depth contour is a line of constant depth on the bottom surface. If you encounter an obstacle when laying the line, go around (rather than above) it so as to keep the transect on a constant depth.

Review Questions

1. How do you tell the difference between a live hard coral and a dead hard coral?
2. How do you tell the difference between a hard coral and a soft coral?

Live hard corals are frequently pigmented. Dead hard corals are white and have no tissue. Hard corals with algae growing on them (not inside them) are almost always dead or dying.

OBSERVING REEF FISHES: FISH VISUAL CENSUS

6



Definition

Fish visual census is the identification and counting of fishes observed within a defined area.

Purpose

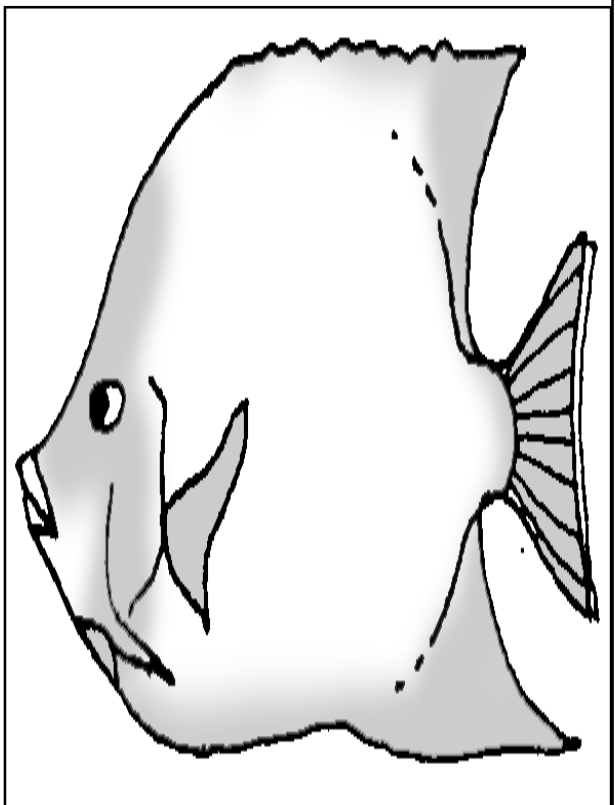
Fish visual census can be used to estimate the variety, numbers, and even sizes of common, easily-seen, easily-identified fishes in areas of good visibility. This information may reflect the health of the fish stocks within the surveyed coral reef areas.

Requirements

- Picture book of the animals (e.g. reef fishes) to be counted
- Goggles or mask and snorkel
- One or two 50-m lines each marked every 5 m
- Underwater slates with attached pencil

Optional

- Boat (depending on where the survey site is)
- Laminated fish identification guide (if observers are not familiar with the various fish types)
- Laminated butterflyfish identification guide (if indicator species are to be censused)
- Fins
- Life jackets

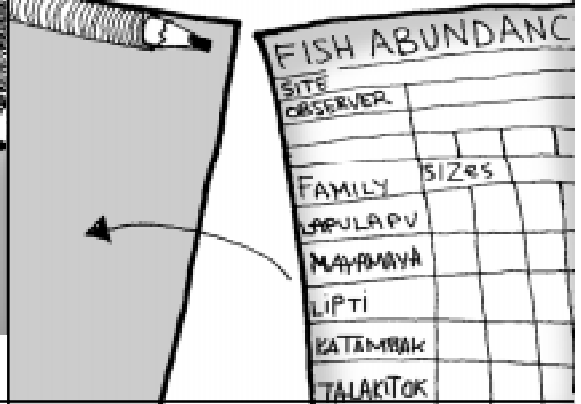


1

Select the sampling stations and fish types to be censused.

**2**

Copy the Data Form 5A onto the slates and draw columns for the different size classes.



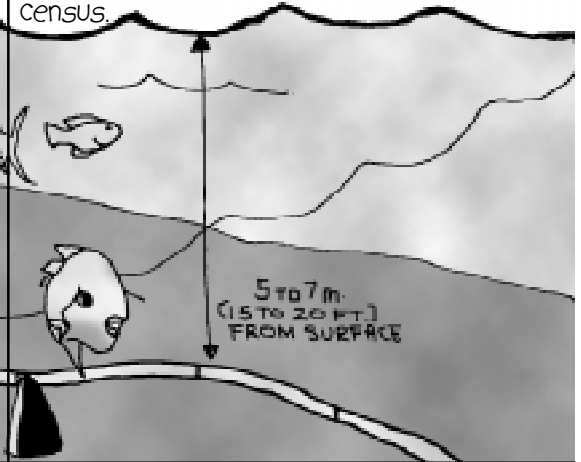
For each of the stations, do steps 2 to 6.

3

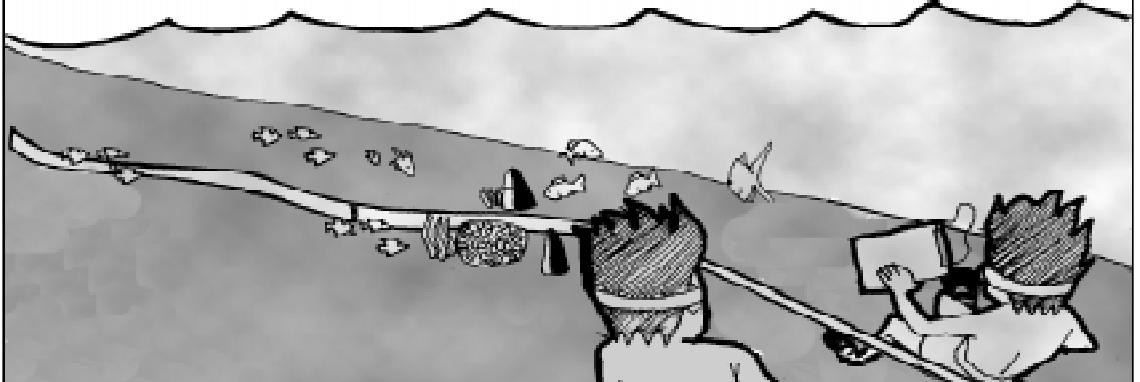
Lay the transect line on a constant depth contour. Record the depth.

**4**

Wait 10-15 minutes for the disturbed fishes to return. Be careful not to disturb the fishes during the census.

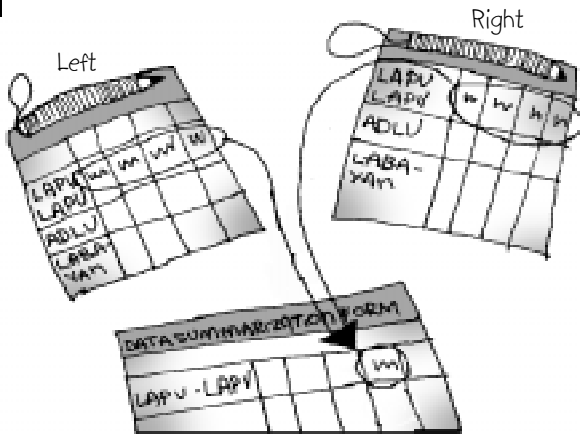
**5**

Starting at one end of the line, each observer floats on each side of the transect line while observing 5-m to his/her side of the transect and forward until the next 5-m mark.



9

Total the counts of the different size classes for each type of fish per transect.



10

Write these sub-totals onto the appropriate boxes on a copy of the summary form.

| TRANSECT | TRANSECT | TRANSECT | TRANSECT | TOTAL | AVERAGE |
|----------|----------|----------|----------|-------|---------|
| 1 | 2 | 3 | 9 | 10 | |
| 2 | 11 | 5 | | | |
| 4 | 7 | 8 | | | |
| 2 | 12 | 14 | | | |

11

Sum sub-totals for each fish type/group for each transect group.

Standardize the sub-total by sample size: Divide the total counts by the number of transects actually observed.

12

| SUB-TOTAL | | | | | | |
|-----------|----------|----------|----------|-------|---------|---|
| TRANSECT | TRANSECT | TRANSECT | TRANSECT | TOTAL | AVERAGE | |
| 1 | 2 | 3 | 9 | 10 | | |
| 2 | 11 | 5 | 3 | 5 | 36 | |
| 4 | 7 | 8 | 5 | 1 | 25 | 5 |
| 2 | 12 | 14 | 0 | 2 | 30 | 6 |



Example:

$$\frac{12 + 11 + 5 + 3 + 5}{5 \text{ transects}} = 7 \text{ fishes/transect}$$

13

Choose a few fish types of interest and list these along the left side of the Fish Graphing Form.

List the zone/sector, month, and year on the designated space on the form.

14

| GRAPHING FORM | | | | | | | | | |
|---------------|--|--|--|--|--|--|--|--|--|
| ZONE/SECTOR | | | | | | | | | |
| MONTH & YEAR | | | | | | | | | |
| TYPES/GROUPS | | | | | | | | | |
| LAPU | | | | | | | | | |
| LABU | | | | | | | | | |
| MAYA MAYA | | | | | | | | | |
| LIFTI | | | | | | | | | |

| GRAPHING FORM | | | | | | | | | |
|---------------|----|----|----|----|--------|----|--|--|--|
| OUTSIDE | | | | | INSIDE | | | | |
| ZONE/SECTOR | | | | | | | | | |
| MONTH & YEAR | 97 | 98 | 99 | 97 | 98 | 99 | | | |
| TYPES/GROUPS | | | | | | | | | |
| LAPU | | | | | | | | | |
| LABU | | | | | | | | | |
| MAYA MAYA | | | | | | | | | |
| LIFTI | | | | | | | | | |

15

Use the following guide to represent the average number of fishes observed in each zone/sector and month/year.

GRAPHING FORM

| | OUTSIDE | | | | INSIDE | | | |
|--------------|---------|----|----|----|--------|----|---|---|
| ZONE/SECTOR | | | | | | | | |
| MONTH & YEAR | 98 | 99 | 00 | 98 | 99 | 00 | | |
| TYPES/GROUPS | | | | | | | | |
| GROUPERS | ☉ | ☉ | ☉ | ☉ | ☉ | ☉ | ☉ | ☉ |
| SNAPPERS | ☉ | ☉ | | ☉ | ☉ | ☉ | | |
| SWEETLIPS | ☉ | ☉ | ☉ | ☉ | ☉ | | | |

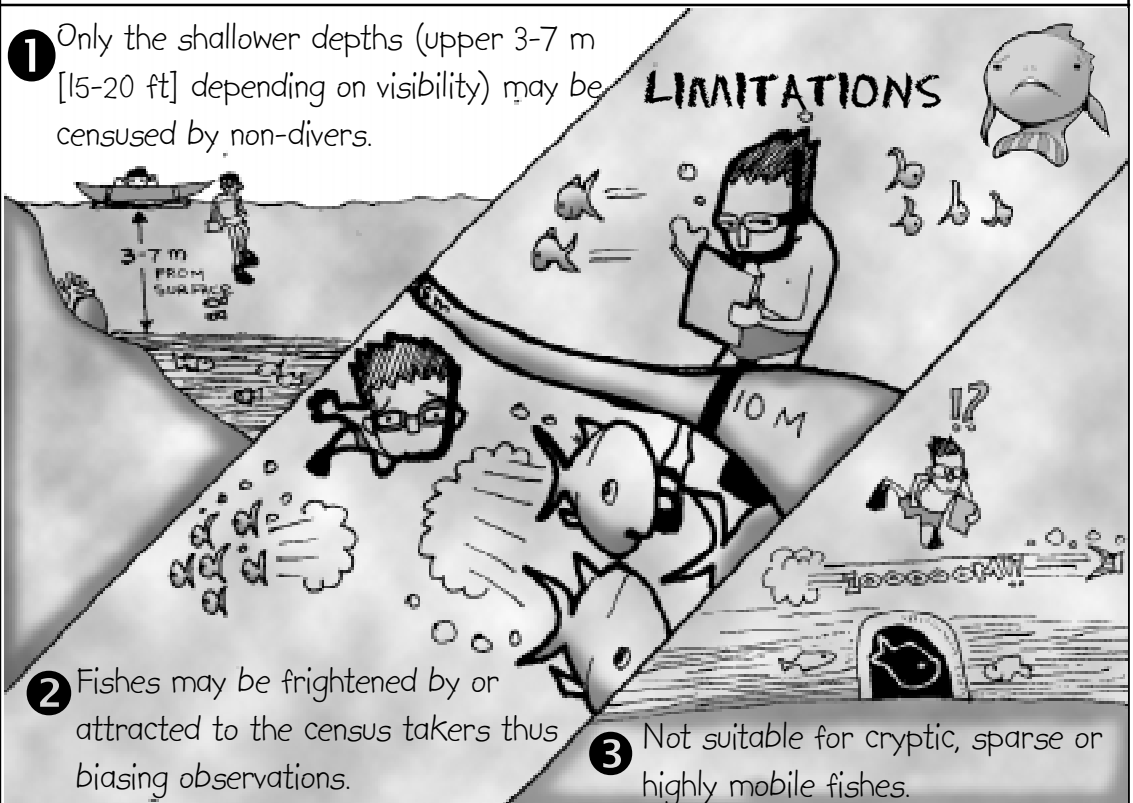
| NUMBER OF FISHES | PICTOGRAPH |
|------------------|------------|
| >0-5 | |
| >5-25 | |
| >25-125 | |
| >125-625 | |
| >625 | |



STRENGTHS

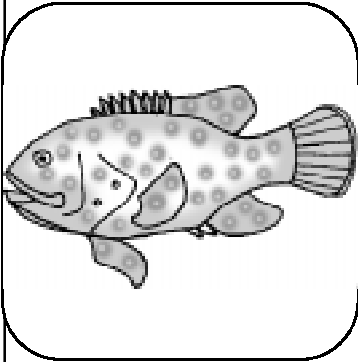
- Useful for simultaneously censusing many species
- Can also be used for other organisms like crown-of-thorns starfish and urchins.

- Only the shallower depths (upper 3-7 m [15-20 ft] depending on visibility) may be censused by non-divers.

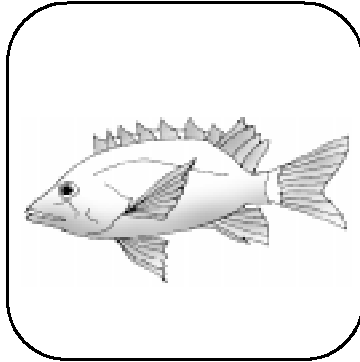


- Fishes may be frightened by or attracted to the census takers thus biasing observations.
- Not suitable for cryptic, sparse or highly mobile fishes.

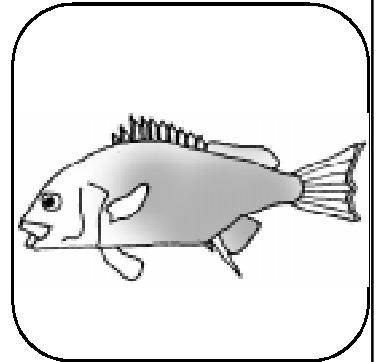
Common Reef



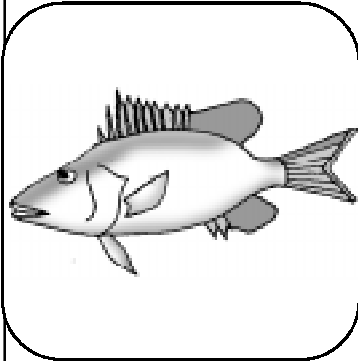
EPINEPHELINAE
groupers,
lapu-lapu, pogapo,
sono



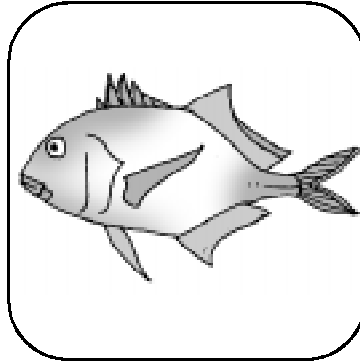
LUTJANIDAE
snapper,
katambak, awoman,
maya-maya, islawan



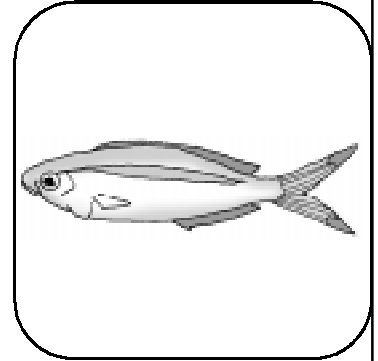
HAEMULIDAE
sweetlips, grunts,
lipti



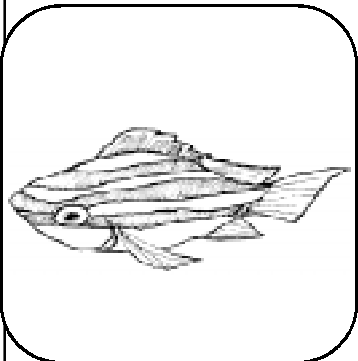
LETHRINIDAE
emperors,
katambak, dugso



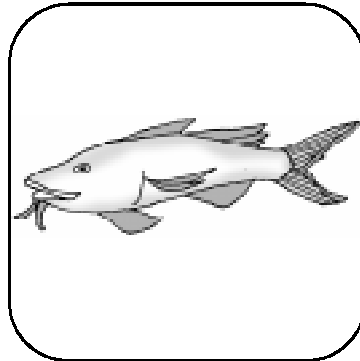
CARANGIDAE
jacks, trevallies,
talakitok, mamsa



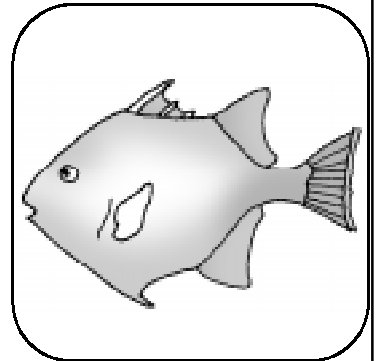
CAESIONIDAE
fusiliers,
dalagang-bukid, solid



NEMIPTERIDAE
coral breams,
silay

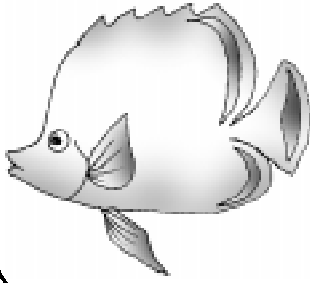


MULLIDAE
goatfish,
timbongan

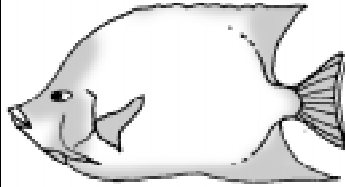


BALISTIDAE
triggerfish,
pakol, pugot

Fish Families



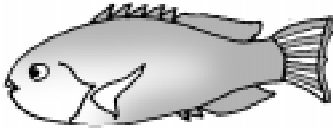
CHAETODONTIDAE
butterflyfish,
alibangbang,
pisos-pisos



POMACANTHIDAE
angelfish,
adlo



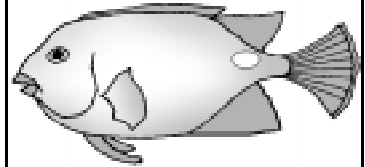
LABRIDAE
wrasses,
labayan



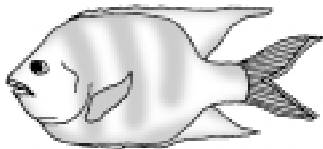
SCARIDAE
parrotfish,
molmol



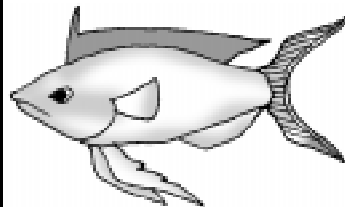
ACANTHURIDAE
surgeonfish,
indangan, labahita,
sunghan, bagis



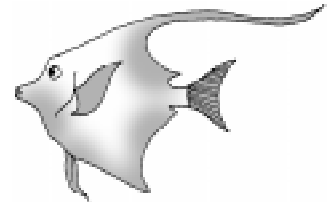
SIGANIDAE
rabbitfish,
danggit, kitong,
samaral



POMACENTRIDAE
damselfishes,
pata, kapaw, palata



ANTHIINAE
fairy basslets,
bilang-bilong



Zanclus cornutus
Moorish idol,
sanggowanding



Sample data for the Fish Abundance Data Form showing data from one transect

| FISH ABUNDANCE DATA FORM | | | Form 5A | | |
|--|---|--|------------------------|----------------------------|--------------------------|
| Site Name: TUKA I (BUFFER ZONE) | | Municipality & Province: Kiamba, Sarangani | | | |
| Transect No.: 10 | Depth (m): | Coordinates: 5°59.10' N, 124°36.71' E | | | |
| Date (mo/day/yr): 3/20/99 | Time: | Left observer: Ben Banquil | | Right observer: Andre U. | |
| Habitat notes: | | Horizontal visibility (m): 3.5 | Angle of slope: 15-20° | Transect orientation: East | |
| FAMILY | Species | Record number of fishes per size class | | | |
| | | 1-10 cm | 11-20 cm | 21-30 cm | specify sizes for >30 cm |
| <EPINEPHELINAE> groupers; lapu-lapu | | 2 | | | |
| | Barramundi cod; seniorita | | | | |
| <LUTJANIDAE> snappers; <i>maya-maya</i> | | 12 | | | |
| <HAEMULIDAE> sweetlips; grunts; <i>lipti</i> | | | | | |
| <LETHRINIDAE> emperors; <i>katambak</i> | | 1 | | | |
| CARANGIDAE jacks; trevallies; <i>talakitok</i> | | | | | |
| CAESIONIDAE fusiliers; <i>dalagang bukid</i> ; <i>solid</i> | | | | | |
| NEMIPTERIDAE coral breams; <i>silay</i> | | 4 | | | |
| MULLIDAE goatfishes; <i>timbangon</i> | | 7 | 2 | | |
| BALISTIDAE triggerfishes; <i>pakol</i> | | 11 | | | |
| CHAETODONTIDAE butterflyfishes; <i>alibangbang</i> | | 21 | | | |
| POMACANTHIDAE angelfishes; <i>adlo</i> | | | | | |
| LABRIDAE wrasses; <i>labayan</i> | | 26 | | | |
| | Humphead wrasse; <i>mameng</i> | | | | |
| [SCARIDAE] parrotfishes; <i>molmol</i> | | 4 | | | |
| | Bumphead parrotfish; <i>taungan</i> | | | | |
| [ACANTHURIDAE] surgeonfish; <i>indangan</i> | | 33 | | | |
| [SIGANIDAE] rabbitfishes; <i>kitong</i> ; <i>danggit</i> | | | 1 | | |
| [KYPHOSIDAE]* rudderfishes; <i>ilak</i> | | | 1 | | |
| POMACENTRIDAE damselfishes; <i>palata</i> | | 670 | | | |
| ANTHIIINAE fairy basslets; <i>bilang-bilong</i> | | 12 | | | |
| | <i>Zanclus cornutus</i> Moorish idol; <i>sanggowanding</i> | | | | |
| sharks | | | | | |
| rays | | | | | |
| sea turtles | | | | | |
| others | cardinal fish | 6 | | | |
| | filefish | 3 | | | |
| | soldierfish | 3 | | | |
| | flutemouth | | 1 | | |

Legend: <fishes> = major reef carnivores; [fishes] = major reef herbivores, **fishes** = fishes which are indicators of hard corals

DATA SUMMARY FORM

Form 5B

| Site Name: Tuka Reef (Barangay Poblacion) | | | | | | | | | | Municipality & Province: Kiamba, Sarangani | | | | | | | | |
|--|-----------|------|------|-----|------------|---|-------|-------|-----------|---|-----|-----|-----|---|-------|-------|--|--|
| Zone/Sector: | | | | | Outside | | | | | Inside | | | | | | | | |
| Month & year: | | | | | March 1999 | | | | | March 1999 | | | | | | | | |
| Transect #: | | | | | 1 | 2 | 3 | 9 | 10 | | | 4 | 5 | 6 | 7 | 8 | | |
| Types/groups | Sub-total | | | | | | Total | Avg. | Sub-total | | | | | | Total | Avg. | | |
| | | | | | | | | | | | | | | | | | | |
| Groupers | 5 | 0 | 2 | 3 | 2 | | 12 | 2.4 | 5 | 2 | 3 | 2 | 6 | | 18 | 3.6 | | |
| Snappers | 5 | 0 | 1 | 2 | 13 | | 22 | 4.4 | 3 | 7 | 4 | 1 | 1 | | 16 | 3.2 | | |
| Sweetlips | 1 | 0 | 0 | 1 | 0 | | 2 | 0.4 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | | |
| Emperors | 0 | 0 | 2 | 0 | 1 | | 3 | 0.6 | 16 | 0 | 5 | 1 | 1 | | 23 | 4.6 | | |
| Jacks | 0 | 0 | 1 | 2 | 0 | | 3 | 0.6 | 0 | 0 | 1 | 10 | 1 | | 12 | 2.4 | | |
| Fusiliers | 13 | 0 | 0 | 35 | 0 | | 48 | 9.6 | 0 | 0 | 1 | 0 | 0 | | 1 | 0.2 | | |
| Spinecheeks | 1 | 0 | 2 | 14 | 4 | | 21 | 4.2 | 12 | 0 | 14 | 3 | 2 | | 31 | 6.2 | | |
| Goatfishes | 22 | 18 | 21 | 36 | 9 | | 106 | 21.2 | 7 | 23 | 16 | 5 | 0 | | 51 | 10.2 | | |
| Triggertfishes | 33 | 20 | 41 | 36 | 11 | | 141 | 28.2 | 9 | 15 | 21 | 34 | 27 | | 106 | 21.2 | | |
| Butterflyfishes | 82 | 43 | 54 | 49 | 24 | | 252 | 50.4 | 21 | 55 | 50 | 24 | 58 | | 208 | 41.6 | | |
| Angelfishes | 26 | 16 | 21 | 15 | 0 | | 78 | 15.6 | 9 | 45 | 20 | 12 | 4 | | 90 | 18 | | |
| Wrasses | 69 | 65 | 83 | 272 | 26 | | 515 | 103 | 30 | 619 | 239 | 64 | 128 | | 1080 | 216 | | |
| Parrotfishes | 11 | 8 | 0 | 2 | 4 | | 25 | 5 | 2 | 12 | 13 | 2 | 51 | | 80 | 16 | | |
| Surgeonfishes | 122 | 74 | 44 | 118 | 43 | | 401 | 80.2 | 61 | 215 | 227 | 33 | 264 | | 800 | 160 | | |
| Rabbitfishes | 5 | 0 | 1 | 0 | 0 | | 6 | 1.2 | 1 | 10 | 9 | 2 | 2 | | 24 | 4.8 | | |
| Damselfishes | 1032 | 1157 | 1420 | 617 | 670 | | 4896 | 979.2 | 868 | 972 | 686 | 662 | 439 | | 3627 | 725.4 | | |
| Fairy basslets | 13 | 18 | 3 | 45 | 12 | | 91 | 18.2 | 4 | 1 | 12 | 9 | 1 | | 27 | 5.4 | | |
| Moorish idol | 3 | 2 | 2 | 6 | 0 | | 13 | 2.6 | 1 | 12 | 11 | 0 | 3 | | 27 | 5.4 | | |
| Cardinal fishes | 76 | 0 | 0 | 0 | 6 | | 82 | 16.4 | 3 | 0 | 2 | 2 | 1 | | 8 | 1.6 | | |
| Filefishes | 3 | 0 | 7 | 0 | 3 | | 13 | 2.6 | 0 | 0 | 0 | 7 | 2 | | 9 | 1.8 | | |
| Soldier fishes | 38 | 1 | 9 | 0 | 3 | | 51 | 10.2 | 9 | 0 | 10 | 0 | 10 | | 29 | 5.8 | | |
| Hawkfishes | 3 | 2 | 0 | 0 | 1 | | 6 | 1.2 | 0 | 0 | 5 | 0 | 0 | | 5 | 1 | | |

Sample summary data of fish abundance from 10 transects in Tuka, Kiamba, Sarangani

FISH GRAPHING FORM

Form 5C

Site Name: Tuka Reef

Municipality & Province: Kiamba, Sarangani

Zone/Sector:

Outside

Outside

Outside

Inside

Inside

Inside

Month & Year:

Oct. 1998

Mar. 1999

Apr. 2000

Oct. 1998

Mar. 1999

Apr. 2000

Types/groups

Groupers



Snappers



Sweetlips



Jacks



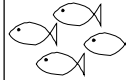
Fusiliers



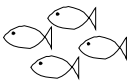
Parrotfishes



Surgeonfishes



Rabbitfishes



ample graph using pictographs
of fish abundance

Learning Laboratory

Write the local names for each of the various fish species in each fish family. Learn the English family name for that family. Do this for each of the fish families on the Data Form.



| Picture | Local Names | English Family Name |
|---------|-------------|---------------------|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |
| 4. | _____ | _____ |
| 5. | _____ | _____ |
| 6. | _____ | _____ |
| 7. | _____ | _____ |
| 8. | _____ | _____ |
| 9. | _____ | _____ |
| 10. | _____ | _____ |

Trainer's Tips for Chapter 6

Explain that species that are closely related are grouped into families.

Be careful not to disturb the fishes before and during the census. So, detailed benthos monitoring (this does not include manta towing) should be done after the fish census.

Check accuracy of count and size estimates. Fish dummies of different lengths may be used to train observers to estimate fish lengths underwater. Count estimates by the local team and by the trainers should not differ by more than one log₅ abundance category (on page 43).

Some ways to collect more detailed information:

- 1. Fish Length Observation.** Estimating the fish size to the nearest cm or inch is particularly effective for assessing marketable food species. However, close attention must be paid to standardizing the length estimates and adjusting the tendency for objects to look larger underwater than in reality. Prior to using this variation, the team must practice estimating underwater with fish models of known lengths. Even though having only one observer yields more consistent results, having a team is more sustainable and participatory.
- 2. Indicator Butterfly Species.** Approximately half the species of butterflyfishes feed almost only on corals and so the number and variety of butterflyfishes is sometimes used as an indicator of the health and biodiversity of a coral reef. Simply list the kinds (species) of butterflyfishes observed on the transect and report this on Form 5D.

Other sampling units (e.g. 7-m radius cylinders) other than 50-m transects are also used by other visual census practitioners. When comparing your data with data from others using different sizes of transects, convert all their data to the same sampled volume (e.g. 2,500 m³) first.

Review Questions:

1. If our marine fishery reserve is managed properly, what do you expect will happen to the fish counts inside the reserve? What about fish counts outside?
2. What should you use to estimate the width of the transect to be observed?

Trainer's Tips for Chapter 7

Invertebrates are counted over a 250 m² area while fishes are counted over a 500 m² area. You must convert the counts to density to make them comparable. For example, if 5 groupers were counted in a 500 m² area and 10 *Diadema* urchins were counted over a 250 m² area:

$$\frac{5 \text{ groupers}}{500 \text{ m}^2} \times \frac{10,000 \text{ m}^2}{1 \text{ hectare}} = \frac{100 \text{ groupers}}{\text{hectare}}$$

$$\frac{10 \text{ urchins}}{250 \text{ m}^2} \times \frac{10,000 \text{ m}^2}{1 \text{ hectare}} = \frac{400 \text{ urchins}}{\text{hectare}}$$

OBSERVING INVERTEBRATES

7



Definition

Invertebrate census is the identification and counting of animals without backbone (vertebrae) observed within an area of interest.

Purpose

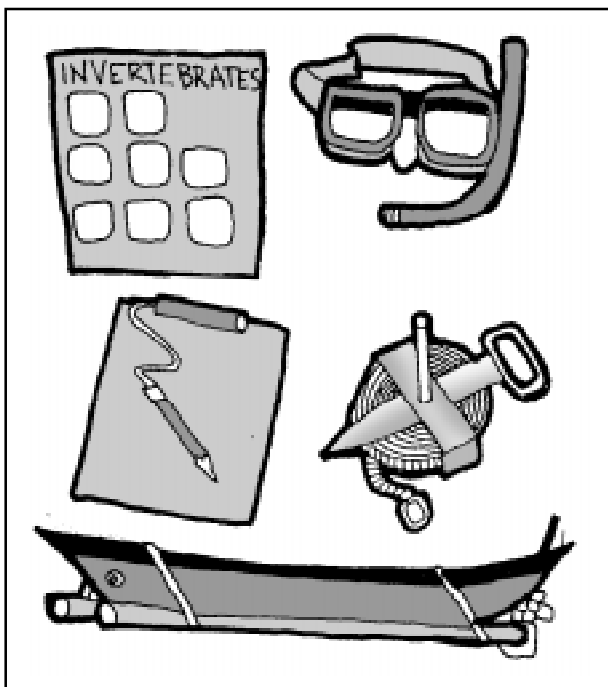
Invertebrate census can be used to estimate the numbers of non-cryptic invertebrates in areas of good visibility (although many invertebrates hide during the day). This information may reflect the health of the coastal resource stocks as well as the extent of invertebrate collection in the area.

Requirements

- Pictures of the animals (see next page) to be counted
- Goggles or mask & snorkel
- 50-m transect line marked every 5 m
- Underwater slates with attached pencil

Optional

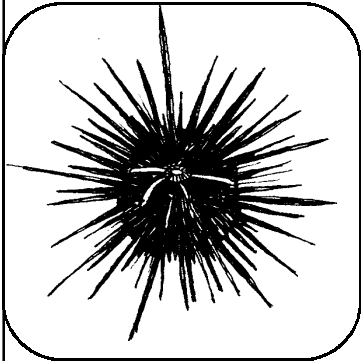
- Boat (depending on where the survey site is)



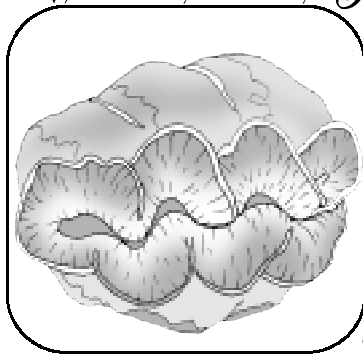
Step-by-step Procedure

Simply use the procedure for monitoring fish but count invertebrates instead (use Form 4A to record data and Form 5C to graph data). Look for invertebrates under overhangs and inside crevices. Sizes of invertebrates may or may not be recorded or monitored.

Invertebrates to be observed

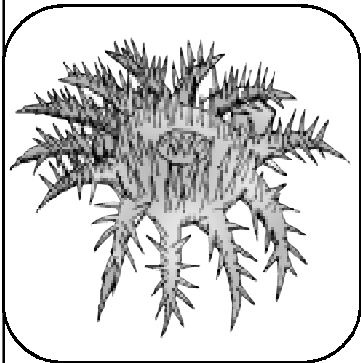


DIADEMA URCHIN
tuyom, para-para

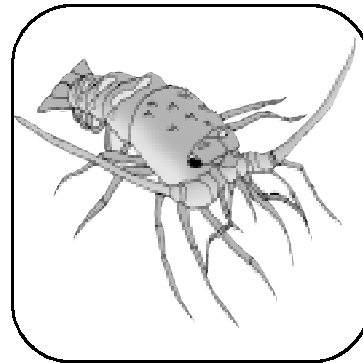


GIANT CLAMS
taklobo

Since invertebrates are not as mobile as fishes, 5-m transect width is used instead of 10-m transect width (total area sampled is 250 m²)



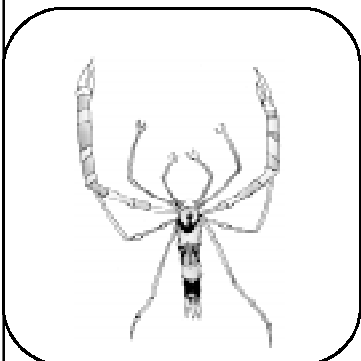
CROWN-OF-THORNS STARFISH
dap-ag, salamay



LOBSTER
banagan



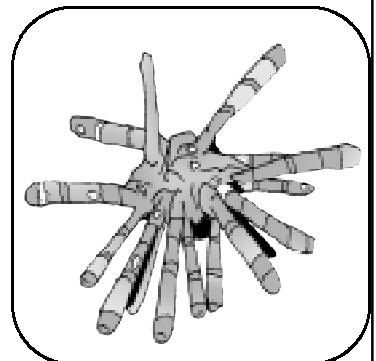
TRITON
tambuli



BANDED CORAL SHRIMP



SEA CUCUMBER
balat



PENCIL URCHIN

OBSERVING HUMAN ACTIVITIES AND NATURAL DISTURBANCES

8



Definition

This procedure is simply one suggested way to quantify various human & natural variables that may be influencing the observed reef community. Other ways may be to simply (1) note presence or absence of various stresses or threats to the reef on a checklist or to just (2) jot down notes which catch the attention of the monitoring team.

Purpose

Human activities, whether beneficial or harmful, and natural disturbances (e.g. storms) are major influences on coral reefs. Noting down some of these may help us explain our observations of the reef environment and resources. Specifically, the observed changes in the reef community through time may be graphed parallel to the changes of relevant human and natural variables through the same time period. Refer to Chapter 4 (Drawing Up a Monitoring Plan) for a list of factors that tend to influence specific community elements.

Requirements

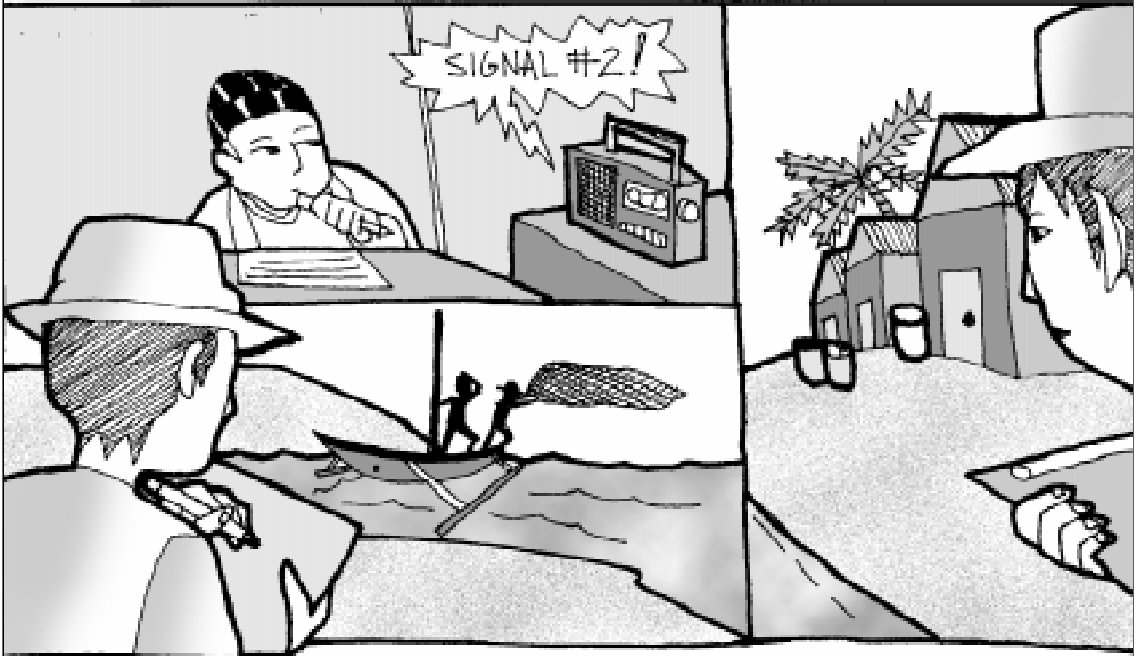
- Data form
- Map of the area
- Resource person(s) / key informant(s) familiar with the area
- Municipal ordinances and other laws relevant to the coastal area

Optional

- Camera
- Binoculars

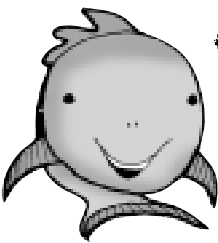


Go to the area of interest and fill out the boxes on the data form with the appropriate estimates. You may base these estimates on your own observations, interviews with key informants and/or through consensus among a group of people familiar with the area.



Many human and natural stresses and threats are not readily observable in the few days of formal field monitoring time per season. Organize a logbook where coastal watchers and/or marine protected area guards will regularly record such observations (e.g. violations of the sanctuary, fishing or tourism activities in the area, oil slicks, storms, etc.).

Photographs of the same areas taken once a year would also be very useful!



STRENGTHS

- 1 Quantified scores facilitate comparison of data sets from different areas
- 2 A checklist of things to observe lessens the possibility of missing important items to take note of.

LIMITATION

Unique features and/or the history of stress/management of the area may be missed.



Sample data from Port Barton Marine Park, San Vicente, Palawan

SITE DESCRIPTION AND DETAILS FORM

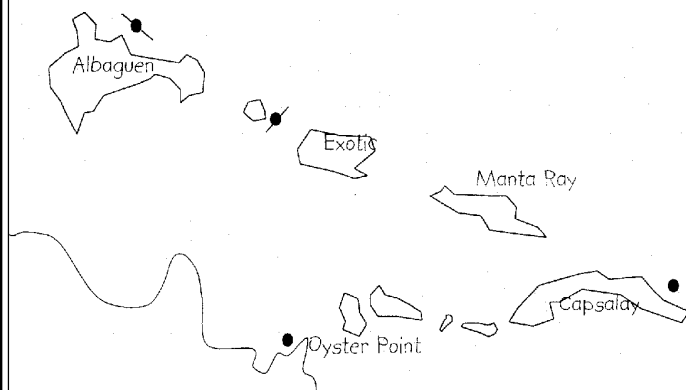
Form 2A

| | |
|---|--|
| Site Name: Port Barton Marine Park | Municipality & Province: San Vicente, Palawan |
| Reason for choosing to monitor this site: It is a marine protected area | Overall Documentor: V. Bungabong |

SURVEY/MONITORING SITE DETAILS

| Transect No. | [Capsalay] | [Exotic] | [N. Albaguen] | [Oyster Pt.] | [Middle Reef] |
|---|--|---------------------------|---------------------------|---------------------------|---------------------------|
| Fish abundance observers | B. Francisco / H. Arceo | B. Francisco / H. Arceo | B. Francisco / H. Arceo | B. Francisco / H. Arceo | B. Francisco / H. Arceo |
| Benthic lifeforms observers | C. Calagui / V. Bungabong | C. Calagui / V. Bungabong | C. Calagui / V. Bungabong | C. Calagui / V. Bungabong | C. Calagui / V. Bungabong |
| Start date (mo/day/year) | 5/7/99 | 5/7/99 | 5/7/99 | 5/7/99 | 5/8/99 |
| Start time (am/pm) | 9:40 AM | 11:40 AM | 2:10 PM | 4:20 PM | 12:45 PM |
| Latitude (e.g. 9°23.012') | 10°27.547' | 10°29.429' | 10°30.301' | 10°27.090' | 10°27.054' |
| Longitude (e.g. 112°34.781') | 119°10.987' | 119°09.075' | 119°08.423' | 119°07.496' | 119°07.487' |
| Transect orientation (e.g. N, NE, ...) | | | | | |
| Depth (in m) | 6.0 | 4.5 | 4.5 | 6.0 | 6.0 |
| Reef zone (e.g. fore slope, flat, etc.) | slope | slope | flat | slope | flat |
| Is the site sheltered or exposed? | sheltered | sheltered | sheltered | sheltered | exposed |
| Approx. steepness of site (angle of slope) | -25-30° | -10-15° | <10° | 70° | <10° |
| Topographic complexity (in m) | medium | medium | medium | mod. high | mod. low |
| Horizontal visibility (in m by transect line) | 10-15 | 10-15 | 10-15 | 10-15 | 10-15 |
| Vertical visibility (in m by secchi depth) | 5.0 | 4.5 | 4.5 | 6.0 | 6.0 |
| End date (mo/day/year) | 5/7/99 | 5/7/99 | 5/7/99 | 5/7/99 | 5/8/99 |
| End time (am/pm) | 10:20 AM | 12:25 PM | 3:10 PM | 4:50 PM | 1:25 PM |
| Weather | Sunny [<input checked="" type="checkbox"/>] Cloudy [<input type="checkbox"/>] Rainy [<input type="checkbox"/>] Windy [<input type="checkbox"/>] | | | | |
| Temperature: (not taken) | Air [<input type="checkbox"/>] Water surface [<input type="checkbox"/>] 3-m depth [<input type="checkbox"/>] 10-m depth [<input type="checkbox"/>] | | | | |

Sketch map or reef and coastline showing transect locations and other features



Coordinates from map [] or GPS []

If GPS, specify map datum:
WGS 84

HUMAN ACTIVITIES & NATURAL DISTURBANCES FORM

Form 2B

| A. FISHING | % or # | Notes |
|---|--|---|
| # fishing boats observed w/in 500 m | 1 | |
| # aquarium fishers w/in 500 m | 0 | |
| # invertebrate gleaners w/in 500 m | 0 | |
| # blasts heard during the dive | 0 | |
| % area used for mariculture w/in 500 m | 1 | near Oyster Point |
| B. POLLUTION | % or # | Notes |
| Distance to nearest pop. center (in km) | | depends to which specific transect |
| Population of pop. center (in thousands) | 4,000 | |
| # factories per km of adjacent coast | 0 | |
| Distance to nearest river (in km) | | depends to which specific transect |
| % farmed area of coastline | 0 | |
| % forested area of coastline | 88%-90% | |
| # mines within sight | 0 | |
| # items of floating trash observed | 1 | plastic bottle |
| # items of trash observed underwater | 1 | old fish trap |
| # fish nets left as trash | 5-10 | at Black Coral |
| C. OTHER STRESSES & THREATS | % or # | Notes |
| # boats anchoring within 500 m | >4 boats | at Exotic Beach only; 5-6 picnickers or more per boat |
| # divers observed within 500 m | 0 | |
| # dive shops within 10 km | 1 | |
| Years since last typhoon (>100 kph) | <1 | Typhoon Norming, 11 December 1998 |
| # large ships within sight | 0 | |
| % of coast built-up with structures | 1 | Just at main village center |
| Years since last mass bleaching | 1 | April to May 1998 |
| % bleached coral area | 0 | none now; already recovered |
| % diseased coral area | 0 | |
| MANAGEMENT OF AREA | Is this a legally protected area? Yes | |
| Name of Marine Protected Area: Port Barton Marine Park (additional regulations have been proposed) | Organization responsible: Albaguen Fishermen's Association | |
| Describe restrictions herein: No fishing or gathering of marine organisms and diving in core zones (Albaguen, Exotic, Manta Ray and Haines Reef) | | |
| Ordinance No. & Year: Ordinance 1997-03, Jan. 6, 1999 | Start date of protection by law: Jan. 6, 1999 | |
| Date boundaries were marked: April 26, 1999 | Date patrols/enforcement began: | |
| Coordinates of protected area boundaries: 119°8'13.03"E, 10°29'50.19"N Albaguen 119°9'5.62"E, 10°29'50.19"N Exotic 119°8'29.73"E, 10°30'19.48"N Haines Island | | |

MONITORING FISH CATCH



Definition

Fish catch monitoring is the systematic collection of standardized information about fish catch, fishing gear, fishing effort/time, and fishing grounds.

Purpose

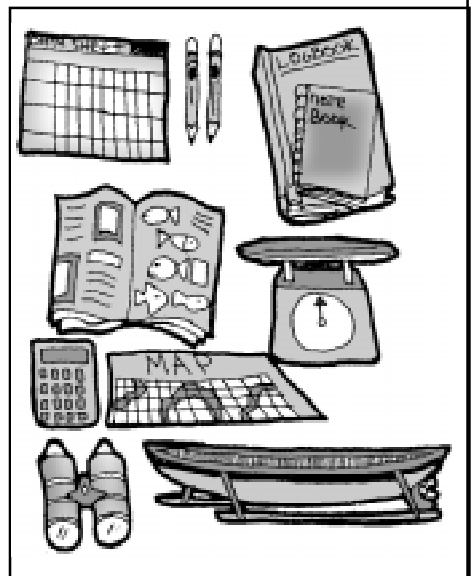
Catch data can be used to help determine if, when, and where fish catches are increasing or decreasing. These changes may be due to management practices (e.g. properly protected sanctuary vs. rampant illegal fishing) or natural causes.

Requirements

- Data forms and pencils
- Logbook or notebook
- Fish identification materials (picture book)
- Resource map (with grids, habitats, and use zones marked)
- Weighing scale preferably that which can measure from 0.1 to 10 Kg (or whatever is available or used locally for measurement)
- Calculator

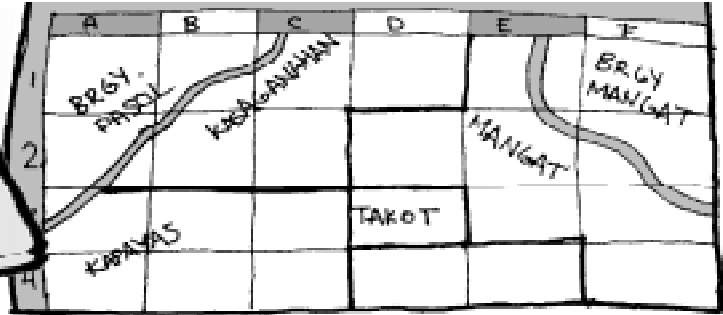
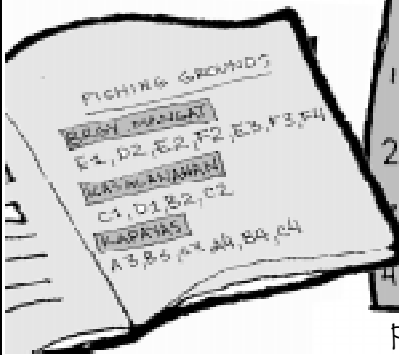
Optional

- Binoculars & boat (depending on the distance of the fishing grounds from the shore)



1

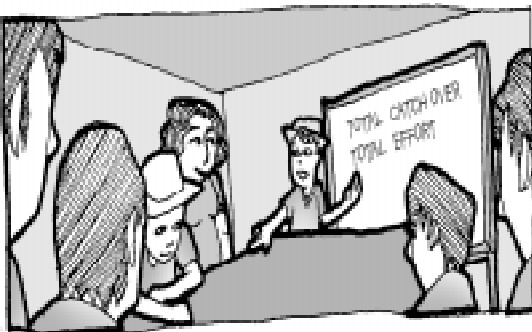
List in a logbook or notebook a) the locations of fishing grounds, b) the different types of fishing gear, and c) the fishes of interest to the area or to the group of fishers. These lists will be used as the standard lists for data entry and analysis.



Plot the names of the fishing grounds on the gridded map.

2

Discuss the concepts of 'Catch per unit Effort', 'Total Fishing Effort', 'Total Catch' and look at sample catch monitoring outputs.

**3**

Fill out the gear survey form (Form 6A). Multiply the number of people using each gear type by the typical effort per person to get an estimate of the Total Fishing Effort of the village.

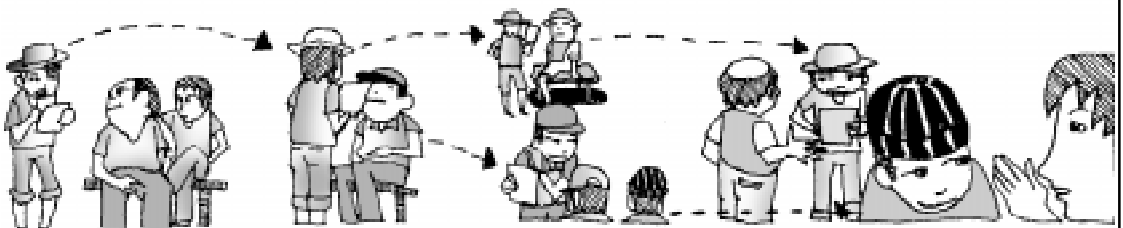


For some gear types, it may sometimes be more useful to use the number of gear units (e.g.traps) rather than time as the measurement of fishing effort.

4

Plan how to get data to compute Catch per unit Effort per gear type.
 Catch per unit Effort = $\frac{\text{total catch}}{\text{total person-hours or total units of gear}}$

The data may be gathered by:

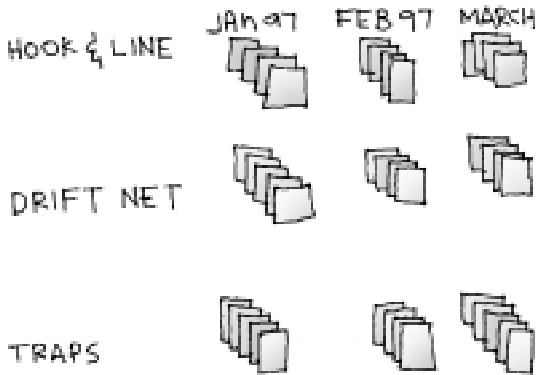


a. A team member collecting catch information (Form 6B) once a week, or...

b. many individual fishers voluntarily recording their own catches 5 times per month & submitting their forms (Form 6C) every month.

5

Collect all forms and sort according to gear type and month.



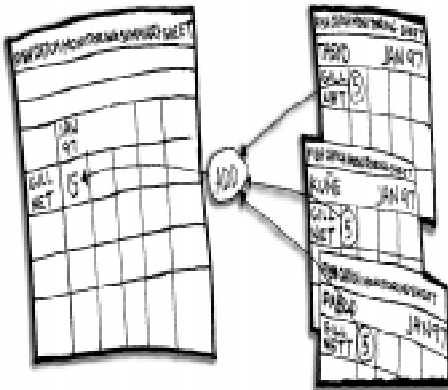
6

List down zone/sector and month year on the upper portion of the Summary Form and write the gear types on the left side of the Summary Form.

| FISH CATCH MONITORING FORM | | | | | | | | | | | | |
|----------------------------|--------|--------|--------|--------|--|--|--|--|--|--|--|--|
| ZONE/SECTOR | | | | | | | | | | | | |
| MONTH/HR | Jan 97 | Feb 97 | Mar 97 | Apr 97 | | | | | | | | |
| | kg/hr | kg/hr | kg/hr | kg/hr | | | | | | | | |
| FISHING GEAR | | | | | | | | | | | | |
| GILL NET | | | | | | | | | | | | |
| BUBO | | | | | | | | | | | | |
| PANA | | | | | | | | | | | | |

7

Compute the Total Catch per gear type per month for the data sample.



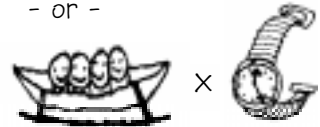
8

Compute Total Effort per gear type per month for the data sample.



Total Effort = total # of units of gear

- or -



Total Effort = # of fishers x time spent fishing

9

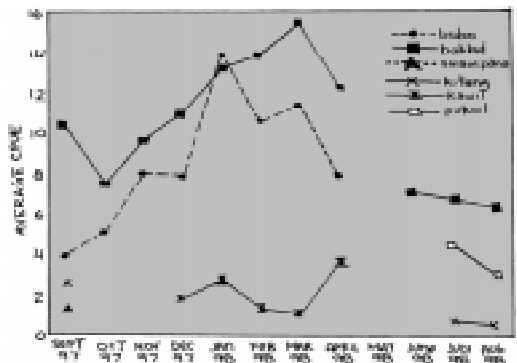
Compute Catch per unit Effort (CPUE) for each gear type per month.

$$\text{Catch per unit Effort} = \frac{\text{total catch (from step \#7)}}{\text{total effort (from step \#8)}}$$

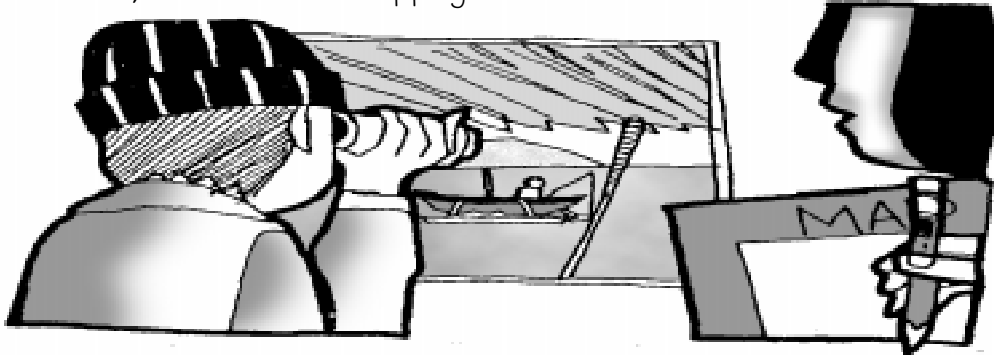


10

Using the gear, catch and effort data, plot Catch per unit Effort per gear type through months from the data in the Summary Form.



Most of the time, fishing grounds are not exclusive to particular communities. To get a better estimate of the total catch for the village waters, conduct Gear Mapping.



Gear mapping may be used by more advanced communities.

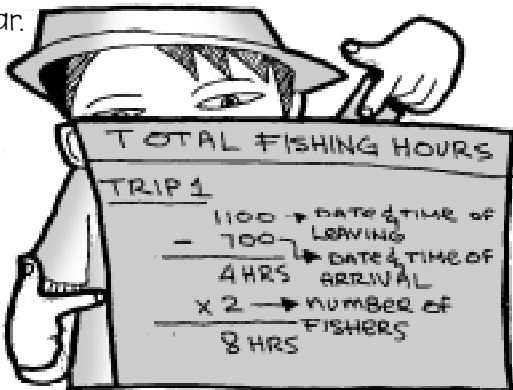
11

Based on the Gear Survey Form, get the peak hours per gear type.



13

Compute the Total Effort in village waters by multiplying the observed number of fishers per gear type by the typical number of hours spent using that gear.



12

From these peak hours select one hour with the most gear types to observe the village waters. Write how many fishers are seen using what gear type per grid box.

| | | | | | | |
|---|----------|------|------|------|------|------|
| | A | B | C | D | E | F |
| 1 | SP-UPPER | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP |
| 2 | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP |
| 3 | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP |
| 4 | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP | 2 SP |

14

To get Total Catch, multiply CPUE (from Step 9) with Total Effort (from Step 3 or Step 13).

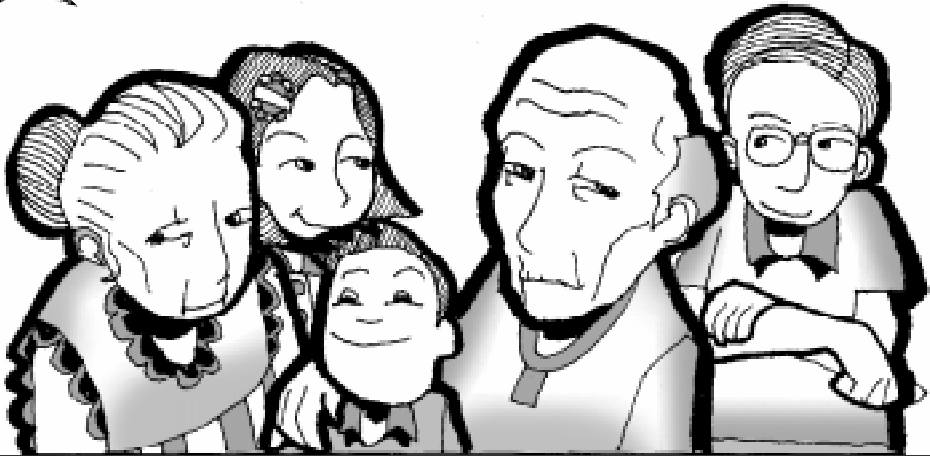
$$\text{Total Effort in village waters (Step 9)} \times \text{TOTAL CPUE (Step 13)} = \text{TOTAL CATCH in village waters}$$

$$\text{CPUE (Step 9)} \times \text{Total Effort of village fishers (Step 3)} = \text{TOTAL CATCH of village fishers}$$



STRENGTH

Nearly anyone can be involved and help.



LIMITATIONS

1 Some fishers may not want to cooperate because of misconceptions about the objectives of the monitoring and/or selfish interests. This may bias the results.




It may be difficult to locate the fishing grounds on maps (due to their distance from shore, the lack of landmarks, and/or the lack of maps).



A lot of data may be needed before trends are revealed.

| GEAR SURVEY FORM | | | | | | | Form 6A | | | |
|--------------------------------|---|----------------------------------|-------------------------------|--|-----------------------------------|--|------------------------------------|---|--|--|
| Site Name: Poblacion 13 | | | | Municipality & Province: Tingloy, Batangas | | | | | | |
| Date (month/day/year): 7/14/97 | | | | | | | | | | |
| Type of fishing gear | # of persons in village using gear type | # of motor boats using gear type | Typical # of persons per boat | Months when gear is typically used | Hours when gear is typically used | Fishing grounds (use grid letter in map) | Where is catch sold (which market) | Type(s) of fish usually caught | # of persons from whom information was collected | |
| hook and line | 12 | 0 | 1 | All year | 0700-1800 | G | Pob. 13 market | groupers, coral breams, rainbow runner | 4 | |
| gillnet | 8 | 1 | 6-7 | All year | 1900-2230 | G, H, M, N, O, P | Pob. 13 market | fusiliers, needlefish, mackerel | 4 | |
| push net (sakag) | 4 | 2 | 2 | May-July | 0700-1800 | G, H, M | Pob. 13 market | herring fry | 4 | |
| traps | 3 | 0 | 2-3 | All year | 24 hr | G | Pob. 13 market | grouper, damselfish, sea bream, triggerfish | 4 | |
| | | | | | | | | | | |
| | | | | | | | | | | |


 Sample Gear Survey Form with
 data from Poblacion 13,
 Tingloy, Batangas

FISH CATCH MONITORING FORM FOR DATA COLLECTION TEAMS

Form 6B

Name: Patricio Semante

Village/Barangay: Lomboy, Calape, Bohol

Collect catch data once per week. Be sure to record the trip even if nothing was caught (record '0' in the weight).

Use one line per kind of fish. Use more than one line per fishing trip if needed.

| Type of fishing gear | # Fishers in boat | Fishing ground (use grid letter in the map) | Time & date of departure | Time & date of arrival | Number of gear units | Kind of fish caught | Weight (kg) |
|----------------------|-------------------|---|--------------------------|------------------------|----------------------|---------------------|-------------|
| | | | | | | | |
| corral | 1 | B4 | 9/5/97 7:00 AM | 9/5/97 8:00 AM | 1 | rabbitfish | 0.8 |
| corral | 1 | B4 | 9/6/97 6:00 AM | 9/6/97 7:00 AM | 1 | rabbitfish | 1 |
| corral | 1 | B4 | 9/7/97 6:00 AM | 9/7/97 7:00 AM | 1 | rabbitfish | 0.5 |
| corral | 1 | B5 | 10/24/97 7:00 AM | 10/24/97 8:00 AM | 1 | catfish | 0.5 |
| | | | | | | rabbitfish | 4.5 |
| corral | 1 | B4 | 10/24/97 7:00 AM | 10/24/97 8:00 AM | 1 | rabbitfish | 2.5 |
| | | | | | | mojarra | 0.5 |
| corral | 1 | B4 | 10/25/97 7:00 AM | 10/25/97 8:00 AM | 1 | rabbitfish | 0.5 |
| | | | | | | mojarra | 0.5 |
| double net | 2 | C2 | 9/16/97 11:00 AM | 9/16/97 5:00 PM | 1 | rabbitfish | 3 |
| double net | 2 | B5 | 9/17/97 1:00 PM | 9/17/97 5:00 PM | 1 | parrotfish | 3 |
| double net | 2 | B5 | 9/18/97 4:00 PM | 9/18/97 5:00 PM | 1 | parrotfish | 2 |
| | | | | | | rabbitfish | 1 |
| double net | 3 | C3 | 10/24/97 9:00 AM | 10/24/97 4:00 PM | 1 | rabbitfish | 2 |
| double net | 2 | C3 | 10/24/97 1:00 PM | 10/24/97 5:00 PM | 1 | rabbitfish | 5 |
| double net | 2 | C3 | 10/27/97 7:00 AM | 10/27/97 1:00 PM | 1 | rabbitfish | 2 |
| spear | 1 | B2 | 9/1/97 3:00 PM | 9/1/97 4:00 PM | 1 | parrotfish | 1 |
| | | | | | | unicornfish | 2 |
| spear | 1 | D3 | 9/15/97 12:00 AM | 9/15/97 5:00 AM | 1 | octopus | 1.1 |
| spear | 1 | C6 | 9/16/97 2:00 AM | 9/16/97 5:00 AM | 1 | octopus | 2 |
| spear | 1 | C6 | 9/19/97 7:00 PM | 9/19/97 12:00 PM | 1 | octopus | 1 |
| | | | | | | assorted fish | 2 |
| spear | 1 | C2 | 10/24/97 9:00 AM | 10/24/97 11:00 AM | 1 | rabbitfish | 1.5 |
| | | | | | | grouper | 0.5 |
| spear | 1 | C2 | 10/26/97 7:00 AM | 10/26/97 8:00 AM | 1 | parrotfish | 1 |
| spear | 1 | B2 | 10/30/97 2:00 PM | 10/30/97 3:00 PM | 1 | unicornfish | 2.5 |



Sample data for Fish Catch
Monitoring in Lomboy, Calape, Bohol



Sample Fish Catch Monitoring Form with data from Lomboy, Calape, Bohol

FISH CATCH MONITORING FORM FOR INDIVIDUAL FISHERS

Form 6C

Site/Village/Barangay: Lomboy

Month & Year/Buwan at Taon: Nov. 1997

List down at least 5 fishing days per month (e.g. once a week). Be sure to record the trip even if nothing was caught (record '0' in the weight). Magtala ng hindi bababa sa limang araw ng pangangisda sa bawat buwan. Siguraduhin na magtala pa rin kahit walang nahuli sa paglaot [magtala pa rin ng '0' sa timbang (kilos)].

| | | Record catch per fishing trip | | | | |
|---|--|-------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | 1 | 2 | 3 | 4 | 5 |
| Date & time of leaving Petsa at oras ng paglabas | | 11/02/97 10:00 PM | 11/08/97 7:00 PM | 11/19/97 10:00 PM | 11/24/97 3:00 AM | 11/27/97 1:00 AM |
| Fishing gear Uri ng pamamalakaya | | spear w/ light | spear w/ light | spear w/ light | spear w/ light | spear w/ light |
| # Fishers in boat Bilang ng tao sa bangka | | 1 | 1 | 1 | 1 | 1 |
| Fishing ground (use grid letter on map) Lugar na pinangisdaan | | B3 | B3 | B3 | D2 | B3, D2 |
| Weather condition, tide and sea state Kumusta ang panahon, hunas/taob at alon | | sunny calm | sunny calm | sunny calm | cloudy rough | sunny calm |
| Date & time of return Petsa at oras ng pagbalik | | 11/03/97 3:00 AM | 11/08/97 10:00 PM | 11/20/97 3:00 AM | 11/24/97 6:00 AM | 11/27/97 6:00 AM |
| CATCH Huli | Kinds of fish caught Mga uri ng nahuli | Weight Timbang | Weight Timbang | Weight Timbang | Weight Timbang | Weight Timbang |
| | octopus | 5.5 | | 2 | | |
| | parrotfish | | 3 | 1 | 1.5 | 1 |
| | rabbitfish | | | | | 2 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| TOTAL CATCH (kilograms) Pangkalahatang huli (kilos) | | 5.5 | 3 | 3 | 1.5 | 3 |

Circle each date that you went out to fish. Bilugan ang bawat petsa na ikaw ay nangisda.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Trainer's Tips for Chapter 9

Catch monitoring is quite laborious so there should be a well-defined need for these detailed data. If only general information on the local fisheries is needed, only some or other participatory methods (e.g. group discussions with key informants) may be more appropriate.

Take special time and effort to make sure that trainees understand the implications of the catch per unit effort equation. By knowing 2 out of the 3 variables, the 3rd variable may be estimated. For example, to estimate the total catch (which in practice can almost never be actually observed), you can multiply the catch per unit effort by your estimate of the total effort.

Warning on local names

Many different fish species/fishing grounds/fishing gear may be referred to by the same local name. Many different local names may also refer to the same species, area or gear. When using local names, make sure that the local names are distinct for each of the different objects you want to distinguish by adding an adjective/modifier to the local name.

CPUE, total catch, and total effort may be summarized (not only through time) but also by each of the grids on the fishing grounds. This way you can determine if catches near the fishery reserve are increasing more quickly than catches away from the reserve.

Fishers from other areas may fish in the area being monitored while local fishers may fish outside the area of interest.

Fish length monitoring

It may sometimes be useful to monitor the average lengths of certain fish species prized by fishers.

- Ask the team to select a few indicator or representative fish species to monitor.
- Demonstrate to the volunteers how to measure fish in the standard way (from the tip of the snout to the peduncle of the tail).
- Once per week, measure the lengths of a random sample of 10-20 individuals (from various batches of fishes caught) of the species being monitored. The average length (through time) of the fish species being monitored can also be plotted on the billboard.
- Groupers (*Plectropomus*, *Cephalopholis*), parrotfishes (*Scarus*), snappers (*Lutjanus*), and/or jacks (*Caranx*) might be possible fishes to measure when monitoring coral reef reserves.

The team must decide beforehand which of the following measurements of effort they are interested in (those marked with * are preferred):

- a) * both the number of gear units (e.g. fish traps) & the time spent fishing or
- b) only the time spent fishing is to be recorded
and
- a) * the total time spent fishing or
- b) the total time spent fishing and traveling to the fishing area
... and record data accordingly.

Review Questions

1. If our marine fishery reserve is managed properly, what do you expect will happen to the fish catch near the reserve? How might fishers who now fish in far waters benefit in the future?
2. Since we cannot collect data on all the catch taken from the village waters, what data can we use to estimate the total catch of the village waters?

INTERPRETING OBSERVATIONS

10★



Relating various observations with each other and with ideas/theories/concepts about how other similar systems operate can help us understand the processes in the observed system.

For accuracy, compile all data before team members separate! Summarize and feedback for validation as soon as possible.

Requirements

- Completed summary forms and graphs of the Manta Tow, Benthos Transect, Fish And Invertebrate Visual Censuses, and Fish Catch observations
- Completed data forms for Human Activities and Natural Disturbances observations
- Crayons or colored pencils



1 Use the various summary and data forms to fill out the Correlation Table.

Review each result again.

2 Look for and note down possible trends.

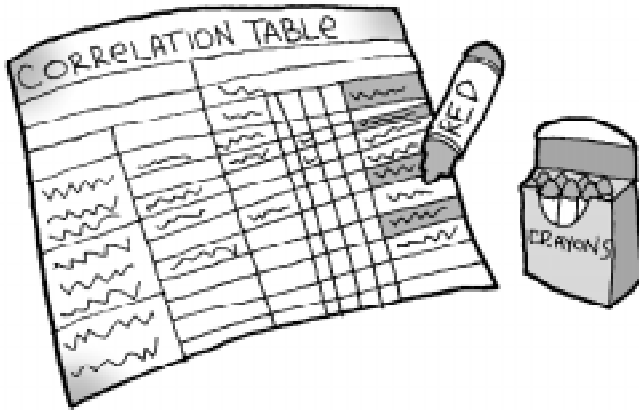
What constitutes a trend?

- consistent increase
- consistent decrease
- increase or decrease at regular intervals (for example, seasonally; look at the pattern of your graph)

3 Look for and note down relationships of variables.

Some things may tend to increase or tend to decrease together. Others may act in opposite ways; that is, one thing increases whenever the other thing decreases.

4 Use a colored pencil or crayon to mark things with opposite trends with different colors on the Correlation Table.



For example,

- things which are increasing may be marked with warm colors—reds and oranges;
- things which are decreasing might be marked with cool colors—blues and greens.

5 See to it that things which seem to increase and/or decrease together are marked with the same or similar colors on the Correlation Table.

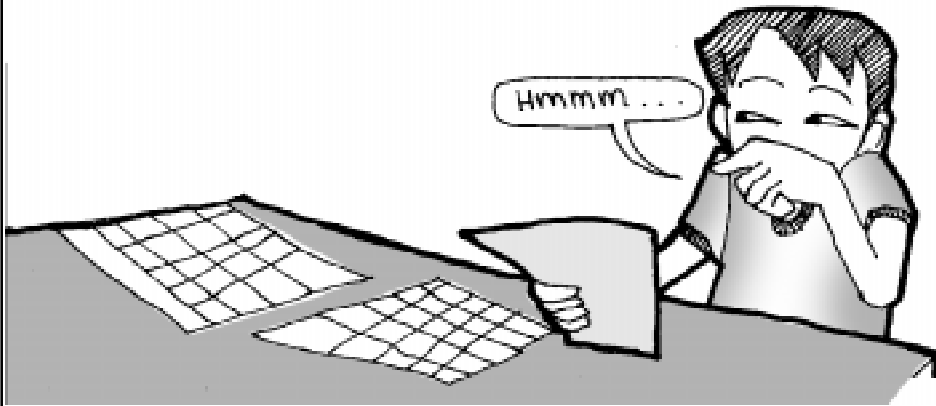


6 Look for potential problems or issues in the Correlation Table and note these down for later discussion (see Evaluation & Action).



6

Look for improving trends in the Correlation Table and try to see whether they are related to improvements in management.



STRENGTH May reveal patterns of change and/or relationships between things that may not have been considered.

LIMITATION

Similar or opposite behavior of things observed does not necessarily mean that one causes the change in the other.

Trainer's Tips for Chapter 10

Correlation is the relationship between things which tend to change together in a way not on the basis of chance alone. Positive correlation is when things increase and/or decrease together. Negative correlation is when one thing increases whenever one thing decreases.

Objects that increase or decrease in the same manner might have a cause-effect relationship or may just both be reacting to still another object (e.g. environment) in the same manner.

Data are represented into pictographs, pie charts, line graphs, and the like to make them easy to understand and remember.

CORRELATION TABLE

Form 7

Site Name: Brgy. Flores fish reserve

Municipality & Province: Baybay, Catanduanes

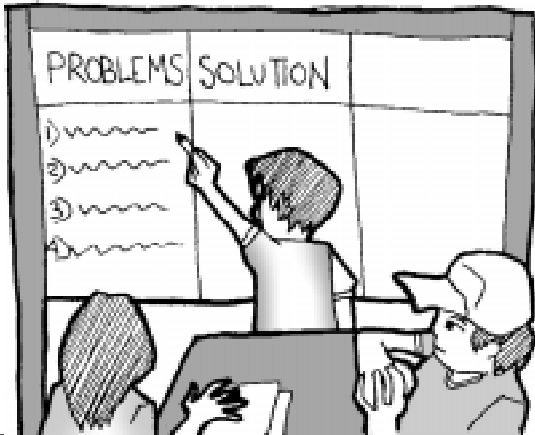
Period covered (mo/day/yr): May 1997 to May 1999

Zone/Sector: outside MPA

| INDICATORS | units | potential problem if... | Year I | | | Year II | | | Year III | | | Trend observed |
|-------------------------------------|---------------------|-------------------------|-----------------|------------------|----|-----------------|-------------------|----|-----------------|-------------------|---|----------------|
| | | | a | b | c | a | b | c | a | b | c | |
| FISH (Carangidae+Caesionidae) | average count | decrease | 5 ¹ | 0 ¹ | 0 | 35 ¹ | 30 ¹ | 20 | 11 ¹ | 6 ¹ | 4 | |
| FISH (Lutj+Leth+SEpin+Haem) | average count | decrease | 6 ¹ | 5 ¹ | 4 | 9 ¹ | 8 ¹ | 7 | 10 ¹ | 9 ¹ | 8 | inc. |
| LOBSTER | average count | decrease | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| GIANT CLAMS | average count | decrease | | 0 ¹ | | | 1 ¹ | | | 0 ¹ | | |
| TRITON | average count | decrease | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| CROWN-OF-THORNS | average count | increase | | 0 ¹ | | | 7 ¹ | | | 1 ¹ | | |
| OVERHARVESTING/OVERFISHING | no. of fishers obs. | increase | | 12 ¹ | | | 10 ¹ | | | 15 ¹ | | |
| CORALS (Hard & Soft) | average % cover | decrease | | 26 ¹ | | | 22 ¹ | | | 19 ¹ | | dec. |
| FISH (Chaetodontidae) | average count | decrease | 18 ¹ | 15 ¹ | 13 | 13 ¹ | 10 ¹ | 8 | 6 ¹ | 4 ¹ | 3 | dec. |
| DEAD CORAL (w/ or w/o ALGAE) | average % cover | increase | | 2 ¹ | | | 4 ¹ | | | 10 ¹ | | inc. |
| RUBBLE | average % cover | increase | | 8 ¹ | | | 5 ¹ | | | 6 ¹ | | |
| DESTRUCTIVE FISHING | evidence of blasts | increase | | 3 ¹ | | | 1 ¹ | | | 0 ¹ | | dec. |
| ANCHOR DAMAGE | overturned corals | present | | x ¹ | | | x ¹ | | | ✓ ¹ | | |
| STORMS | no. of strong ones | high | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| TOURISM | no. of resorts | >med or inc. | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| ALGAE (turf+macroalgae) | average % cover | increase | | 12 ¹ | | | 18 ¹ | | | 23 ¹ | | inc. |
| FISH (Balistidae+Tetradontidae) | average count | decrease | 0 ¹ | 0 ¹ | 0 | 0 ¹ | 0 ¹ | 2 | 0 ¹ | 0 ¹ | 0 | |
| FISH (Scar+Acan+Kyph) | average count | decrease | 35 ¹ | 30 ¹ | 25 | 15 ¹ | 11 ¹ | 10 | 12 ¹ | 10 ¹ | 8 | dec. |
| URCHINS | average count | large change | | 20 ¹ | | | 4 ¹ | | | 3 ¹ | | dec. |
| ALGAL OVERGROWTH | occurrence | common | | 6 ¹ | | | 8 ¹ | | | 9 ¹ | | |
| AGRICULTURAL/FARMED AREA | % of coastline | > low or inc. | | 30 ¹ | | | 40 ¹ | | | 45 ¹ | | inc. |
| POPULATION | | high | | 16,000 | | | 18,000 | | | 20,000 | | inc. |
| TRASH/GARBAGE (total) | no. observed | present | | 6 ¹ | | | 30 ¹ | | | 42 ¹ | | inc. |
| MARICULTURE | % area | high | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| SAND/SILT | average % cover | increase | | 17 ¹ | | | 13 ¹ | | | 15 ¹ | | |
| RIVER | distance | near | | 3km ¹ | | | 13km ¹ | | | 13km ¹ | | |
| VISIBILITY (horizontal & vertical) | in meters | decrease | | 15 ¹ | | | 12 ¹ | | | 8 ¹ | | dec. |
| FORESTED AREA | % of coastline | decrease | | 10 ¹ | | | 2 ¹ | | | 0 ¹ | | |
| COASTAL STRUCTURES BUILT-UP | % of coastline | > low or inc. | | 5 ¹ | | | 5 ¹ | | | 8 ¹ | | inc. |
| SHIPPING | no. of large ships | > 3-5 | | 0 ¹ | | | 0 ¹ | | | 1 ¹ | | |
| MINING POLLUTION | no. observed | present | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| INDUSTRIAL POLLUTION | no. of factories | > low or inc. | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| MASS BLEACHING | % cover | > 20% | | 0 ¹ | | | 10 ¹ | | | 0 ¹ | | |
| DISEASED CORALS | % cover | > 20% | | 0 ¹ | | | 0 ¹ | | | 0 ¹ | | |
| FISH KILLS & other mass deaths | | present | | x ¹ | | | x ¹ | | | x ¹ | | |
| Crown-of-thorns, algae, urchins,... | average count | rapid inc. | | | | | | | | | | algae inc. |
| OTHER REMARKS: | | | | | | | | | | | | |

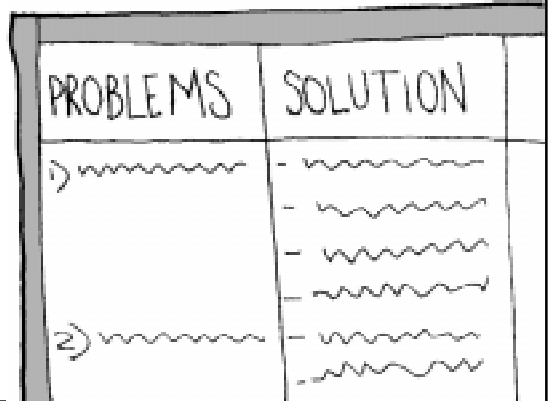
1

List potential problems/issues identified in the Correlation Diagram.



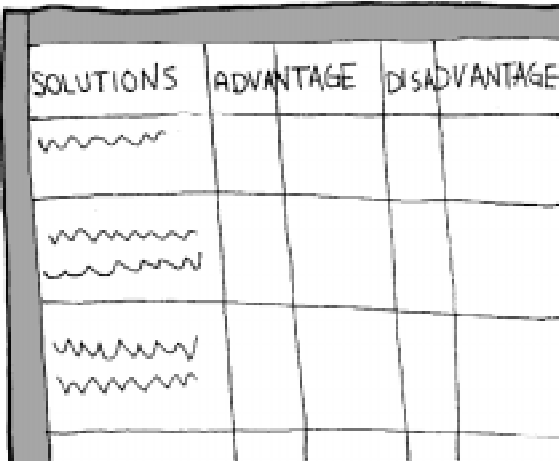
2

Generate as many as possible solutions for each problem/issue.



3

Get the top 5 solutions & write down their advantages & disadvantages.



4

Choose which solution to implement.



5

Implement the possible solution.



6

Monitor and evaluate the progress.

| ACTION | TARGET DATE | STATUS | |
|-----------------------------|--------------|--------|-----------|
| | | OK | DOCUMENTS |
| PUBLIC CONSULTATION | JUNE 11 1999 | ✓ | |
| LOBBYING FOR ORDINANCE | JUNE 15 1999 | ✓ | |
| MARKING OF SANCTUARY BORDER | DEC 1999 | | |
| ORGANIZATION OF ENFORCEMENT | JAN 1999 | | |

SOME STRATEGIES

On this page are some suggested strategies to address problems identified on the Correlation Table.

| PROBLEM | STRATEGY/METHOD |
|--|--|
| Overfishing | Harvest Regulations (Marine Protected Area/Zoning, Seasonal closure, Gear restriction, Species restriction), Patrolling & Enforcement, Reseeding (e.g. Sea-Ranching) |
| Destructive fishing | Education, Patrolling & Enforcement, Harvest Regulations (Marine Protected Area/Zoning, Seasonal closure, Gear restriction, Species restriction) |
| Pollution (garbage & sewage) | Waste collection (& proper disposal system), Recycling |
| Pollution (agricultural & sediments) | Mangrove reforestation, Watershed revegetation, Organic farming, Crop rotation, Education |
| Pollution (mining & industrial) | Lobbying for waste reduction, detoxification, and redirection |
| Reef damage from tourism activities | Education, Mooring buoys, Patrolling & Enforcement, Marine Protected Area/Zoning |
| Coastal construction | Lobbying for impact reduction measures and relocation |
| Storms, global warming, mass bleaching, & other natural disturbances | Reduce man-made stresses (other problems above) to enable the environment to recover more easily |

On the following pages the above strategies are further described...

| STRATEGY/METHOD | STRATEGY/METHOD | PURPOSE/WHEN TO USE |
|--|---|--|
| CONSERVATION: Regulation & Enforcement | | |
| Marine Protected Area/Zoning | Closing an area to some uses; Assigning areas for other uses | To protect and allow recovery of an area and its resources; To reduce resource-use conflicts |
| Seasonal closure | Not allowing fishing or diving during certain times of the year | To allow resources or habitats to recover |
| Gear restriction | Not allowing the use of certain gear | To prevent destruction of habitat; To promote equitability or to limit exploitation level |
| Species restriction | Not allowing the catching of certain species | To protect endangered species or breeding of overexploited species |
| Patrolling & Enforcement | Helping the authorities impose compliance with the law | Essential to realize the objectives of the above regulatory methods |
| CONSERVATION: Impact Reduction | | |
| Recycling | Reusing materials for the same or for another use (e.g. composting) | To reduce waste production and extraction of materials |
| Waste collection/clean-ups | Moving scattered garbage from coastal habitats to a landfill | To contain waste to a place where it will do less damage |
| Watershed revegetation | Replanting erosion prone areas | To reduce the sediments going to the coastal area |
| Anchor buoys | Providing a safe place for boats to moor without causing habitat damage | To reduce anchor damage to corals |
| Supplementary livelihoods | Providing additional sources of income | To reduce dependence on and extraction of coastal resources |
| Lobbying | Using the force of a large number of people to influence... | To influence groups not concerned with the coast to be concerned |
| ENHANCEMENT & REHABILITATION: Transplantation & Reseeding | | |
| Mangrove reforestation | Transferring mangrove young (propagules, seedlings or saplings) | To start up mangrove growth & reproduction and restore abundance of mangrove forest |
| Reseeding | Transferring young or breeding adults of species to a depleted area (e.g. sea cucumber, urchins, giant clams) | To speed up restocking of a depleted area and allow growth of these species there |
| Artificial reefs | Putting hard structures in a soft bottom area | To serve as a shelter for fish to aggregate |

| CONSIDERATIONS | ADVANTAGES | DISADVANTAGES |
|--|---|--|
| CONSERVATION: Regulation & Enforcement | | |
| Must be widely accepted; Boundaries must be marked | Promotes consensus and networking; Easier to enforce than most other regulations | Legislation difficult to get; May highlight conflicts; Benefits may take a few years before becoming evident |
| May need alternatives for those affected; Info campaign needed | Allows use of the area at other times | Loss of fishing opportunity |
| May need alternatives for those affected; Info campaign needed | | Usually difficult to enforce; Loss of fishing opportunity |
| May need alternatives for those affected; Info campaign needed | | Difficult to enforce; Loss of fishing opportunity |
| Volunteers need para-legal training and have to be deputized; Better to prevent than apprehend violators; Boat, fuel, & radios needed | | Sometimes dangerous for the deputized wardens; Cases may get stuck in court |
| CONSERVATION: Impact Reduction | | |
| External facilities needed to re-use certain materials (e.g. metals) | Also reduces cost and even generates income | |
| May encourage with awards | Sanitation also improves health | |
| May also depend on farming and upland communities; Don't introduce foreign species | Also reduces air pollution | |
| Care needed in putting down buoy's weight | Can also be used to delineate MPA boundaries | Concentrates impact to one place |
| Should be environment-friendly | Sustained increased income | Activities could multiply too much and harm the environment |
| Prevent rather than wait for trouble | Can serve as a rallying point for unity | Potential conflicts among resource users |
| ENHANCEMENT & REHABILITATION: Transplantation & Reseeding | | |
| Don't introduce foreign species or mangroves where there was none; Multi-species forests are more natural; Availability of seedlings | Stabilizes coast and reduces sedimentation | May take a long time so must ensure control of area for 10-25 years after for benefits to be felt |
| Young or breeding adults must be protected; Don't introduce foreign species; Watch out that other species are not harmed; Requires input of young or breeding adults | Spawn also reseeds the areas beyond; Usually economically-valuable species are reseeded | Young may die before they mature |
| Currently controversial; Carefully consider site, materials, & regulations | Might also serve as a substrate for corals to settle and grow | May speed up resource depletion if it is fished |

CHALLENGE

Well-coordinated and time-consuming involvement by dedicated groups of people is usually critical to the success of solutions.



References

Hughes, T.P. 1994. Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science* 265: 1547-1551.

Earlier versions of the methods described herein can be found in:

Dela Cruz, M.T. and M.C.G. Militante. 1998. Marine reserve monitoring manual for communities. Guiuan Development Foundation, Inc., Guiuan, Eastern Samar, Philippines.

IIRR (International Institute for Rural Reconstruction). 1998. Participatory methods in community-based coastal resource management. International Institute for Rural Reconstruction, Silang, Cavite, Philippines.

Most of the methods in Chapters 5 to 9 were adapted from methods developed by others and described in:

English, S., C. Wilkinson and V. Baker. 1997. Survey manual for tropical marine resources, 2nd ed. Australian Institute of Marine Science, Townsville, Australia.

Hodgson, G. 1999. Reef Check. URL <http://www.ReefCheck.org>

McManus, J.W., M.C.A. Ablan, S.G. Vergara, B.M. Vallejo, L.A.B. Meñez, K.P.K. Reyes, M.L.G. Gorospe and L. Halmarick. 1997. ReefBase Aquanaut Survey Manual. ICLARM Educ. Ser. 18, 61 p.

White, A.T., C.A. Courtney, M.C. Meyer, A. Alvarado, E. White, J. Apurado and P. Christie. 2000. Summary field report: Coral reef monitoring expedition to Tubbataha Reef National Marine Park, Sulu Sea, Philippines, May 21-30, 2000. Coastal Resource Management Project and the Sulu Fund for Marine Conservation Foundation, Inc., Cebu City, 79 p.

Some useful references for identifying reef organisms in the Indo-Pacific are:

Allen, G.R. 1996. Marine life of Southeast Asia and the Pacific. Periplus Editions, Ltd., Singapore.

Allen, G.R. 1997. Marine fishes of Tropical Australia and South-East Asia. Western Australian Museum, Australia.

Allen, G.R. and R. Steene. 1996. Indo-Pacific coral reef field guide. Tropical Reef Research, Singapore.

Allen, G., R. Steene and M. Allen. 1998. A guide to angelfishes and butterflyfishes. Odyssey/Tropical Reef Research, Western Australia.

Calumpong, H.P. and E.G. Meñez. 1997. Field guide to the common mangroves, seagrass and algae of the Philippines. Bookmark, Inc., Makati City, Philippines.

Collin, P.L. and C. Arneson. 1995. Tropical Pacific invertebrates: A field guide to the marine invertebrates occurring on tropical Pacific coral reefs, seagrass beds and mangroves. Coral Reef Press, California.

Lieske, E. and R. Myers. 1996. Collins pocket guide, coral reef fishes: Indo-Pacific and Caribbean. Harper Collins Publishers, London.

Myers, R.F. 1989. Micronesian reef fishes: A practical guide to the identification of the coral reef fishes of the tropical Central and Western Pacific. Coral Graphics, Guam.

Randall, J.E., G.R. Allen and R. Steene. 1998. Fishes of the Great Barrier Reef and Coral Sea, 2nd ed. University of Hawai'i Press, Hawai'i, USA.

White, A.T. 2001. Philippine coral reefs: A natural history guide. Bookmark Inc., and Sulu Fund for Marine Conservation Foundation, Inc. 259 p.



APPENDIX I

Resources for training in reef monitoring skills

Suggested training plan

The entire training course can actually be taught in a week's time. However, it is recommended that the training be spread over the course of 3 years in order to allow the team sufficient time to practice under supervision and to allow the study area to actually change in response to management activities enough to be observed. If a community is being trained by external trainers, at least two visits by them should be planned for each year. The trainees should be encouraged to collect data 2 to 4 times a year (i.e. once per season) together with their local development workers.

| Year & Season | Scheduled Activities | Ongoing Activities |
|---|--|--|
| Year 1. Season 1. (e.g. Nov.-Mar.) | Introduce the idea of participatory monitoring & evaluation to key community leaders. Check the site for appropriate biophysical and socioeconomic conditions, logistics, and counterpart arrangements and offer to conduct the training. | |
| Year 1. Season 2. (e.g. Apr.-May) 3-4 days | Review of basic reef ecology and management. Teach Chapters 1-4 and the data collection and recording steps of Chapters 5-9. Have trainees practice collecting data while experienced people collect baseline data (on the benthos, reef fishes, and invertebrates). Intro to Monitoring & Evaluation of Coral Reefs (1 hr talk) Observing Corals and Algae [data collection] (1 hr talk/ 1 day fieldwork) Observing Reef Fishes [data collection] (1 hr talk/ 1 day fieldwork) Monitoring Fish Catch [data collection] (1-2 hr talk & planning) Human Activities & Natural Disturbances (1 hr talk) Drawing Up a Monitoring Plan (1-2 hr talk & planning) | |
| Year 1. Season 3. (e.g. Jun.-Oct.) 2-3 days | Trainees and their local development workers collect data (on the benthos, reef fishes, and invertebrates) again. If data collection skills are good by this point, local development workers can begin teaching the data summarization steps of | Trainees continue collecting data on fish catch and human activities |

| Year & Season | Scheduled Activities | Ongoing Activities |
|-------------------------------|---|--------------------|
| | Chapters 5-9. Otherwise, these may be taught the following season. | |
| Year 2. Season 1. 2-3 days | Trainees and local development workers collect data (on the benthos, reef fishes, and invertebrates) together. | |
| Year 2. Season 2. 2-3 days | Review the data collection and recording steps of Chapters 5-9 and quiz trainees on this knowledge. Trainees, local development workers, and external trainers collect data (on the benthos, reef fishes, and invertebrates) together. Drawing Up a Monitoring Plan (review & revision of plan) (½-1 hr) Observing Invertebrates (½ hr) Human Activities & Natural Disturbances (review) (½ hr) | |
| Year 2. Season 3. 2-3 days | Trainees and local development workers collect data (on the benthos, reef fishes, and invertebrates) together. Trainees use the data collected during the previous monitoring exercises to practice data summarization under the supervision of external trainers. Observing Corals & Algae [summarization & graphing] (1 hr) Observing Reef Fishes [summarization & graphing] (1 hr) Monitoring Fish Catch [summarization & graphing] (1-2 hr) | |
| Year 3. Season 1. 2 days | Trainees collect data (on the benthos, reef fishes, and invertebrates). | |
| Year 3. Season 2. 2-3 days | Trainees, local development workers, and external trainers collect data (on the benthos, reef fishes, and invertebrates) together. Supervise data summarization by trainees. Teach Chapters 10-11 especially using the past 3 years' monitoring data. Interpreting Observations (1 hr) Evaluation & Action (1 hr) | |
| Year 3. Season 3. 3 days | Trainees collect data (on the benthos, reef fishes, and invertebrates). A contest-conference amongst various trainee teams may help teams share insights with each other. | |

IMPORTANT

Volunteers are rarely able to participate for more than 2 straight days. So, it would be best to spread out each season's monitoring and training activities within a week's time.

No matter when you decide to formally teach Chapters 10 & 11, facilitators must always feedback monitoring results and discuss management implications at least once per season. Monitoring team members should also regularly (e.g. 2 to 4 times a year) present their findings to their organization and community for validation and comments. Encourage the community to discuss the possible implications of the data and plan for appropriate action. Graphs of the results may be displayed on a billboard near the monitoring station. This billboard should be updated regularly.

Trainers tips

Things to consider when planning a training:

- ✓ Who is the target audience?
- ✓ How many teachers will be needed?
- ✓ Who is in charge of first-aid?
- ✓ How much time is available for the training?
- ✓ Who will provide meals and snacks?

- * Prepare and review before the actual training. Practice what you teach.
- * Repeat and/or summarize key points after each talk. To facilitate understanding, assign participants to summarize.
- * Understand what motivates your trainees and address their particular concerns.
- * Time is usually scarce: keep talks short and simple; train through actual monitoring.
- * Laminated identification guides for underwater use are especially helpful for training.
- * Organize trainees into teams and assign transects and organisms to be assessed to each team.
- * Assign one person to fill out Form 2 and collect all data forms from the team members. All data forms must be complete and in one place at the end of the monitoring period.
- * Encourage trainees to ask questions and participate actively. Be open to ideas (especially indigenous methods) from trainees.

Training effective reef monitors requires that the trainer helps the trainee learn accurate and effective monitoring techniques through education, practice, testing, and quality checking. Appendix I provides materials useful to assist trainers in educating and developing effective reef monitors. The resources and their uses are:

1. Evaluation form for simple reef monitoring for management. This form may be used to assess each team member and the team as a whole in their ability to apply the various techniques explained in the guide. Under each monitoring technique are listed important points of knowledge or procedures that each trainee should master and understand. The form provides a means of rating the proficiency of each trainee or group in the various techniques and their attributes.
2. Evaluation guide. The evaluation guide provides a means of assigning points and quantification to various behavioral objectives that the trainee should master to be a good reef monitor. How to assess the behavioral traits of the trainee is explained so that points can be assigned to different levels of proficiency. This evaluation guide can be used to rate trainees or groups. It covers:
 - a. Demo teaching
 - b. Benthos observation
 - c. Fish visual census
 - d. Invertebrate census
 - e. Interpretation and evaluation.
3. Comparison of reef monitoring methods. This sheet helps us decide on the level of detail required in doing reef monitoring in relation to the time and effort required. Table 1 shows the level of detail possible in relation to the level of effort where 3 is the highest level of effort. Table 2 compares four reef survey protocols. Level 3 coincides with the Global Coral Reef Monitoring Network methods of English *et al.* (1997) and requires the most effort. It is noted that the simple method of this guide collects data on most of the parameters of the other 3 methods but lacks detail in several categories such as identifying coral and fish to genera or species level.

I. Evaluation form for simple reef monitoring for management

Site Name:

Municipality & Province:

Team member:

Name of team:

Reef Monitoring and Evaluation Training

| | Year 1 | Year 2 | Year 3 |
|---|--------|--------|--------|
| I. General knowledge | | | |
| <ul style="list-style-type: none"> ■ Value of monitoring & evaluation to adaptive management ■ Components of the monitoring program ■ Monitoring (through time), inside/outside, replication, representative | | | |
| II. Manta tow | | | |
| <ul style="list-style-type: none"> ■ Procedure (2-minute segments, timer keeps close watch on observer) ■ Estimate % cover ■ Distinguish between live hard, dead hard, live soft coral ■ Depict hard coral cover onto map | | | |
| III. Fish visual census | | | |
| <ul style="list-style-type: none"> ■ Procedure (lay transect on depth contour, 5-m to each side, count, size class, 50-m length, 1x/season) ■ Recognize and name the 18 reef families on Data Form 5 ■ Conduct on-site (doesn't splash about, damage coral, poach or throw litter) ■ Summarization (total count per fish type per transect, average count per fish type per area) ■ Graphing (convert average into log score, draw picto-table) | | | |
| IV. Invertebrate census | | | |
| <ul style="list-style-type: none"> ■ Procedure (5-m to each side, count, 50-m length) ■ Recognize & name: <i>Diadema</i> urchins, crown-of-thorns starfish, giant clams | | | |
| V. Fish catch monitoring | | | |
| <ul style="list-style-type: none"> ■ Procedure (records weekly; records date, fishing gear, fishing ground, catch quantity, effort) ■ Recognize and name the major fishing gear ■ Can map fishing effort (at peak time) on gridded map ■ Understands: $CPUE \times \text{total effort} = \text{total catch}$ ■ Summarization (total sampled effort, total sampled catch) ■ Graphing (CPUE per month or area, est. total effort or total catch per month or area) | | | |
| VI. Interpretation and evaluation | | | |
| <ul style="list-style-type: none"> ■ Understands the concept of correlation ■ Can suggest relevant causes of observed trends | | | |

| Symbol | Definition |
|--------|-------------------------------|
| ✓ | Okay |
| ~ | needs improvement or practice |
| x | has not yet been taught |
| ? | not assessed |

This form may be used to assess each team member and to assess the team as a whole. Copies of assessments may be made for the individual team member, for the team leader and for the trainer.

2. Evaluation guide

| 2. Evaluation Guide | | Demo Teaching: 200 points |
|---|---|---|
| Behavioral Objective Trainee should be able to... | Method of assessment | Scoring/ Quantification |
| <p>Discuss the different aspects of the following topics:</p> <ul style="list-style-type: none"> • Why monitor reefs? • Drawing up a monitoring plan* • Manta tow • Fish visual census • Invertebrate census • Observing human activities & natural disturbances • Fish catch monitoring • Interpreting observations* • Evaluation & action (based on the lectures and the handbook) <p>* choose either of these if you are only evaluating one team & time is only sufficient to test one of the above topics</p> | <p>Demo teaching by each team</p> <p>Evaluator poses the scenario: "After having been trained in reef monitoring methods, it is now your turn to train others. Discuss your given topic in the most creative manner you can think of."</p> <p>Trainees draw lots to determine their topic for presentation. Trainees are given time (2-3 hours) to prepare their presentation. Each team is evaluated according to the following criteria:</p> <ul style="list-style-type: none"> • Organization and coherence of presentation (discusses points in a logical manner) • Clear presentation of the objective at the start and a summary at the end of the presentation • Completeness and accuracy of details • Creativity in presentation: extra points given to team that presents topic in a form other than straight lecture • Accuracy and clarity of visual aids (if any) • Speed or pace of presentation <p>If trainees miss some points in their presentation, the evaluator asks questions to check if the trainee simply forgot or really does not know that detail.</p> | <p>Objective (15 points)</p> <p>Logical order of presentation (25 points)</p> <p>Major points of the topic (60 points)</p> <p>Pace (15 points)</p> <p>Visual aids (20 points)</p> <p>Summary (15 points)</p> <p>Total: 150 points</p> |
| <p>Display understanding beyond "factual" level</p> | <p>In-depth questioning by evaluator(s) and audience.</p> <p>These require insight and application of the facts as described in this guidebook into a context or situation (e.g. to a particular area being monitored).</p> | <p>Total: 50 points</p> |

2. Evaluation Guide

Benthos observation: 125 points

| Behavioral Objective Trainee should be able to... | Method of assessment | Scoring/ Quantification | | | | | | | | | | | | | | |
|--|--|--|----------------|---|---|------|---|-------|---|-------|---|-------|---|--------|---|---|
| Identify the different life forms | On-site identification of 5 lifeforms pre-marked by evaluator. Items to be tagged: <ul style="list-style-type: none"> • Hard coral • Soft coral • Dead coral / dead coral with algae • Rubble • Macroalgae | Five (5) points per lifeform correctly identified. Total: 25 points | | | | | | | | | | | | | | |
| Practice the basic procedure of the manta tow | Actual conduct of manta tow. Evaluator notes whether the following are practiced by the trainee: <ul style="list-style-type: none"> • Correct hand signals (left, right, ok, speed up, slow down, stop) • Towing done over the reef crest • Towing done in two-minute intervals • Mapping of landmarks | Five (5) points per observed correct behavior. Total: 20 points | | | | | | | | | | | | | | |
| Estimate the percent cover of each lifeform accurately | Evaluator tows along with the trainees then computes the accuracy of each trainee's estimates using his/her estimates. Three tows with HC, SC, DC/ DCA and S recorded for each tow. *% Cover bracket ranges from (English <i>et al.</i> 1997): <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>% cover</th> <th>Cover category</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1-10</td> <td>1</td> </tr> <tr> <td>11-30</td> <td>2</td> </tr> <tr> <td>31-50</td> <td>3</td> </tr> <tr> <td>51-75</td> <td>4</td> </tr> <tr> <td>76-100</td> <td>5</td> </tr> </tbody> </table> | % cover | Cover category | 0 | 0 | 1-10 | 1 | 11-30 | 2 | 31-50 | 3 | 51-75 | 4 | 76-100 | 5 | For each of the estimates, points may be assigned according to the scale below: Within the same % cover bracket* (5 points) Difference of 1 bracket (3 points) Difference of 2 brackets (1 point) Difference of >2 brackets (0 point) Total: 60 points |
| % cover | Cover category | | | | | | | | | | | | | | | |
| 0 | 0 | | | | | | | | | | | | | | | |
| 1-10 | 1 | | | | | | | | | | | | | | | |
| 11-30 | 2 | | | | | | | | | | | | | | | |
| 31-50 | 3 | | | | | | | | | | | | | | | |
| 51-75 | 4 | | | | | | | | | | | | | | | |
| 76-100 | 5 | | | | | | | | | | | | | | | |
| Plotting the tow results on the map | Observe the trainees plot their tow results on the map | Ten (10) points for plotting the proper tow number on the right place on the map. Another ten (10) points for drawing the proper pie pictographs Total: 20 points | | | | | | | | | | | | | | |

2. Evaluation Guide

Fish Visual Census: 210 points

| Behavioral Objective | Method of assessment | Scoring | | | | | | | | | | | | | | |
|---|---|--|----------------------------|---|---|------|---|-------|---|---------|---|----------|---|------|---|--|
| Identify the major fish families | Identification. Evaluator shows each team a set of 15 pictures and asks them to identify the family of the fish in each picture (local names may be used instead of scientific names). Select the families to be tested by selecting the most common 15 fish families in the area from the list of 18 in the data form. | Two (2) points per fish family correctly identified. Total: 30 points | | | | | | | | | | | | | | |
| Practice the basic procedure of the fish visual census | Actual conduct of fish visual census. Evaluator notes whether the following are practiced by the trainee: <ul style="list-style-type: none"> • Laying the transect on a constant depth contour • Waiting 10-15 minutes before censusing • Swimming side by side • Minimal movement | Five (5) points per observed correct behavior. Total: 20 points | | | | | | | | | | | | | | |
| Estimate 5-m width from the transect | On-site testing by evaluator. 15 plastic fishes are laid inside and outside a 5-m width transect belt. Instruct trainees to "census" the plastic fishes as they normally would. Purposely set 5 of the fishes outside the 5-m width. Determine from their data whether or not they can properly estimate 5-m width. | Three (3) points for every "inside" fish correctly identified; subtract five (5) points for every "outside" fish recorded (improperly identified as "inside"). You may also have the trainees estimate the size of the plastic fish as part of the 3 points to be gained per "inside" fish Total: 30 points | | | | | | | | | | | | | | |
| Estimate size class and number of fish per family accurately. | Evaluator censuses a pre-selected set of 9 fish families together with the team, then computes the accuracy of each team's estimates using his/her estimates. Log ₅ abundance brackets: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Fish count</th> <th>Log₅ abundance</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>>0-5</td> <td>1</td> </tr> <tr> <td>>5-25</td> <td>2</td> </tr> <tr> <td>>25-125</td> <td>3</td> </tr> <tr> <td>>125-625</td> <td>4</td> </tr> <tr> <td>>625</td> <td>5</td> </tr> </tbody> </table> | Fish count | Log ₅ abundance | 0 | 0 | >0-5 | 1 | >5-25 | 2 | >25-125 | 3 | >125-625 | 4 | >625 | 5 | For each of the estimates of pre-selected fish families, points may be assigned according to the scale below: Within the same log ₅ abundance bracket* (10 points) Difference of 1 bracket (5 points) Difference of 2 brackets (2.5 points) Difference of >2 brackets (0 point) |
| Fish count | Log ₅ abundance | | | | | | | | | | | | | | | |
| 0 | 0 | | | | | | | | | | | | | | | |
| >0-5 | 1 | | | | | | | | | | | | | | | |
| >5-25 | 2 | | | | | | | | | | | | | | | |
| >25-125 | 3 | | | | | | | | | | | | | | | |
| >125-625 | 4 | | | | | | | | | | | | | | | |
| >625 | 5 | | | | | | | | | | | | | | | |
| Data summarization and graphing | Observe the trainees summarize and chart their results | Ten (10) points for each correct set of sums, averages, selection of families to depict, & proper conversion of abundances into pictographs Total: 40 points | | | | | | | | | | | | | | |

| 2. Evaluation Guide | | Invertebrate Census: 15 points |
|--|--|---|
| Behavioral Objective Trainee should be able to... | Method of assessment | Scoring |
| Identify the important invertebrate indicators | Identification. Evaluator shows pictures and asks the trainees to identify each picture (local names may be used instead of scientific names): <ul style="list-style-type: none"> • <i>Diadema</i> urchins • Crown-of-thorns starfish • Giant clams | Five (5) points per invertebrate type correctly identified. Total: 15 points |

Site Details: 50 points

| | | |
|--|--|--|
| Properly record details of the monitoring site | Evaluator observes the area being monitored and checks whether the data form describing the site and the human activities & natural disturbances therein have been properly filled out. <ul style="list-style-type: none"> • Site description form • Fisheries • Pollution • Other stresses & disturbances • Management | Ten (10) points per section of the form correctly estimated. Total: 50 points |
|--|--|--|

General Behavior: 50 points

| | | |
|--|--|--|
| Work well with fellow trainees | Observation by evaluator Each team will be judged according to the following criteria: <ul style="list-style-type: none"> • Respect and cordiality shown to fellow trainees • Initiative in performing task at hand • Level of participation in discussions with fellow trainees | Total: 70 points |
| Anticipate and organize things needed for the field work | Observation by the evaluator | Thinks through and prepares the materials and facilities needed for monitoring ahead of time Total: 30 points |
| Show respect and care for the environment | The "secret" test (offer cigarettes and candy - watch that trainee doesn't throw butts or wrappers into the water) | Total: 50 points |

2. Evaluation Guide

Interpretation & Evaluation: 150 points

| Behavioral Objective Trainee should be able to... | Method of assessment | Scoring/ Quantification |
|---|--|---|
| Copy the data of the proper time and place from the summary forms into the correlation form | Evaluator observes the trainees filling out the correlation form | Twenty (20) points for copying the various data types properly aligned (by times and places) on the data form. Total: 20 points |
| Identify trends | Evaluator observes the trainees filling out the correlation form | Ten (10) points each for correctly identifying things with increasing trends, decreasing trends, and things without trends. Total: 30 points |
| Identify problems based on observed trends | Evaluator discusses the trends with the trainees and helps them relate this to potential problems. | For potential problems correctly identified: 30 points for the top problem 20 points for the next most important problem Total: 50 points |
| Identify solutions relevant to potential problems | | For each set of appropriate solutions correctly identified: 30 points for the top problem 20 points for the next most important problem Total: 50 points |

3. Comparison of Reef Monitoring Methods

The reef monitoring methods described in this guide generally collect the simplest type of data with which changes can be detected. More detailed data may be collected for indicators of particular interest. The tables below outline how these methods may collect more detailed information as well as what levels of detail are collected by other monitoring systems. The greater the desired level of detail, the more time you will need for the observations.

Table 1. Level of detail required for reef monitoring.

| | Level | | | |
|--------------------------------------|----------------|----------------------|--------------------|-----------------------------|
| | 0 | 1 | 2 | 3 |
| Manta tow survey | | | | |
| Number of variables estimated | 3 | 3-5 | 3-5 | 3-5 |
| Horizontal visibility estimated? | no | no | no | yes |
| Estimation scale | 5-pt scale | 5-pt scale & = | % | % |
| Fish visual census | | | | |
| Taxonomic detail | family | family | genus | species |
| Butterflyfish species counted? | no | no | yes | yes |
| Size estimate | estimated | 10-cm size classes | 10-cm size classes | estimated to the closest cm |
| Number of invertebrate types counted | none | Acanthaster, Diadema | several | several |
| Benthos transect | | | | |
| Taxonomic detail | | | | |
| Number of lifeforms | ~12 | ~12 | 28 | 28+ |
| Coral genera identified? | no | no | no | yes |
| Number of points sampled per meter | % est. per 5 m | 2 | 4 | 100 |

Table 2. Comparison of various reef survey protocols.

| | Protocol | | | |
|---|----------------------------|----------------------------|------------------|----------------|
| | GCRMN | Reef Check | Aquanaut | This Guide |
| Manta tow survey | | | | |
| Variables estimated | HC, SC, DC | | | HC, SC, DC |
| Number of tows | Min. 9 | | | Min. 9 |
| No. & location of detailed transects | | | | |
| Number of areas | 1 to 3 | | 2 | 2+ |
| Quality of areas to be sampled | Representative | Best except drop-offs | Representative | Representative |
| Quality of optional areas to be sampled | | Moderate and heavy impacts | | |
| Depth of transects | 3 to 6 m (& 10 m optional) | 2-6 m and >6-12 m | 3, 5, 8 and 10 m | 6 m |
| Transect position relative to the shore | Parallel | Parallel | Parallel | Parallel |
| Photos/videos | | Recommended | | Recommended |
| Site description | | Yes | | Yes |

| | Protocol | | | |
|--|------------------------|---------------------------------------|---------------------------------------|--|
| | GCRMN | Reef Check | Aquanaut | This Guide |
| Fish visual census | | | | |
| Number of transects per depth per area | 3 | 4 | 2 | 5 |
| Transect length | 50 m | 20 m | 5 m | 50 m |
| Transect width & height | 5 m | 5 m | 2 m | 10 m |
| # Seasons sampled | Pref. 2 | 1 | | 1-3 |
| Monitoring interval | 1x/1-2 yr | 1x/yr | | 1x/season |
| Taxonomic detail | Species | Groupers & 4 other sp. | None | Family |
| Butterflyfish species | Identified and counted | Species counted | As part of fishes | Counted |
| Size estimate | Food fishes | Groupers only | | All to size categories |
| Types of invertebrate counted | | | | |
| Banded coral shrimp | | Y | | Y |
| <i>Diadema</i> urchin | | Y | | Y |
| Sea fans | | | Y | |
| <i>Echinometra</i> /pencil urchins | | Y | Y | Y |
| <i>Acanthaster planci</i> | | Y | Y | Y |
| Sea cucumber | | Y | Y | Y |
| Giant clams | | Y | Y | Y |
| Triton | | Y | | Y |
| Lobster | | Y | | Y |
| Conch/whelk | | | Y | |
| Benthos transect | | | | |
| Number of transects/area | 5 | 4 | 2 | 5 |
| Transect length | 20 m | 20 m | 5 m | 5 m |
| Taxonomic detail: number of lifeforms | 28 | HC, SC, DC, FS, SP, RCK, R, S, SI, OT | HC, SC, DC, FS, SG, RCK, R, S, SI, OT | HC, SC, DC, DCA, MA, TA, CA, RCK, R, S, SG, SI, SP, OT |
| Coral genera identified? | Pref. species | No | No | No |
| Points sampled per m | 100 | 2 | 2 | % est. per 5 m |

Legend: FS = fleshy seaweed; SG = seagrass

APPENDIX 2

Blank data forms used in this guide

The following pages contain blank data forms referred to in this guide. In addition, several new forms are included that are not explained in this guide that may be useful for more specialized reef monitoring activities by persons trained in those techniques. These new forms are self-explanatory for those who may wish to use them. All the forms are reproduced here in full size so that they can be photocopied for reef monitoring activities.

Titles of the forms that follow are:

- Form 1: Data Checklist Form
- Form 2A: Survey Site Description and Details Form
- Form 2B: Human Activities & Natural Disturbances Form
- Form 3: Manta Tow Data Form
- Form 4A: Benthic Lifeforms & Invertebrates Data Form
- Form 4B: Benthic Lifeforms & Invertebrates Data Form with coral lifeforms
- Form 4C: Data Summary Form
- Form 4D: Benthos Graphing Form
- Form 5A: Fish Abundance Data Form
- Form 5B: Data Summary Form
- Form 5C: Fish Graphing Form
- Form 5D: Butterflyfish Species Checklist Form
- Form 6A: Gear Survey Form
- Form 6B: Fish Catch Monitoring Form for data collection teams
- Form 6C: Fish Catch Monitoring Form for individual fishers
- Form 6D: Fish Catch Monitoring Summary Form
- Form 7: Correlation Table

SURVEY SITE DESCRIPTION AND DETAILS FORM

Form 2A

| | | | | | |
|---|--|---------|---------|---------|---------|
| Site Name: | Municipality & Province: | | | | |
| Reason for choosing to monitor this site: | Overall Documentor: | | | | |
| Transect No. | [] | [] | [] | [] | [] |
| Fish abundance observers | | | | | |
| Benthic lifeforms observers | | | | | |
| Start date (mo/day/year) | | | | | |
| Start time (am/pm) | | | | | |
| Latitude (e.g. 9°23.012') | | | | | |
| Longitude (e.g. 112°34.781') | | | | | |
| Transect orientation (e.g. N, NE, ...) | | | | | |
| Depth (in m) | | | | | |
| Reef zone (e.g. fore slope, flat, etc.) | | | | | |
| Is the site sheltered or exposed? | | | | | |
| Approx. steepness of site (angle of slope) | | | | | |
| Topographic complexity (in m) | | | | | |
| Horizontal visibility (in m by transect line) | | | | | |
| Vertical visibility (in m by secchi depth) | | | | | |
| End date (mo/day/year) | | | | | |
| End time (am/pm) | | | | | |
| Weather: | Sunny [] Cloudy [] Rainy [] Windy [] | | | | |
| Temperature: | Air [] Water surface [] 3-m depth [] 10-m depth [] | | | | |

Sketch map of reef and coastline showing transect locations and other features

Coordinates from
map [] or GPS []
If GPS, specify map datum:

HUMAN ACTIVITIES & NATURAL DISTURBANCES FORM

Form 2B

| A. FISHING | % or # | Notes |
|---|---------------|-----------------------------------|
| # fishing boats observed w/in 500 m | | |
| # aquarium fishers w/in 500 m | | |
| # invertebrate gleaners w/in 500 m | | |
| # blasts heard during the dive | | |
| % area used for mariculture w/in 500 m | | |
| B. POLLUTION | % or # | Notes |
| Distance to nearest pop. center (in km) | | |
| Population of pop. center (in thousands) | | |
| # factories per km of adjacent coast | | |
| Distance to nearest river (in km) | | |
| % farmed area of coastline | | |
| % forested area of coastline | | |
| # mines within sight | | |
| # items of floating trash observed | | |
| # items of trash observed underwater | | |
| # fish nets left as trash | | |
| C. OTHER STRESSES & THREATS | % or # | Notes |
| # boats anchoring within 500 m | | |
| # divers observed within 500 m | | |
| # dive shops within 10 km | | |
| Years since last typhoon (>100 kph) | | |
| # large ships within sight | | |
| % of coast built-up with structures | | |
| Years since last mass bleaching | | |
| % bleached coral area | | |
| % diseased coral area | | |
| MANAGEMENT OF AREA | | Is this a legally protected area? |
| Name of Marine Protected Area: | | Organization responsible: |
| Describe restrictions herein: | | |
| Ordinance no. & year: | | Start date of protection by law: |
| Date boundaries were marked: | | Date patrols/enforcement began: |
| Coordinates of protected area boundaries: | | |

BENTHIC LIFEFORMS & INVERTEBRATES DATA FORM

Form 4A

| | | | | | |
|----------------------------------|--------|--------------------------|--------------|-------------------------|--------|
| Site Name: | | Municipality & Province: | | | |
| Transect No.: | Scuba: | Snorkel: | Coordinates: | | |
| Date (mo/day/yr): | | Benthos observer: | | Invertebrates observer: | |
| Horizontal water visibility (m): | | Depth (m): | Reef zone: | Topography: | Slope: |
| Habitat notes: | | | | | |

| BENTHIC LIFEFORMS | | Tally number of points or est. % occupied by each lifeform e.g. 11 11 11 11 or 12%+34%+22%+... | Total Count | % Cover |
|-------------------|-----------------------------------|---|-------------|-------------|
| coral | HC live hard coral | | | |
| | SC soft coral | | | |
| dead coral | DC white dead coral | | | |
| | DCA dead coral w/ algae | | | |
| other animals | SP sponges | | | |
| | OT other animals | | | |
| plants | TA turf algae | | | |
| | MA fleshy macroalgae | | | |
| | CA coralline algae | | | |
| | SG seagrass | | | |
| non-living | R rubble | | | |
| | RCK rock | | | |
| | S / SI sand/silt | | | |
| TOTAL | | | | 100% |

| INVERTEBRATES | # within 5-m width | Causes of coral damage: |
|---|--------------------|---|
| <i>Diadema</i> urchins; <i>tuyom</i> | | Put x if found on corals. Circle the box of the dominant cause <input type="checkbox"/> sediment <input type="checkbox"/> seaweed overgrowth <input type="checkbox"/> blasting patterns <input type="checkbox"/> coral-eating snails <input type="checkbox"/> anchor damage <input type="checkbox"/> crown-of-thorns starfish <input type="checkbox"/> other breakage <input type="checkbox"/> plastics <input type="checkbox"/> bleaching <input type="checkbox"/> other trash <input type="checkbox"/> black band disease <input type="checkbox"/> other causes (specify): <input type="checkbox"/> white band disease _____ <input type="checkbox"/> other coral disease _____ |
| Pencil urchin | | |
| Crown-of-thorns starfish; <i>dap-ag</i> | | |
| Giant clam; <i>taklobo</i> | | |
| Triton shell; <i>tambuli</i> | | |
| Lobster; <i>banagan</i> | | |
| Sea cucumber; <i>balat</i> | | |
| Banded coral shrimp | | |
| others | | |

BENTHIC LIFEFORMS & INVERTEBRATES DATA FORM WITH CORAL LIFE FORMS

Form 4B

| Site Name: | | Municipality & Province: | | | |
|---|-----------------------------------|---|--|---|---------|
| Transect No.: Scuba: Snorkel: | | Coordinates: | | | |
| Date (mo/day/yr): | | Observers: | | | |
| Horizontal water visibility (m): | | Depth (m): | Reef zone: | Topography: | Slope: |
| Habitat notes: | | | | | |
| BENTHIC LIFEFORMS | | Tally number of points or est. % occupied by each lifeform e.g. III-III-III-III or 12%+34%+22%+... | | Total Count | % Cover |
| coral | HC live hard coral | | | | |
| | branching (CB) | | | | |
| | massive (CM) | | | | |
| | flat/encrusting (CE) | | | | |
| | foliose/cup (CF) | | | | |
| | SC soft coral | | | | |
| dead coral | DC white dead coral | | | | |
| | DCA dead coral w/ algae | | | | |
| other animals | SP sponges | | | | |
| | OT other animals | | | | |
| plants | TA turf algae | | | | |
| | MA fleshy macroalgae | | | | |
| | CA coralline algae | | | | |
| | SG seagrass | | | | |
| non-living | R rubble | | | | |
| | RCK rock and block | | | | |
| | S / SI sand/silt | | | | |
| TOTAL | | | | | |
| INVERTEBRATES | | # within 5-m width | Causes of coral damage: | | |
| <i>Diadema</i> urchins; <i>tuyom</i> | | | Put x if found on corals. Circle the box of the dominant cause | | |
| Pencil urchin | | | <input type="checkbox"/> sediment | <input type="checkbox"/> seaweed overgrowth | |
| Crown-of-thorns starfish; <i>dap-ag</i> | | | <input type="checkbox"/> blasting patterns | <input type="checkbox"/> coral-eating snails | |
| Giant clam; <i>taklobo</i> | | | <input type="checkbox"/> anchor damage | <input type="checkbox"/> crown-of-thorns starfish | |
| Triton shell; <i>tambuli</i> | | | <input type="checkbox"/> other breakage | <input type="checkbox"/> plastics | |
| Lobster; <i>banagan</i> | | | <input type="checkbox"/> bleaching | <input type="checkbox"/> other trash | |
| Sea cucumber; <i>balat</i> | | | <input type="checkbox"/> black band disease | <input type="checkbox"/> other causes (specify): | |
| Banded coral shrimp | | | <input type="checkbox"/> white band disease | _____ | |
| others | | | <input type="checkbox"/> other coral disease | _____ | |

BENTHOS GRAPHING FORM

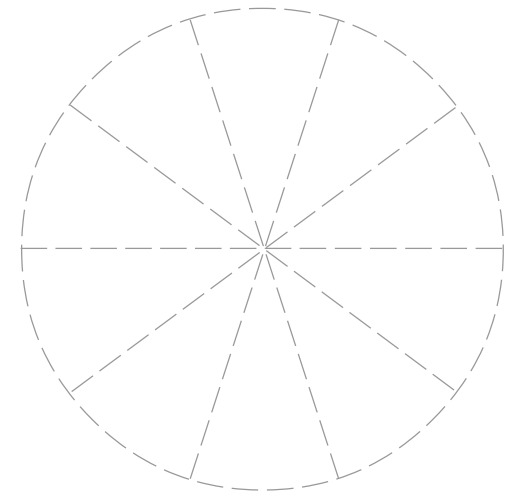
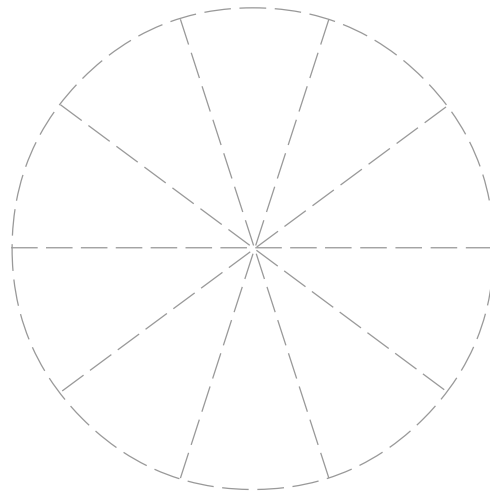
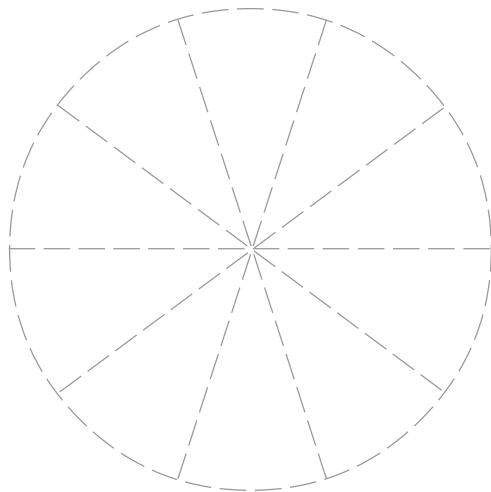
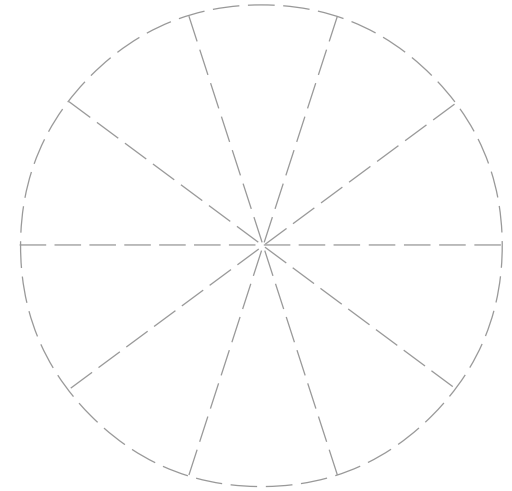
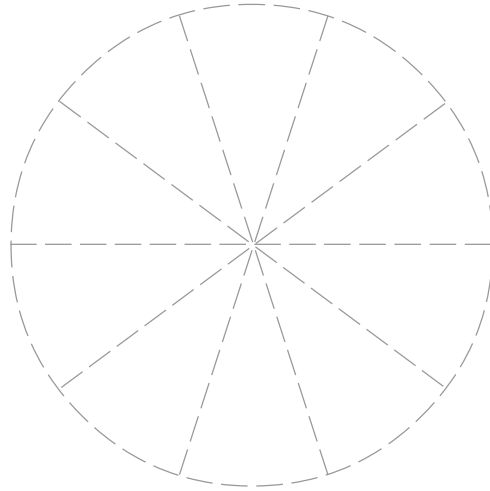
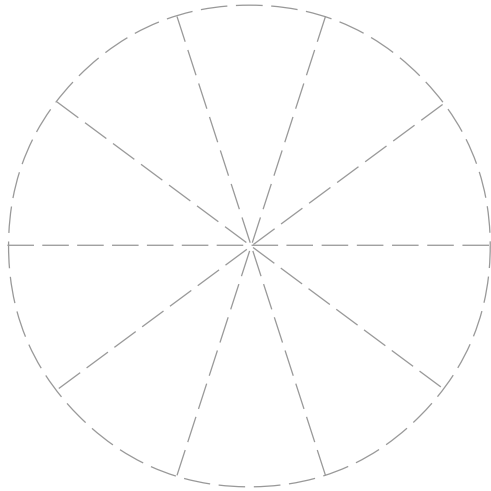
Form 4D

Site Name:

Municipality & Province:

Month & year

Zone/Sector



FISH ABUNDANCE DATA FORM

Form 5A

| Site Name: | | Municipality & Province: | | | |
|--|---|--|-----------------|-----------------------|--------------------------|
| Transect No.: | Depth (m): | Coordinates: | | | |
| Date (mo/day/yr): | Time: | Left observer: | | Right observer: | |
| Habitat notes: | | Horizontal visibility (m): | Angle of slope: | Transect orientation: | |
| FAMILY | Species | Record number of fishes per size class | | | |
| | | 1-10 cm | 11-20 cm | 21-30 cm | specify sizes for >30 cm |
| <EPINEPHELINAE>* groupers; <i>lapu-lapu</i> | | | | | |
| | Barramundi cod; <i>señorita</i> | | | | |
| <LUTJANIDAE>* snappers; <i>maya-maya</i> | | | | | |
| <HAEMULIDAE>* sweetlips; grunts; <i>lipiti</i> | | | | | |
| <LETHRINIDAE>* emperors; <i>katambak</i> | | | | | |
| CARANGIDAE* jacks; trevallies; <i>talakitok</i> | | | | | |
| CAESIONIDAE* fusiliers; <i>dalagang-bukid; solid</i> | | | | | |
| NEMIPTERIDAE* coral breams; <i>silay</i> | | | | | |
| MULLIDAE* goatfishes; <i>timbongan</i> | | | | | |
| BALISTIDAE triggerfishes; <i>pakol</i> | | | | | |
| CHAETODONTIDAE butterflyfishes; <i>alibangbang</i> | | | | | |
| POMACANTHIDAE angelfishes; <i>adlo</i> | | | | | |
| LABRIDAE wrasses; <i>labayan</i> | | | | | |
| | Humphead wrasse; <i>mameng</i> | | | | |
| [SCARIDAE]* parrotfishes; <i>molmol</i> | | | | | |
| | Bumphead parrotfish; <i>taungan</i> | | | | |
| [ACANTHURIDAE]* surgeonfish; <i>indangan</i> | | | | | |
| [SIGANIDAE]* rabbitfishes; <i>kitong; danggit</i> | | | | | |
| [KYPHOSIDAE]* rudderfishes; <i>ilak</i> | | | | | |
| POMACENTRIDAE damsel fishes; <i>palata</i> | | | | | |
| ANTHIINAE fairy basslets; <i>bilang-bilong</i> | | | | | |
| | <i>Zanclus cornutus</i> Moorish idol; <i>sanggowanding</i> | | | | |
| sharks | | | | | |
| rays | | | | | |
| sea turtles | | | | | |
| others: e.g. tunas | | | | | |

Legend: <fishes> = major reef carnivores; [fishes] = major reef herbivores, **fishes** = fishes which are indicators of hard corals, * = fishery target families

BUTTERFLYFISH SPECIES CHECKLIST FORM

Form 5D

| | |
|------------------|-------------|
| Observer | Site Name |
| Date (mo-day-yr) | Coordinates |

| Species | Common Name | 1 | | 2 | |
|--------------------------------------|------------------------------------|---------|----|---------|----|
| | | Present | No | Present | No |
| 1. <i>Chaetodon adiergastos</i> | Philippine butterflyfish | | | | |
| 2. <i>C. auriga</i> | Threadfin butterflyfish | | | | |
| 3. <i>C. baronessa</i> | Eastern triangular butterflyfish | | | | |
| 4. <i>C. bennetti</i> | Bluelashed butterflyfish | | | | |
| 5. <i>C. citrinellus</i> | Speckled butterflyfish | | | | |
| 6. <i>C. ephippium</i> | Saddle butterflyfish | | | | |
| 7. <i>C. kleinii</i> | Klein's butterflyfish | | | | |
| 8. <i>C. lineolatus</i> | Lined butterflyfish | | | | |
| 9. <i>C. lunula</i> | Raccoon butterflyfish | | | | |
| 10. <i>C. melannotus</i> | Blackback butterflyfish | | | | |
| 11. <i>C. mertensii</i> | Merten's butterflyfish | | | | |
| 12. <i>C. meyeri</i> | Meyer's butterflyfish | | | | |
| 13. <i>C. ocellicaudus</i> | Spottail butterflyfish | | | | |
| 14. <i>C. octofasciatus</i> | Eightband butterflyfish | | | | |
| 15. <i>C. ornatissimus</i> | Ornate butterflyfish | | | | |
| 16. <i>C. oxycephalus</i> | Spot-nape butterflyfish | | | | |
| 17. <i>C. plebeius</i> | Blueblotch butterflyfish | | | | |
| 18. <i>C. punctatofasciatus</i> | Spotband butterflyfish | | | | |
| 19. <i>C. rafflesi</i> | Latticed butterflyfish | | | | |
| 20. <i>C. reticulatus</i> | Mailed butterflyfish | | | | |
| 21. <i>C. selene</i> | Yellowdotted butterflyfish | | | | |
| 22. <i>C. semeion</i> | Dotted butterflyfish | | | | |
| 23. <i>C. speculum</i> | Mirror butterflyfish | | | | |
| 24. <i>C. trifascialis</i> | Chevron butterflyfish | | | | |
| 25. <i>C. trifasciatus</i> | Melon butterflyfish | | | | |
| 26. <i>C. ulietensis</i> | Pacific doublesaddle butterflyfish | | | | |
| 27. <i>C. unimaculatus</i> | Teardrop butterflyfish | | | | |
| 28. <i>C. vagabundus</i> | Vagabond butterflyfish | | | | |
| 29. <i>C. xanthurus</i> | Pearscale butterflyfish | | | | |
| 30. <i>Chelmon rostratus</i> | Copperband butterflyfish | | | | |
| 31. <i>Forcipiger flavissimus</i> | Longnose butterflyfish | | | | |
| 32. <i>F. longirostris</i> | Longnose butterflyfish | | | | |
| 33. <i>Hemitaurichthys polylepis</i> | Pyramid butterflyfish | | | | |
| 34. <i>Heniochus acuminatus</i> | Pennant coralfish | | | | |
| 35. <i>H. chrysostomus</i> | Threeband pennantfish | | | | |
| 36. <i>H. singularis</i> | Singular bannerfish | | | | |
| 37. <i>H. varius</i> | Horned bannerfish | | | | |
| 38. <i>Parachaetodon ocellatus</i> | Sixspine butterflyfish | | | | |
| 39. <i>Coradion chrysozonus</i> | Goldengirdled coralfish | | | | |
| 40. <i>Coradion melanopus</i> | Twospot coralfish | | | | |
| Total number of Species/Site | | | | | |

FISH CATCH MONITORING FORM FOR INDIVIDUAL FISHERS

Form 6C

Site/Village/Barangay:

Month & Year/Buwan at Taon:

List down at least 5 fishing days per month (e.g. once per week). Be sure to record the trip even if nothing was caught (record '0' in the weight). Magtala ng hindi bababa sa limang araw ng pangingsda sa bawat buwan. Siguraduhin na magtala pa rin kahit walang nahuli sa paglaot [magtala pa rin ng '0' sa timbang (kilos)].

| | | Record catch per fishing trip | | | | |
|---|--|-------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | 1 | 2 | 3 | 4 | 5 |
| Date & time of leaving <i>Petsa at oras ng paglabas</i> | | | | | | |
| Fishing gear <i>Uri ng pamamalakaya</i> | | | | | | |
| # of fishers in boat <i>Bilang ng tao sa bangka</i> | | | | | | |
| Fishing ground (use grid letter on map) <i>Lugar na pinangisdaan</i> | | | | | | |
| Weather condition, tide, and sea state <i>Kumusta ang panahon, hunas/taob, at alon</i> | | | | | | |
| Date & time of return <i>Petsa at oras ng pagbalik</i> | | | | | | |
| CATCH <i>Huli</i> | Kinds of fish caught <i>Mga uri ng nahuli</i> | Weight <i>Timbang</i> | Weight <i>Timbang</i> | Weight <i>Timbang</i> | Weight <i>Timbang</i> | Weight <i>Timbang</i> |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| TOTAL CATCH (kilograms) <i>Pangkalahatang huli (kilos)</i> | | | | | | |

Circle each date that you went out to fish. *Bilugan ang bawat petsa na ikaw ay nangisda.*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

CORRELATION TABLE

Form 7

Site Name:

Municipality & Province:

Period covered (mo/day/yr):

Zone/Sector:

| INDICATORS | units | potential problem if... | Year I | | | Year II | | | Year III | | | Trend observed |
|-------------------------------------|---------------------|-------------------------|--------|---|---|---------|---|---|----------|---|---|----------------|
| | | | a | b | c | a | b | c | a | b | c | |
| FISH (Carangidae+Caesionidae) | average count | decrease | | | | | | | | | | |
| FISH (Lutj+Leth+SEpin+Haem) | average count | decrease | | | | | | | | | | |
| LOBSTER | average count | decrease | | | | | | | | | | |
| GIANT CLAMS | average count | decrease | | | | | | | | | | |
| TRITON | average count | decrease | | | | | | | | | | |
| CROWN-OF-THORNS | average count | increase | | | | | | | | | | |
| OVERHARVESTING/OVERFISHING | no. of fishers obs. | increase | | | | | | | | | | |
| CORALS (Hard & Soft) | average % cover | decrease | | | | | | | | | | |
| FISH (Chaetodontidae) | average count | decrease | | | | | | | | | | |
| DEAD CORAL (w/ or w/o ALGAE) | average % cover | increase | | | | | | | | | | |
| RUBBLE | average % cover | increase | | | | | | | | | | |
| DESTRUCTIVE FISHING | evidence of blasts | increase | | | | | | | | | | |
| ANCHOR DAMAGE | overturned corals | present | | | | | | | | | | |
| STORMS | no. of strong ones | high | | | | | | | | | | |
| TOURISM | no. of resorts | >med or inc. | | | | | | | | | | |
| ALGAE (turf+macroalgae) | average % cover | increase | | | | | | | | | | |
| FISH (Balistidae+Tetrodontidae) | average count | decrease | | | | | | | | | | |
| FISH (Scar+Acan+Kyph) | average count | decrease | | | | | | | | | | |
| URCHINS | average count | large change | | | | | | | | | | |
| ALGAL OVERGROWTH | occurrence | common | | | | | | | | | | |
| AGRICULTURAL/FARMED AREA | % of coastline | > low or inc. | | | | | | | | | | |
| POPULATION | | high | | | | | | | | | | |
| TRASH/GARBAGE (total) | no. observed | present | | | | | | | | | | |
| MARICULTURE | % area | high | | | | | | | | | | |
| SAND/SILT | average % cover | increase | | | | | | | | | | |
| RIVER | distance | near | | | | | | | | | | |
| VISIBILITY (horizontal & vertical) | in meters | decrease | | | | | | | | | | |
| FORESTED AREA | % of coastline | decrease | | | | | | | | | | |
| COASTAL STRUCTURES BUILT-UP | % of coastline | > low or inc. | | | | | | | | | | |
| SHIPPING | no. of large ships | > 3-5 | | | | | | | | | | |
| MINING POLLUTION | no. observed | present | | | | | | | | | | |
| INDUSTRIAL POLLUTION | no. of factories | > low or inc. | | | | | | | | | | |
| MASS BLEACHING | % cover | > 20% | | | | | | | | | | |
| DISEASED CORALS | % cover | > 20% | | | | | | | | | | |
| FISH KILLS & other mass deaths | | present | | | | | | | | | | |
| Crown-of-thorns, algae, urchins,... | average count | rapid inc. | | | | | | | | | | |
| OTHER REMARKS: | | | | | | | | | | | | |

