

Protocol for Monitoring Marine Protected Areas  
Protected Areas Network

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The Republic of Palau



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Pursuant to the Protected Areas Network Regulations adopted on April 11, 2007, the following Protocol for Monitoring Marine Protected Areas is adopted this

2 day of April 2012.

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Ministry of Natural Resources, Environment and Tourism,  
The Republic of Palau

# Protocol for Monitoring Marine Protected Areas Protected Areas Network

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## **Foreword**

Marine protected areas are increasingly becoming an important management tool to protect coral reef resources, not only in Palau and Micronesia, but globally. In 2003, Palau enacted the Protected Areas Network (PAN) Act to create a national framework to facilitate both financial and technical resources to state government to support the management of protected areas. Monitoring is an essential component of resource management by providing science-based information to guide key management decisions like prioritizing conservation strategies, proper allocation of resources, and ultimately, whether or not these marine protected areas are meeting their intended objectives. Marine protected areas that are formally recognized within the PAN framework are required to develop a management plan with a monitoring and evaluation element. This monitoring protocol has been developed by PICRC and endorsed by the Ministry of Natural Resources, Environment and Tourism. The protocol is intended to provide technical guidance to state governments in developing site-based monitoring plans to complement existing management plans or new ones. This protocol aims to standardize monitoring across MPAs by providing guidance on monitoring objectives, sampling design, indicators, and methodology. This guide was developed for marine protected area managers, including conservation officers and researchers who collect monitoring data.

## **1. Introduction:**

### **Marine Protected Areas and Protected Area Network for coastal resource management**

Coral reefs are important resources for the people of Palau and other Pacific Islands. Yet, coral reef resources are increasingly being stressed by human activities such as overfishing and land-use change. The use of Marine Protected Areas (MPAs) as a strategy for conserving marine resources is widely used in Palau and other islands of Micronesia. To date, there are at least 35 MPAs throughout the islands of Palau, encompassing all the different habitats that Palau has to offer. In 2003, Palau established the Protected Areas Network (PAN) under the Ministry of Natural Resource, Environment and Tourism (MNRET). PAN established a framework for providing financial and technical support to state governments and allow National and State to collaborate on protecting the country's biodiversity. PAN aims to establish a network of MPAs that would include all of Palau's rich biodiversity. In 2006, the 5 jurisdictions within the Micronesian region, including Palau, launched the Micronesia Challenge, a commitment to "effectively conserve 30% of near-shore marine and 20% of the forest resources across Micronesia by 2020".

### **Monitoring for MPA management**

MPA management requires information to assess whether MPAs are meeting their objectives and goals of improving resource status. Monitoring can provide the information that management need on the status of MPAs and how the resources are changing over time. The information gained by monitoring is needed for adaptive management.

### **Ecological and Socioeconomic monitoring**

Monitoring should include both ecological and socioeconomic monitoring. While ecological monitoring provides information on resources, socio-economic monitoring will provide information on people and how they benefit or are affected by the establishment of MPAs. To improve management and the chances for success, we need socio-economic monitoring. Through ecological monitoring, data including the status of coral reef resources are collected periodically and used to evaluate whether or not the management measures are indeed contributing to improved conditions. On the other hand, socioeconomic monitoring provides information that can help us improve our understanding of the link between the condition of an MPA and its impacts on the socio-cultural, economic and political well-being of individuals, households, communities, groups, and organizations connected to the MPAs.

## **Monitoring protocol**

This monitoring protocol describes the entire process that can be followed when we are trying to establish a monitoring program. The protocol includes the methodologies and indicators as well as the initial preparation that needs to take place and the reporting once the monitoring has produced some results. This protocol was prepared for conservation officers, researchers and others who conduct MPA monitoring and management. This Protocol can be used as a guide to prepare a monitoring plan for MPAs.

## **How this protocol was prepared**

The objectives of monitoring as well as the indicators and methods to measure these indicators were discussed and agreed upon by participants from all of MC jurisdictions in the “2nd Meeting of the MC Measures Working Group/PICRC-JICA Coral Reef Monitoring Project Meeting” held in February 15-19, 2010 in Koror. Palau International Coral Reef Center, in a collaborative project with JICA, “Capacity Enhancement Project for Coral Reef Monitoring”, conducted monitoring based on the agreed methods at selected 4 MPAs as pilot sites in Palau. PICRC researchers, in collaboration with its counterparts from relevant agencies, used the monitoring methods in Pohnpei, Yap, Chuuk States of FSM and Marshall Islands between February and October 2011.

This protocol was produced by PICRC as a main output of CEPCRM, based on the experiences and lessons learned from the pilot sites and initial surveys as well as through discussions at Palau Environment Conservation Consortium – an informal group of environment practitioners in Palau.

This protocol was approved as the official protocol for coral reef monitoring of PAN sites by the Minister of Natural Resource, Environment and Tourism in April 2012.

## **2. Objectives of monitoring**

The objectives of coral reef monitoring are to assess how successful and efficient management strategies are in improving resource conditions and to provide the information to managers to help them promote adaptive management of MPAs. Monitoring objectives should reflect goals outlined in the management plan of an MPA.

The data collected by monitoring can be used for producing annual reports and annual action plan. At the national or regional level, the data could be used to assess MPAs across the nation or the region.

Coral reef monitoring is also expected to answer questions relating to the condition of resources and the views and behavior of people using the resources.

- Ecological and socioeconomic conditions of a reef site that has been designated as a monitoring site
- Differences in ecological conditions inside and outside a marine protected area and among sites
- Ecological and socioeconomic characteristics of an MPA over time compared with conditions outside the MPA
- The role of stakeholders in resource extraction and effective enforcement of an MPA
- The role of stakeholders in the management of MPAs and the resources

## **3. What is measured and how**

### **(1) Understanding the characteristics of target MPAs that we will monitor**

Before making a monitoring plan, it is necessary to gain clear understanding on:

- Location and area
- Management Objectives

- Managing body/Socio-cultural structure/Jurisdictions/Legislation/Type of management (Surveillance, monitoring, etc.)
- Types of resource-uses
- Existing information on ecological/socioeconomic conditions including cultural and traditional values

**(2) What do we measure to determine whether the objectives of the MPA are being achieved?**

During the Palau workshop in 2010, the participants discussed and selected indicators to measure effectiveness of managing MPAs and chose those in the list below as ‘common’ indicators. Based on these results, PICRC determined the ecological indicators to be measured as below.

General Indicator	Measurable Indicator	Survey Method*
Reef fish	<ul style="list-style-type: none"> <li>• Species density (No. of fish/m<sup>2</sup>)</li> <li>• Species biomass (Kg of fish/m<sup>2</sup>)</li> </ul>	Underwater visual census by snorkel or SCUBA <ul style="list-style-type: none"> <li>• Belt transect (5m x 50m) along 50m transect.</li> <li>• Five x 50 m transects per station</li> <li>• 3 stations per MPA and Control site (each habitat type)</li> </ul>
Benthic community	<ul style="list-style-type: none"> <li>• % Coral cover (genus level)</li> <li>• % Benthic cover (Sand, Rubble, Carbonate, macroalgae, turf, etc.)</li> </ul>	Photo quadrat method by snorkel or SCUBA <ul style="list-style-type: none"> <li>• Photo quadrat (0.5m x 0.5m) every meter per transect</li> <li>• Five x 50 m transects per station</li> <li>• 3 stations per MPA and Control site (each habitat type)</li> </ul>
	<ul style="list-style-type: none"> <li>• Coral recruitment (genus level) (Number of colonies/m<sup>2</sup>)</li> <li>• Size of individual recruits)</li> </ul>	Underwater visual census by SCUBA <ul style="list-style-type: none"> <li>• Belt transect (0.3m x 10m at the beginning of each 50m transect, See above)</li> </ul>
Invertebrates(high value for commercial and subsistence)	<ul style="list-style-type: none"> <li>• Species density (Number of individual/m<sup>2</sup>)</li> <li>• Size of individual invertebrate</li> </ul>	Underwater visual census by Snorkel or SCUBA <ul style="list-style-type: none"> <li>• Belt transect (2 x 50m) of each 50m transect, See above)</li> </ul>
Sea grass community	Species cover	Quadrat method by snorkel or SCUBA <ul style="list-style-type: none"> <li>• Quadrat (0.5m x 0.5m) every 5 meter at the first 20m of each 50m transect (i.e., 5 quadrat/transect, See above)</li> </ul>
Sediment	Organic and inorganic sediment weight (mgcm <sup>2</sup> /d)	Sediment traps <ul style="list-style-type: none"> <li>• 2 sediment traps (5.08cm diameter)/station</li> <li>• Traps retrieved every month.</li> </ul>
Visibility	Horizontal or vertical visibility in meter at seabed	Use of Secchi disc
Temperature	Water temperature (°C)	Data logger deployed at the site that records every 20 minutes

*(See Appendix 1 for details of methods)*

Socioeconomic indicators are selected based on the assessment objectives and need to be identified by the assessment team. These indicators will form the basis for the creation of the questions that will be asked. Below is a list of suggested indicators and methods to measure them.

General Indicators	Indicators	Suggested Methods**
*Demographics	Number of people in household	Household survey
	Number of visitors	Key informants
	Age	Household survey
	Marital status	Household survey
	Occupation	Household survey
	Sources of household income	Household survey
Coastal and Marine Activities	Number of males and females who fish or harvest	Household survey
	Types of important fish and invertebrates for household use, consumption, sale, and cultural value	Household survey
	Average frequency of fishing and harvesting by household members	Household survey
Threats/Opportunities	Perceived conditions of marine resources	Household survey, Key informant interview
	Perceived threats/Opportunities to MPA	Household survey, Key informant interview,
	Perceived solutions to threats to MPA	Household survey, Key informant interview, Focus group discussion
Management	Benefits of MPA to household and community	Household survey, Key informant interview, Focus group discussion
	*Number of MPA supporters	Household survey
	Awareness of rules and regulations	Household survey
	Management effectiveness	Household survey, Key informants, Focus group discussion
	*Level of enforcement	Household survey, Key informant interview

(\*These Micronesian Challenge (MC) indicators should always be included in the socioeconomic household questionnaires. These MC indicators were adopted during the 2<sup>nd</sup> MC measures workshop. \*\* See Appendix 2 for more detail.)

When planning a monitoring program, different combination of indicators in the table can be used depending on management objectives of the MPA, interests of stakeholders, cost and capacity.

### Other important indicators

On the other hand, there may be other indicators that managers may wish to measure depending on their interests and site specific objectives. These indicators may include salinity around river mouths, nutrient level, coral predators such as Crown-of-Thorns starfish and level of compliance with the law and regulations. For MPAs that are established to support fishermen's income, their catch or catch per unit of effort is an important indicator to measure. Data on catch are critical so that the benefits of MPAs can be demonstrated and such information can be used to secure long-term support from resource users. The methods to measure the different indicators that we did not present should be determined by seeking for technical assistance from experts.

#### **4. How to conduct monitoring**

##### **(1) Reconnaissance site visits**

Before you set up the monitoring program, it is necessary to conduct initial reconnaissance surveys of target MPAs, reference sites and surrounding areas to gain preliminary information such as boundary markers of MPAs and number of households nearby and other basic demographics of the area, type of habitats, size, resources and accessibility for monitoring.

##### **(2) Sampling design**

[Ecological monitoring]

The following sampling design is used for ecological monitoring.

- Reference (Control) site:

For each MPA, a “reference” area with similar habitat will be selected outside the MPA, within proximity of the MPA for comparison of data collected.

- Number of Stations:

At each MPA and reference site, a minimum of three stations per major habitat type are randomly selected, preferably using software or other random-selection technique. GPS coordinates for these stations are recorded and repeatedly visited for subsequent surveys.

- Transects:

Five 50-m transects for each station will be placed during each survey, with 2 to 3 meters between the end of one transect and the start of the next.

[Socioeconomic monitoring]

For socioeconomic monitoring, based on the assessment objectives and the identified indicators, the assessment team will need to design questions for household surveys as well as questions and topics for key informant interviews and focus group discussions. The survey respondents and sampling approach should be determined based on the objectives, available number of staff, their capacity, time and fund. The sampling approach could either be random or non-random sampling. It is recommended to consult experts for finalizing sampling design. For more details see Bunce et al (2000) and Wongbusarakum and Pomeroy (2008).

##### **(3) Formation of study team/determine duties/training**

[Ecological monitoring]

To conduct ecological monitoring, the following personnel are required.

- Boat driver—remains with the boat while the divers are in the water
- One diver—Fish visual census (to be capable to identify fish species on scuba)
- One diver—Laying transect tapes following the diver doing the fish census and winding transect tapes once all the data have been collected
- One diver—getting pictures of quadrats along the transects
- One diver-invertebrates survey (to be capable to identify invertebrate species on scuba)
- One diver-recruits survey (to be capable to identify coral recruits at genus level on scuba)

If number of people is limited, then monitoring can be conducted by a minimum of three people. One is the boat driver while two will be doing field surveys. They would have to lay the tape and count the fish, then take photos of quadrates and count invertebrates after that. So while it is possible to do monitoring with 3 people, it would take longer. The safety of the divers needs to be taken into account when doing surveys and divers need to have diving buddies.

Extracting data from photo quadrats requires personnel who can identify benthic organisms.

[Socioeconomic monitoring]

For socioeconomic monitoring the following personnel is needed.

- Trained team leader – Taking the lead by preparing/planning for the monitoring and redeveloping monitoring objectives based on the assessment objectives and other needs for management, supervising development of data collecting tools (which may include household survey questionnaires, semi-structured questions for key informant interviews, and focus group discussion, arranging field logistics, data collecting, training team members, analyzing, and reporting results
- Team member(s) recruited from assessment community, preferably 2 (must have a clear and unbiased mind set) – Support team leader with the above tasks, collect and analyze data
- Other team members (at least 4-must have a clear and unbiased mind set) – Data collection. 3 teams of 2 people (this includes the local team members)
- Data manager – Data entry and analysis

Both for ecological and socioeconomic monitoring, proper briefings and trainings have to be provided before data collection.

#### **(4) Monitoring equipment, cost and time required**

[Ecological monitoring]

Ecological monitoring equipment such as boat, diving gear, digital camera with housing, GPS, 50m transect tape, 50cm x 50cm PVC quadrat, slate and underwater data sheets, and sediment traps are needed. To process sediments, it may be necessary to bring specimen to an institute that is equipped with the proper equipment for weighing and processing the sediments. The recurring costs for monitoring include fuel, salary, food and drinks, underwater data sheets, etc. (Please see detail in Appendix 1). A group of 5 divers can complete 3 stations, which means that it requires 2 days to survey the 3 stations in each MPA with 3 stations and its reference sites.

[Socioeconomic monitoring]

For socioeconomic monitoring, materials such as questionnaires, pens, clip boards, recorder, household list, and maps are needed. In dealing with the data, computers and software for data analysis/management are needed. For each monitoring, costs incurred include those for transportation, salary, printing and food. One pair of surveyors may be able to complete surveys for six households per day, but this would vary depending on the length of the questionnaire and the availability of household members to be interviewed.

#### **(5) Monitoring frequency**

Ecological monitoring should be conducted according to the following frequency based on the indicator being measured:

- Benthic community: Every 2 years
- Seagrass: Every 2 years
- Invertebrates: 2 times per year
- Reef Fish: 2-4 times per year

Socioeconomic study should occur every 3-5 years, unless there are drastic changes at the site that influence existing socioeconomic conditions. If such changes do occur, a socioeconomic assessment is required sooner than the recommended 3-5 years in order to capture the changes.

#### **(6) Draft a monitoring plan and pre-test**

Based on the information obtained, a monitoring plan needs to be prepared. This include, monitoring objectives, indicators, methods, sampling design, monitoring frequencies, survey team structure, necessary equipment and budget.

It is highly recommended that a pre-test be conducted prior to refining indicators, methods, survey team structure and other details. Based on the results of the pre-test, the monitoring plan can be revised and consultation made with those who are experienced in monitoring. When necessary, further trainings have to be provided to survey team.

#### **(7) Process to obtain consensus from stakeholders**

It is important to obtain consensus on monitoring plan of the site from relevant stakeholders such as state government, community leaders, and resource users such as fishers and tourism operators. The consensus is needed so that monitoring activities can be conducted with the support from the different stakeholders. The consultation will include explanation of objectives, methods and expected outcomes of monitoring. Consultation can be conducted by holding targeted meetings, using printed materials and mass media such as TV and radio programs to provide information to the public. Public meetings are also useful to learn about the interests and concerns the people have on environment and resources.

#### **(8) Conducting monitoring work**

Once the monitoring plan is approved and budget is secured, the survey team can initiate monitoring according to the monitoring plan.

#### **(9) Check the quality of monitoring**

Always make sure all the necessary data are collected and recorded on data sheets before leaving the sites. Data should be entered into a database such as Access or a spreadsheet such as Excel, as soon as possible. Special care should be taken to avoid errors in data entry. Original data sheets should be stored in safe place so that researchers can consult when necessary in future. Simple descriptive analysis after entering data may help detect errors in the data entry. Process for backing up data should be developed.

### **5. Data management**

When the monitoring plan is prepared, it is important to determine how to manage the data from monitoring. Management of data include: 1) the way in which data are forwarded by whom to what institute; 2) the way in which data are stored and analyzed; 3) the way in which information is shared among what kinds of stakeholders (those who collect data, decision makers, resource users, scientists, etc.).

We recommend that the head of the monitoring team in each state forward the data to PICRC. The database manager at PICRC will store, compile and analyze data to extract information useful for data management.

### **6. Feedback of monitoring results to management**

The results of the monitoring need to be communicated back to management and stakeholder and communities. The results can inform management whether they are meeting their management objectives. Therefore, it is important to schedule regular meeting where monitoring results are presented and discussed.

### **7. PICRC's role in monitoring**

PAN regulations require PAN sites to develop a management plan. An important component of the management plan is the monitoring plan. Since PICRC has been monitoring marine sites around Palauan since its establishment in 2001, it has the capacity to assist states in coral reef monitoring. Since most states at present do not have the capacity to conduct coral reef monitoring, it is recommended that the states work with PICRC to design their monitoring program and to manage their data.

**8. Funding** – Make the green fee available for PICRC to assist states' monitoring.

For each state, their monitoring program to measure effectiveness of their MPAs would require technical assistance from PICRC. For PICRC to support state monitoring programs, funding for salary, equipment and supplies would be needed. Therefore, a reliable and steady funding to PICRC, from the green fee would allow PICRC to focus on state needs rather than rely on grants. Grants have certain priorities for funding and those do not necessarily match with the monitoring needs of state MPAs.

#### **9. Process to revise**

This protocol can be revised through discussions among members of PAN Technical Committee and approval by the Ministry of Natural Resources, Tourism and Environment.

#### **References**

- Bunce, L. et al. (2000). Socioeconomic Manual for Coral Reef Management. Australian Institute of Marine Science.
- Moving Toward Measuring our Effectiveness: The 2nd Meeting of the MC Measures Working Group and PICRC-JICA Coral Reef Monitoring Project Meeting, 15-19 February, 2010.
- PICRC (2011) MPA Monitoring Plan v. 1.
- Wongbusarakum, S. and Pomeroy, R. (2008). SEM-Pasifika - Socioeconomic Monitoring Guidelines for Coastal Managers in Pacific Island Countries. Secretariat of the Pacific Regional Environment Programme.

## Appendices

### Appendix 1: Description of ecological monitoring

#### a. Fish Size and Abundance

Fish size and abundance will be conducted visually while diving or snorkeling. Fish within 2.5 m of either side of the 50m transect will be recorded by species, size (cm) and number of individuals. Target fish species are those that local people consume and/or that have economic and ecological importance. Target species recorded should be listed on the fish list. The survey is replicated for the four remaining transects. In order to minimize interference by the individual laying the transect tape, the fish surveyor should swim slightly ahead of the tape as it is being laid. The survey and tape laying should be done at the same depth. This results in a sampling area of 250m<sup>2</sup> per transect.

#### b. Coral Cover

Starting at 0m and then at every meter interval, a 0.50 x 0.50 m quadrat will be photographed along the 50 m transect in the field. In the laboratory, the photo will be analyzed using Coral Point Count with Excel extensions (CPCe). For each picture frame, five randomly selected points are overlaid on the photograph and the substrate underneath each point is identified (to the genus level if a coral species) and recorded.

Before beginning the survey, a photograph of the site and station name, data collector, coordinates, and other relevant information should be taken. At the beginning of each transect, a photo of the individual's hand raising the number of fingers that correspond to the transect number. This helps in organizing the photos once they have been downloaded onto a computer for extraction.

#### c. Coral Recruitment

Recruit surveys will be conducted using a belt transect of an area of 0.3m x 10m (only the first 10m of each of the 5 transects). All recruits or young hard coral colonies  $\leq 5$ cm in diameter will be measured to the nearest 0.5 cm and recorded. If possible, the recruit will be identified to the lowest taxonomic level possible. If taxonomic skills are lacking, the recruits will be only recoded as coral recruits. This will be replicated along the four remaining transects. This equals to a sample area of 3m<sup>2</sup> per transect.

#### d. Invertebrate size and abundance

Invertebrates will be identified, measured and recorded along a 2m x 50m transect. A 1-m long stick or pipe will be used to measure the size of the belt transects. Those species to be monitored should be listed on the invertebrate list. Survey will be replicated along the four remaining transects.

#### e. Seagrass Survey

Monitoring of seagrass will be conducted along the five transects used for the coral surveys. Starting from zero, every 5 m interval, a 0.5m x 0.5m quadrat will be placed on the side of the transect and surveyed. For each transect, five quadrats will be surveyed, which mean, only the first 20 m of the 50 m transect will be used for the seagrass surveys. Each species in the quadrat and their percent cover will be recorded.

#### f. Sedimentation Study

The study of sedimentation rate will be conducted on MPAs that are close to watershed drainage areas and are affected from land-use change. A gradient moving away from the mouth of the river toward the MPA will be established and sediment traps will be deployed along the gradient. The number of stations along the gradient will vary depending on the community type along gradients and changes in communities along the gradient. Stations will be established at sites where communities change along the gradient. For each station, two sediment traps with the size of 5.08 cm diameter will be deployed at few meters apart from each other. The traps are established at the same depths throughout the site

and are replaced about every month. Sediment samples collected from the traps will be dried and weighed to obtain total sedimentation rates ( $\text{mg DW cm}^{-2} \text{ d}^{-1}$ ), then re-weighed after treatment with 10% hydrochloric acid to remove carbonate to obtain the carbonate fraction, and then burned at 600 °C for 2 hours to remove organic matter, to obtain the organic matter fraction. The remaining weight will be used to estimate terrestrial (inorganic non-carbonate) sediments.

The traps are fabricated using the pipes and pipe caps, where individual pipes are capped on one end. Once the stations are determined, rebar is hammered about two-thirds of the way into the substrate at a fixed location identified using GPS coordinates and the trap is attached to the rebar with the open end facing up at a depth of ten feet.

#### *Sediment Processing*

Once the traps have been collected in the field, transfer the sample from trap into a 1000mL beaker and use a small hose to remove excess water and refill with new water. Let the sample sit overnight or until all sediment is at the bottom of the beaker. Repeat rinsing of the sample and let it sit overnight three times. Once the sample has been rinsed thoroughly, transfer to a 500mL beaker and let it settle overnight. Once the sediment has settled, remove as much water as possible from the sample and transfer to 50mL-beaker (that has been weighed and recorded) and dry in dryer at 60°C for 24 hours, remove, weigh, and record the sample for 1<sup>st</sup> weight.

Place back into 1000mL beaker and add muriatic acid diluted at 9 parts water to 1 part acid or 8 parts water to 2 parts acid (depending on calcium content of sample) with water for a minimum time of 1 hour. Remove and rinse sample using similar method discussed above, making sure to prevent sediment from being removed, add more water, leave overnight and repeat. Repeat this step three times to remove all acid traces. Transfer to ceramic bowl (that has been weighed and recorded) and dry for 24 hours at 60°C. Once sample has been dried, remove to weigh and record the sample weight (2<sup>nd</sup> weighting). After weight has been recorded, place in furnace to burn for 2 hours at 600°C (1112°F). After sample has dried, obtain and record weight (3<sup>rd</sup> weighting).

#### **g. Visibility**

Measurement of horizontal visibility near seabed will be taken by using a Secchi disc with tape measure at each monitoring station when fish counting is conducted and at each station of sediment traps when traps are replaced.

#### **h. Temperature**

Temperature data logger, HOBO, will be deployed at each MPA. Data logger will be set with intervals of 20 minutes and collected every 3 months.

#### Equipment and Supplies

- Boat
- Boat fuel
- Dive gear for all divers
- Five 50m transect tape (plus a spare)
- 0.5mX0.5m PVC quadrat designed with a camera mount
- Camera and housing
- 1-m stick or pipe
- Slate, underwater data sheets and pencils, scale for recruits
- GPS and batteries
- Food and water
- First Aid Kit
- Secchi disc with a tape measure
- Sediment traps (2" schedule-40 water pipe (5.08cm diameter, cut to 12"), 2" Pipe Caps, Rebar (cut to 1 meter), Cable ties,

#### Laboratory Equipment for Sediment Processing

- Electronic weight scale to  $10^{-4}$  g accuracy
- Drying oven
- Graduated beakers 900mL, 300mL, 50mL
- 1-Liter plastic transfer containers
- Ceramic bowl with minimum 40mL capacity
- High temperature laboratory furnace oven

#### Budget Planning:

##### Recurring costs:

- Fuel
- Salary
- Food and drink
- Equipment maintenance
- Underwater data sheets and pencils

##### One-time costs:

- GPS
- Slates
- First Aid Kit
- Transect tapes
- Camera and housing

#### Supplies

- Questionnaires
- Pens
- Clip boards
- Recorders-key informant and/or focus group interviews (optional)
- Household list
- Map (if necessary)
- Computers
- Software for data analysis and management

#### Expense

- Transportation
- Printing
- Pens
- Clip boards
- Food
- Recorders
- Analytical software (if it's preferred)
- Contractor(s)- if no one is available to produce study
  - To take the lead of the study
  - To be a team member

## Appendix 2: Details of Socioeconomic Monitoring

### Indicators and Methods

Indicators are selected based on the assessment objectives and need to be identified by the assessment team. These indicators will form the basis for the creation of the questions that will be asked.

The different methods for doing a socioeconomic study are described below:

- **Secondary data** are documents, reports, or any collected information that can be helpful in identifying gaps in existing knowledge in preparation for the assessment.
- **Key informant interview** involves experienced and/or knowledgeable individuals who can provide information for larger population such as a state. This semi-structured interview allows the interviewer(s) to deeply explore certain topics and allows the key informants to freely express and present the information that is needed.
- **Focus group discussion** is a type of a “semi-structured interview” resulting in qualitative data. This usually involves a selected group (4-10) of people who share a common background or knowledge. These discussions are based on a set of open-ended questions or discussion topics to generate qualitative information as well as to interact with each other to reach a consensus.
- **Household survey** is a questionnaire that has specific questions with the result of mostly quantitative data.

### Data collection and entry design

Based on the assessment objectives and the identified indicators, the assessment team will need to design questions for household surveys as well as questions and topics for key informant interviews and focus group discussions. These questions will need to be specific and straight forward in order to get a direct answer to the assessment objectives. Household data collection is a method that should be used at all times and depending on how much is known, key informant interviews and/or focus group discussions can also be used. These two types of methods are used to collect qualitative and more in-depth data and information. Once the questions are designed and pre-tested, the sampling approach should be determined. The sampling approach could either be random or non-random sampling.

The design of database is important because it will be used for storing data as well as for data analyses. Codes will need to be developed along with the database especially for the household data collection which can be done on an Excel spread sheet or SPSS or any other statistical analysis software. The analysis of the data will need to include the comparison of the quantitative data from the household surveys and/or focus group discussions.

### Frequency of monitoring

A socioeconomic study should occur every 3-5 years, unless there are drastic changes at the site that influence existing socioeconomic conditions. If such changes do occur, a socioeconomic assessment is required sooner than the recommended 3-5 years in order to capture the changes.

**Personnel**

<b>Team members</b>	<b>Tasks</b>
Trained team leader	Taking the lead by preparing/planning for the monitoring and redeveloping monitoring objectives based on the assessment objectives and other needs for management, supervising development of data collecting tools (which may include household survey questionnaires, semi-structured questions for key informant interviews, and focus group discussion, arranging field logistics, data collecting, training team members, analyzing, and reporting results
Team member(s) recruited from assessment community, preferably 2 (must have a clear and unbiased mind set)	Support team leader with the above tasks, collect and analyze data
Other team members(at least 4-must have a clear and unbiased mind set)	Data collection. 3 teams of 2 people (this includes the local team members). It is ideal for those who collect data to be part of data entry. Members of the data collection team can work with the data manager on data entry.
Data manager	Data entry and analysis

**Supplies**

- Questionnaires
- Pens
- Clip boards
- Recorders-key informant and/or focus group interviews (optional)
- Household list
- Map (if necessary)
- Computers
- Software for data analysis and management

**Expenses**

- Transportation
- Printing
- Pens
- Clip boards
- Food
- Recorders
- Analytical software (if it's preferred)
- Contractor(s)- if no one is available to produce study
  - To take the lead of the study
  - To be a team member