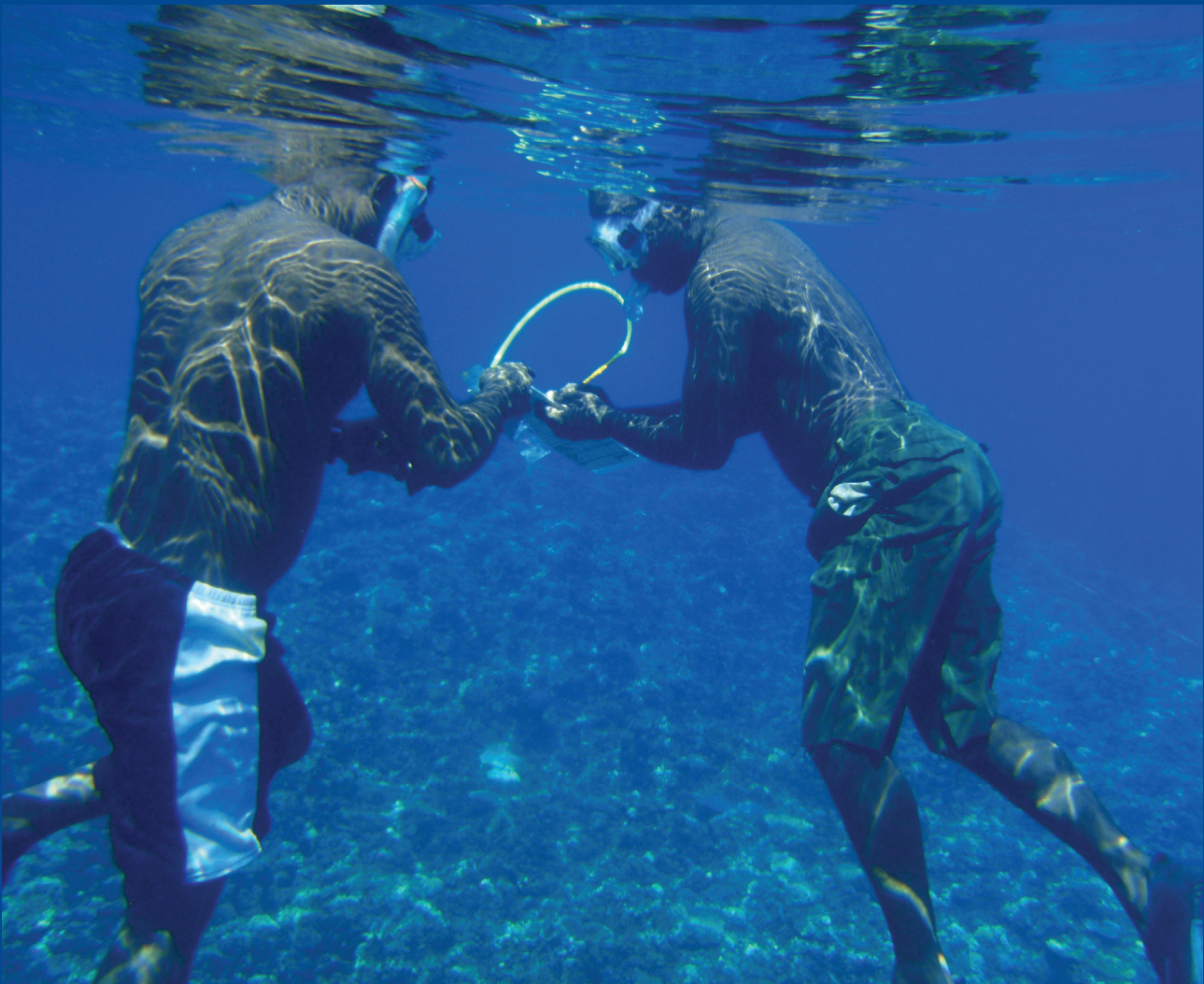




**CORAL TRIANGLE
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Guidelines for Community-Based Marine Monitoring in the Solomon Islands



May 2013

This publication was prepared by WWF in partnership with the Solomon Islands Locally Managed Marine Areas (SILMMA) for the Solomon Island's National Coordinating Committee with funding from the United States Agency for International Development's Coral Triangle Support Partnership (CTSP)



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Guidelines for Community-Based Marine Monitoring in the Solomon Islands

May 2013

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I. Introduction

The Solomon Islands are made up of almost one thousand Islands that are surrounded by ocean and reefs. These marine habitats have a high diversity of flora and fauna which are depended on as resources by the communities that inhabit the Islands. Currently there are numerous conservation and fisheries management organizations working with communities throughout the Solomon Islands to help them manage and monitor their natural resources. As a consequence there is a wide range of management, training, and monitoring methods used for a wide range of species and habitat types.

Through Coral Triangle Support Program (CTSP) funding, the Ministry for Fisheries and Marine Resources (MFMR) and the Ministry for Environment, Conservation, Meteorology and Disaster Management (MECMDM) joined together in 2009 to develop the Coral Triangle Initiative (CTI) National Plan of Action (NPoA). It represents the first comprehensive planning tool for guiding marine resource management and conservation in the Solomon Islands. The NPoA document is now officially recognized by the Solomon Islands government and is guiding the program development of the CTSP Solomon Islands workplan.

In an attempt to better coordinate all conservation and fisheries management activities in the Solomon Islands the National Coordinating Committee (NCC) was formed. The NCC is a technical coordination and advisory body which includes key stakeholders from government and non-government agencies including WWF, TNC, World Fish Center and Foundation of the Peoples of the South Pacific International. The NCC is the key organization for promoting implementation of the national and regional CTI National Plan of Action.

This document provides an overview and review of existing biological/ecological monitoring methods currently used in the Solomon Islands by Government, non-Government organizations (NGOs), research bodies and the communities they support. Funded by the CTSP, it is to be provided to the NCC and partner organizations with guidelines and recommendations for some standardized biological/ecological monitoring protocols that can be used by community groups in the Solomon Islands.

Biological monitoring undertaken by communities ideally should be part of a larger encompassing management plan. A focus of both the NPoA and the Solomon Islands Government Ministry of Fisheries and Marine Resources (MFMR) is Community-Based Resource Management (CBRM). This document can be used as a monitoring tool to assist communities to sustainably manage their resources, which is in alignment with the MFMR and NPoA CBRM objectives. There is also scope for it to be used to help measure against community management targets set in the NPoA. Furthermore, it can link into the Solomon Islands Locally Managed Marine Area (SILMMA) Management Effectiveness Model (currently being developed), as a tool to help assess the effectiveness of Locally Managed Marine Areas in the Solomon Islands. It should be used together with socio-economic monitoring to assess effectiveness of community based marine management.

The objective of this report is to identify and recommend the most appropriate, efficient, and internationally-recognized monitoring methods which can be used in the field, applied by local communities, which provide statistically sound data for management purposes. The aim is to provide some guidelines for standardized biological/ecological monitoring across the Solomon Islands to enable better data sharing and a more coordinated approach to monitoring. It continues on the work completed at The Nature Conservancy (TNC)/ Solomon Islands Locally Managed Marine Areas (SILMMA) workshop held in Gizo (May 2010) to develop standardized monitoring methods for communities.

2. Report Content & Structure

- 1) Firstly, the report provides an overview of the outcomes from the SILMMA/TNC workshop that was held in Gizo in May 2010, which provide a significant contribution to this report.
- 2) Secondly, it provides an assessment of all other monitoring undertaken in the Solomon Islands by communities and partner organizations. In doing so, it considers the benefits and limitations of each of the methods.
- 3) Thirdly, and most significantly, this report provides a discussion on the importance of defining the management objective of the community when selecting a monitoring method. It provides a framework that community groups or partners can use when selecting the most appropriate monitoring method for them.
- 4) Finally, it makes recommendations on some standardized monitoring protocols, for community groups and partner organizations. It provides some discussion on linkages to the NPoA, SILMMA, and the MFMR's National Inshore Fisheries Strategy. It also presents details on the resource requirements and training needs of the recommended monitoring methods.

Conservation, Government, and Research organizations undertaking monitoring and resource management in the Solomon Islands who contributed to this document:

- The Nature Conservancy
- Ministry for Fisheries and Marine Resources (MFMR)
- Foundation of the Peoples of the South Pacific International (FSPI)
- World Fish Centre
- Solomon Islands Locally Managed Marine Area Network
- Tetepare Descendants Association
- Ministry for Environment, Conservation, Meteorology, and Disaster Management
- University of Queensland
- World Wide Fund for Nature
- Rovianna Conservation Foundation
- University Of South Pacific

3. TNC/ SILMMA Community Monitoring Workshop

The main purpose of the TNC/SILMMA Workshop was to have a focused consultative stakeholders review and discussion of the monitoring protocols currently in use by communities within the SILMMA Network, and to discuss the objectives and goals of community monitoring. A summary report on the workshop was prepared and circulated in August 2010. Within the report there is;

- 1) A draft agreement on some community based monitoring principles; and
- 2) A discussion of the different objectives of community-based monitoring.

A draft manual of community-based monitoring protocols was also developed. This focused on two monitoring methods; Underwater Visual Surveys (UVS) and Catch Per Unit Effort (CPUE). These methods were recommended primarily for community groups working with or without partner support as being simple to implement and having low resource requirements. These are provided in Additional Resources I of this report and discussed further below.

3.1 SILMMA Community-based Monitoring Principles

The following guiding principles were discussed at the TNC/SILMMA workshop and have been adopted by the partners for community-based monitoring protocols for some key species and habitats.

- 1) Communities must be clear about why, how, and what type of data need to be collected and for who.
- 2) Maintain scientific monitoring principles so that data is reliable for community Marine Resources Management and awareness purposes, for example, importance of replication, use of control sites, site selection, and stratification (where necessary).
- 3) Community must use the appropriate methods for data collection/analysis and be clear about what results are expected.
- 4) Community monitoring is undertaken for the following objectives:
 - Participation, involvement, and education
 - Awareness at the community level
 - To help the community to make management decisions
 - Monitoring and evaluation for projects and country network
- 5) Community monitoring should, as much as possible, be voluntary but in the future SILMMA may be in a position to facilitate with incentives if community meets certain requirements e.g. Registration, Management Plan, Commitment to monitoring, etc.
- 6) If community-based monitoring is done well, it can also support government and other institutions monitoring initiatives.
- 7) Involve provincial Fisheries Officers wherever possible.

4. Review of Existing Monitoring Methods

Currently in the Solomon Islands, there are in excess of twenty different biological/ecological monitoring methods used across a wide range of flora and fauna. The methods vary in their complexity, resource requirements, and scientific rigour. The protocols being used by community groups and partner organizations were recorded for each habitat and species group and are presented in Table 2 below.

The following species and habitat groups were considered.

Habitat

- Seagrass
- Coral Reefs
- Mangroves
- SPAGs

Species groups

- Corals
- Algae
- Invertebrates
- Fishes
- Marine Turtles
- Coconut Crabs

Table 1.
Current Use of Monitoring Protocols in the Solomon Islands by Communities and Partner Organizations

	Seagrass	Reef/ Substrate	Invertebrates	Fish	SPAGs	Turtle	Mangroves	Coconut Crab
World Fish	X	X	CPUE UVS Dashboard/ Indicator Species	CPUE Dashboard/ Indicators, FAD Monitoring	X	X	Carbon Monitoring	X
TNC	X	SICRMN	Transect methods	SICRMN	Density counts	Nesting Tagging	X	X
TDA	Seagrass Watch	Reef Check	Reef Check Timed/ Area Counts	Fish Biomass UVS Resource harvest data (CPUE)	X	Beach, Monitoring, Turtle Rodeo, Tagging	X	Baited trail- transects
WWF	Seagrass Watch	SICRMN	SICRMN	SICRMN	Density counts	X	Replanting Re- vegetation	X
UQ	X	UVS- SILMMA Photo quadrats (coral point count)	UVS- SILMMA UVS – SICRMN	UVS- SILMMA UVS – (biomass) SICRMN	X	X	X	X

	Seagrass	Reef/ Substrate	Invertebrates	Fish	SPAGs	Turtle	Mangroves	Coconut Crab
RCF	X	UVS- SILMMA		UVS- SILMMA UVS - SICRMN	X	X	Mangrove bivalves	X
FSPI	X	Reef Check	Mark and recapture for trochus	Reef Check	X	X	***TBP	X
Other							Ellison 1997.	

* Note: Species surveyed by WorldFish represent „indicator species “selected by the communities they are working with as part of a larger,, adaptive community-based management approach” (Indicator dash-board). See Schwartz et al 1997.

SILMMA UVS: Solomon Islands Locally Managed Marine Area Network Underwater Visual Surveys (Additional Resources 1)

CPUE = Catch Per Unit Effort (SILMMA document courtesy of World Fish) (Additional Resources 2).

UVS = Underwater Visual Surveys – See Notes on (Additional Resources 3).

SICRMN = Solomon Islands Coral Reef Monitoring Network (Additional Resources 4).

SPAGs = Spawning Aggregations (coral trout) (Additional Resources 5).

Ellison 1997 = Manual for mangrove monitoring in the Pacific Islands Regions-Monitoring Changes in Mangrove Condition (Additional Resources 6).

Baited-Trail Transects for coconut crabs, based on Fletcher et al 1990. (Additional Resources 7).

4.1 Summary of Monitoring Methods; Strengths and Limitations of Each

The range of monitoring methods used in the Solomon Islands, as shown in Table 1, can be broadly divided into two categories (Types) based on the resources required and the data being collected. This divide has been created based on the outcomes of the SILMMA monitoring workshop, and through detailed discussions with partner organizations currently working with communities in the Solomon Islands.

- a) Type 1:** Relatively simple (and low resource/cost) methods for communities with little partner support. These methods can be used to detect gross changes but are restricted in their statistical application and scientific rigour. However they can still be powerful tools for engagement, education, and awareness-raising.
- b) Type 2:** More complex (and more resource intensive) methods that are most suitable for communities who have support and training from partner organizations. While more labour and resource intensive, these methods are more scientifically rigorous, and statistically robust, making them more suitable for data sharing between organizations and for comparisons across locations.

The strengths and limitations of each monitoring method were assessed, specifically for community monitoring in the Solomon Islands. They were assigned as either Type 1 or Type 2 and are provided in Table 2 below.

The results from the review (Table 2) are incorporated in the recommendations further in this report.

Monitoring Protocol	Group	Strengths	Limitations
SILMMA UVS	Type 1 Corals Invertebrates Fish	Easy to implement Locally relevant species Gross patterns detected Successfully used by communities Engagement tool Agreed on by SILMMA members Uses local names Engagement tool	Statistical comparisons limited Restricted to shallow depths Some training and resources required Bias relating to diver enthusiasm and ability, underwater visibility, transect placement
SILMMA/WorldFish CPUE. – catch rate/ weight/size	Type 1/2 Invertebrates/Fish	The catch rates for weight or number of fish over a certain size seem most useful to measure indicators as they reflect both ecological status of the reef and the effort required to take the catch Low resources required Detections of gross changes Useful tool for guiding discussions on the performance of marine resource management Engagement tool	CPUE difficult for communities to grasp Some training required Catch rates are relatively complex in calculation and sensitivity to factors other than management performance (e.g. changes in gear efficiency). Can only be used outside an MPA or in a temporal closure (not within tambu area) Effectiveness not determined as yet

Monitoring Protocol	Group	Strengths	Limitations
WorldFish Length/size	Type 1/2 Fish size	The size of fish is a useful way to measure an indicator species if the assumptions of catch rate do not apply or are too confusing for a community Low resources required Detections of gross changes Successfully used by communities Engagement tool	Can only be used outside an MPA or in a temporal closure (not within tambu area) Does not directly reflect the number of fish or how long it takes to catch the fish
TDA – Fish biomass survey	Type 2 Fish	Locally relevant species Statistically meaningful Successfully used at Tetepare Local names used Completed on snorkel Engagement tool	Higher level training required High level resources Bias relating to diver enthusiasm and ability, underwater visibility, transect placement can be minimised through training and consistent divers
SICRMN (see additional notes on UVS Additional Resources 4)	Type 2 Habitats Reef Fish Substrate Invertebrates	Internationally recognized Contributes to GCRMN - ReefBase Different habitats (depths) surveyed Statistically meaningful TNC have modified the designed specifically to monitor effectiveness of MPA's.	Requires SCUBA and training Bias relating to diver enthusiasm and ability, underwater visibility, transect placement
SPAGs (Additional Resources 5)	Type 2 Fish	Successfully completed by TNC/WWF in the SI – with training workshop Proven as an effective monitoring and management tool for SPAGs	Monitoring of SPAGs is best done with technical and funding support by partner organizations. Involvement of technical personnel is recommended. Especially in the first 1-2 years when capacity building is going on. If communities are involved in monitoring then funding has to be provided. SCUBA necessary
Reef Check (Additional Resources 8)	Type 2 Habitats Reef Coral Fish Invertebrates	Internationally recognized Data sheets formulated for communities ReefCheck Int. can provide resources to communities Engagement tool	Requires training and medium resources Limited quantitative measure of bleaching Bias relating to diver enthusiasm and ability, underwater visibility, transect placement Limited division between hard and soft corals Indicator species not commercially relevant species Often not statistically powerful enough to monitor invertebrates in low density areas
Timed swims (Additional Resources 9)	Type 1/2 Invertebrates	Limited training required Low resource - fast and easy to do Statistically powerful enough to monitor populations Engagement tool	Timed swims must have area calculations to make data meaningful and comparable Site selection important Diver bias Some resources (snorkel equipment)
Baited Transects (Additional Resources 7)	Type 1/2 Coconut Crab	Successfully used on Tetepare Simple data techniques Statistically significant changes can be detected with correct replication Engagement tool	With correct replication it can be resource intense High natural variability Engagement tool

Monitoring Protocol	Group	Strengths	Limitations
Seagrass watch (Additional Resources 10)	Type I Habitat: Seagrass	Education and training support provided by SeagrassWatch organization Methods can be adapted for communities Surveys can be completed by women Engagement tool	Some basic training required Medium level of resources
Ellison 1997 (Additional Resources 6) Note: World Fish are intending to develop a how to manual for communities to measure/monitor for carbon, but have not started yet (expected August/Sept 2011).	Type I/2 Habitat: Mangrove	IUCN are promoting the first sections of the manual as possible community activities - but dependant on the reason for sampling Engagement tool	Yet to be tested for community monitoring Requires some training and resources (GPS and aerial photographs)
TDA (and TNC Arnavons) Turtle Monitoring (Additional Resources 11)	Type I/2 Turtles	Beach monitoring (of adults) uses simple and easy techniques Can attract large donor support Attracts tourists Engagement tool	Nest monitoring (egg relocation) can be complex Training/education work shop required Nightly beach patrols require high resources May requires funds to support incentive program or wages for turtle monitors Must have community support
FSPI/RCF (Additional Resources 12)	Type I Mangrove bivalve survey	Successfully used by communities Engagement tool	
Perception Monitoring (A measure of how communities feel they are making progress or meeting their objectives)	Type I	The communities level of satisfaction is an important variable that is relatively easy to track Can be used to monitor against qualitative management plan objectives	Can be observer bias. Qualitative and subjective. Can be difficult to measure change. Other factors may influence community perception.

Training and Resource requirements (see Table 5 for more details):

- **Low (minimum):** ½ day training
- **Medium (e.g ReefCheck):** Three days training, and basic resources like fins; masks; tape measures; slates.
- **High (e.g SIGCRMN):** At least five days, + SCUBA training and equipment; some biological knowledge e.g. coral growth forms etc

5. Guidelines for Community-based Monitoring within a Management Context

The NPoA aims to have 25percent of Solomon Island’s marine habitats and resources better managed (by 40percent) through community-based management by 2015. The SILMMA (Solomon Islands Locally Marine Managed Area) network is the key institution that can facilitate this by providing the necessary support and education to assist communities (particularly with no partner support) in making the decisions on how to manage and monitor their resources. This document provides guidelines and a framework for SILMMA network members and communities to use when selecting monitoring methods as part of a larger management plan.

Alternatively, communities or partner organizations can refer to the recommendations in Section 6 of this report which are based on the review of existing methods provided above and the framework outlined below.

5.1 Framework for Selecting Appropriate Monitoring Methods

This framework emphasizes the importance of defining the monitoring or management objective of the community when developing a monitoring program. It also highlights the influence that resource availability and partner support has on selecting a suitable method.

When deciding which monitoring methods are most appropriate for them, communities should ask themselves three questions:

- 1) Most importantly - what is the management objective of the monitoring?
- 2) What resources/support from partner groups is available? and
- 3) What are the skill levels (knowledge/ability) of monitors to complete the task, and how much time can be allocated to monitoring?

By answering these questions they will be well-placed to understand which monitoring program is best suited to them. These are discussed further below.

5.1.1 The Management and Monitoring Objective

Defining the community management objective is the first “monitoring principle” identified by SILMMA. The management objective of a community will determine the subsequent monitoring methods they need to employ. Ideally, monitoring should be part of an “Adaptive Resource Management Plan”, where the data collected from surveys is used to answer questions related to the management objective.

The management objective can vary greatly between communities and as a result they may be monitoring for either one or more of the following reasons, as examples;

- To monitor resources as cash commodities (bêche de mer or Trochus)
- To monitor resources for subsistence or artisanal purposes
- To monitor effectiveness of Marine Protected Areas (Tambu Areas)
- To monitor the effectiveness of conservation measures
- To monitor individual species for conservation (e.g turtles)

The data collected through monitoring can be used to answer questions that will help us to improve the management of our resources. For example:

- Are resources increasing in a Marine Protected (Tambu) Area?
- Are resources decreasing in an area, and do they need to be better managed?
- Are there changes in biodiversity?
- How many turtles are nesting on a beach?

The management question and monitoring purpose needs to be determined in order to select the most suitable monitoring protocol.

Also consider that the management objective of a community may differ from a national objective. For example, a community may mostly want to know about abundance but others (NGOs/Government) will want to know about ecosystem health. The National Plan of Action (NPOA) should be considered.

5.1.2 Resource Availability and Partner Support

The other factor that will influence the appropriateness of a monitoring method, are the resources available (including training) to each community. Three broad categories are:

- Group 1: Community monitoring, with little or no partner support
- Group 2: Community monitoring with partner support (with or without resources); and
- Group 3: Scientific research/monitoring by universities and government agencies.

The focus of this report is on Group 1 and 2. However, data sharing between communities, other organizations and the Government are discussed in Section 9 of this report.

5.2 Applying the Framework

After answering each of the questions in 4.1, a community should select the monitoring methods that best meet their objectives. They can do this by considering the information in Table 2. It is suggested that community groups with little or no support (Group 1) should try to use the methods classified as Type 1 (or Type 1/2).

Alternatively communities may choose to select from the Recommendations in the next section (Section 6) of this report. SILMMA can assist communities during any of these stages.

A summary table with characteristics of the two types of monitoring groups are provided in the following.

Table 3. Characteristics and use for each level of community-based monitoring		
	Group 1: Community Monitoring with no support	Group 2: Independent Community Monitoring with partner support
Characteristics	Type 1. Methods Easy to learn and replicate Requires limited training Low resource requirements (e.g no scuba) Data analysis is simple Sustainable program with limited resources Engagement tool Limited time required from community	Type 2. Methods Training provided Resources available More complicated analysis (statistics)
Suggested use	Community engagement Education and awareness tool Monitor gross changes over time	Comparisons across locations Sampling can accounts for natural variability Statistically comparisons Community engagement Education and awareness tool Securing donor support
Disadvantages	Not statistically meaningful Does not account for natural variability	High resource requirements May not be sustainable with departure of partner organization

6. Recommended Community-based Standardized Monitoring Protocols

This section makes recommendations on some standardized monitoring protocols (Type 1 and Type 2) available to communities and provides details on the resource requirements and training needs of each. By applying a range of standardized monitoring protocols, it can facilitate better data sharing, site comparisons, and more effective assessment of marine management throughout Solomon Islands.

These recommended monitoring protocols can be used as a tool to assist communities to sustainably manage their resources, which is in alignment with the SIMFMR and NPoA CBRM objectives. It can also link into the SILMMA Management Effectiveness Model (currently being developed) as a tool to help assess the effectiveness of locally Managed Marine Areas in the Solomon Islands.

6.1 Message for Communities

It is important for communities to be aware that these recommendations and methods are provided for assistance. A community may choose to use one or more of them if the type of monitoring is relevant for them as a community. Some important points are:

- These monitoring methods are not mandatory to make your management work (or to be a SILMMA member).
- As a community, you should not feel that you must be doing things in a particular way in order to be “doing it right”.

Just swimming over the reef and looking at the water quality, corals, and fish is also useful. Without any training you can still look at the reef and see if your management plan is working (Perception Monitoring).

Also, time put into monitoring should be balanced with the other priority activities that a community has to do to make their management effective. If they are actively monitoring but still experiencing poaching or destructive fishing it may be more important to do a less rigorous monitoring approach and put more time into awareness, outreach, compliance, and enforcement.

6.2. Recommendations for Standardized Monitoring Protocols

In creating a set of recommended monitoring protocols, the following factors were considered:

- SILMMA Community-based Monitoring Principals
- CTI National Plan of Action
- SI National Strategy for the Management of Inshore Fisheries and Marine Resources
- Linkages with the international GCRMN
- Continuity of existing data sets
- Ability to make comparisons across various areas

These factors were considered in alignment with the questions provided in the framework described above:

- Monitoring objective
- Resources and training required by participants
- Skills needed by the monitors (on ground capacity)

Through considering these aspects it was evident that there was no “one-size monitoring approach fits all” suitable for communities in the Solomon Islands. Rather a divide was necessary between community groups that had partner support and those that did not. It was also necessary to group the recommendations based on the objective of monitoring and these are provided in Table 4.

A detailed methods document for each Monitoring Protocol is provided in the Additional Resources. These methods serve for baseline data collection, as well as on-going monitoring.

Table 4. Recommended Monitoring Protocols for Community-based Monitoring in the Solomon Islands		
	Group 1: Independent Community Monitoring with limited support	Group 2: Community Monitoring with partner support
Monitoring Strategy	Type 1 : Limited resources. SILMMA support available	Type 2: Resources, Training and ongoing support required
To monitor resources as cash commodities (bêche de mer or Trochus)	CPUE Timed/Area Counts SILMMA UVS Perception Monitoring	CPUE Timed/Area Counts UVSC - Belt transects SICRMN
To monitor resources for subsistence or artisanal purposes	CPUE SILMMA UVS	CPUE SICRMN Reef Check
To monitor effectiveness of Marine Protected Areas (Tambu Areas)	SILMMA UVS CPUE Perception Monitoring	CPUE SICRMN SPAGs Timed/Area Counts

To monitor effectiveness of conservation measures	SILMMA UVS Perception Monitoring	SICRMN Photo Quadrats Reef Check
Mangroves	RCF method – Mangrove Resources	Ellison 1997
Seagrass	Seagrass Watch	Seagrass Watch
Turtles	Simplified TDA methods (counts only)	TDA and TNC Nesting and tagging Methods
Coconut Crabs	Baited Transects	Baited Transects
SPAGS	Community observations	WWF/TNC methods

Communities will need to collect baseline monitoring data in order to make meaningful comparisons with the ongoing data they collect over time. Baseline data is the initial data collected on a species or habitat that communities can use to make comparisons against over time. The methods for collecting baseline data will be the same ones used for monitoring.

All Monitoring Protocols can be located as PDF attachments on the CTI- CFF website:
www.coraltriangleinitiative.net

7. Resource Requirements (Equipment and Training)

The resource requirements vary significantly between different monitoring methods. Although Type 1 protocols by definition require fewer resources than Type 2, there is still difficulty in determining a clear divide in the level of resource requirements between the two. Even Type 1 protocols require some initial training. A generalized estimate of the minimum training requirements (time) for communities to learn how to undertake monitoring surveys is provided below in Table 5.

A consideration for any type of monitoring is the sustainability of the monitoring program. After initial training resources are provided to communities, are they able to continue the monitoring without partner support? WorldFish are continuing to research what are the minimum resources a community needs to establish an ongoing and sustainable approach to community-based resource monitoring and management. However, in the absence of that information, it is still difficult to define.

It is acknowledged that initial training often also requires on-going guidance and support to be effective. While this defines Type 2 monitoring, in many cases in the Solomon Islands it is also true of Type 1. While it can be argued that partner supported projects are not sustainable or viable over a large number of communities as per the 25percent NPoA goal, it is maintained that it can still be successful and sustainable in the longer term by providing the community with the skills to undertake surveys, and to manage their resources as has been done on Tetepare and in the Arnovons for example.

These organizations have had partner support, but are now capable of operating independently. They can act as examples of community-based marine management for other communities and organizations. They can play an important part in the spread-model that the Solomon Island Government is advocating.

The resources required for developing community-based management plans, or to analyze the monitoring data once collected has not been assessed here. However this is an area that SILMMA (through partner organizations) can assist communities with. It is proposed that the best form of resource investment in community-based management and monitoring is in building local capacity to undertake this type of work.

The information provided in Table 5 is a simple indication of the initial training required to learn the monitoring methods provided in the recommendations. A detailed list of equipment is provided in each of the Monitoring Protocols found in the Additional Resources.

Table 5.**Basic Initial Training Requirements (time) for each Method or Habitat/ Species Type**

Group	Training Requirements
Seagrass (Watch)	3 days training. Theory and practical (in water). Refresher before each sampling.
Reef – UVS/Reef Check	Ideally 3-5 days. Theory and practical (in water). Coral ID familiarity; estimating percent cover; transects.
Invertebrates: UVS	3 days invertebrate ID, theory and practical (in water).
Fish (UVS)	3-5 day. Species/Families, Size training, UVS theory and practical (in water).
SPAGS	5 day workshop – theory and practical.
Turtles	5 days, including look and learn visit to Tetepare or Arnavons.
Mangrove	One week theory and practical.
Coconut Crab Baited Trail	2 days (nights). Bait setting, monitoring – crab measurement, data recording.
CPUE	3 days initial training, with 3 × 1 day 3 monthly follow ups.
Timed swims	2 days. Species identification, measurements, field protocols (collect and return), area estimates.

Training should be conducted by a suitably experienced individual. Training materials are available for SeagrassWatch and Reef Check.

8. Completing the Surveys: Monitoring Schedule, Data Collection, and Management

This section provides some guidance on implementing the recommended monitoring protocols. It discusses site specificity, monitoring schedules, as well as data collection and management.

8.1 Implementing the Surveys

Following the selection of an appropriate monitoring method, and before implementing them in the field, it is important for communities to also take into account local environmental and social factors specific to them such as:

- Local site characteristics (e.g. size of managed area) – can you complete the surveys (number of transects etc) in the area you have?
- Availability of people/resources – who will complete the surveys? Do you have the right equipment? How remote is the site for access?
- What are the costs associated with the monitoring? Fuel, wages, equipment? What is your budget?
- Are there any training needs? Who can provide training for you?
- Community support and commitment – do the whole community support the management and monitoring objectives? Do you need to do any awareness or education programs?

Each of the monitoring methods provided in the Additional Resources provide specific and detailed methods. However some minor variations may need to be made to suit the community location and objective. In doing this some general monitoring things to consider include:

Number of Transects

It is important that the number of transects recommended in the Additional Resources are used as a minimum (especially for the Group 2 Methods – with partner support). Reducing the number may reduce the statistical power or significance of the data collected.

Habitat Selection

It is also important to consider the habitat being monitored. If a community are specifically targeting trochus and want to know densities in an area for example, they will need to target sampling in known trochus habitat. If the objective is to determine the distribution of trochus, they will need to sample across a wide range of habitats.

Frequency of Surveys

The more regular the surveys are completed the better. Sampling every month or three months for example accounts for seasonality and natural variation.

Ideally all marine surveys should be conducted quarterly; however this can be very resource intensive. Semi-annual (twice a year), or even annual surveys can still be valid. However it is important that annual surveys are conducted at the same time each year, using the same methods to allow for meaningful comparisons. More details are provided for each monitoring methods in the respective Additional Resources.

8.2 Data Management

Of equal importance to data collection is data management. All too often data is collected and then subsequently lost or not managed appropriately. The following data management recommendations are made;

- Where possible waterproof paper should be used in the field to collect data.
- Data sheets must be completed 100 percent in the field. As well as the field data, they should include; date, location, and the name of the recorder as a minimum.
- Data collected in the field must be recorded onto a clean data sheet at the end of each day for filing (hard copies should be kept of all data sheets).
- Where available – data should be entered into an excel (or Access) spread sheets (or other suitable database).
- Whenever possible data entry should be checked by a second person to minimise transcribing errors.
- Electronic copies should be stored in relevant (survey type or location) folders with appropriate names (site_location_survey type_ date_ recorder).
- Back-up copies of all electronic data should be made.
- The data should be submitted to LMMA, SILMMA, and ReefBase where appropriate.

9. Analysing and Using the Data to Make Resource Management Decisions

Equally as important as collecting the data is using the data to make resource management decisions. This section discusses three important areas:

- 1) Data analysis
- 2) Community-based adaptive resource management; and
- 3) Sharing data at local, national, and regional levels for higher level strategic resource management.

9.1 Data Analysis

There are numerous types of data analysis suitable for resource management. While in some cases high level statistical analysis is appropriate, often quite simply basic comparisons are sufficient. Community organizations will need to seek training from partner organizations to assist them to analyze their data. Alternatively SILMMA can assist them with this. WorldFish have provided some basic training information on data analysis for CPUE (Additional Resources 13). Likewise Additional Resources 1, SILMMA UVS provides an example of some data that has been analyzed and graphed.

Baseline data (the first survey in a time series) is required for meaningful monitoring. Communities must learn how to make comparisons between the monitoring data they collect, against the baseline data, to understand patterns through time.

Where possible, a Pilot study should be completed when first implementing a new monitoring method (especially for type 2 surveys). A pilot study would include a simple analysis of the data to determine if it is sufficient for statistical analysis and comparisons. If there is high variability in the data (standard errors), or there are too few data points communities may need to:

- Increase the number of samples (increase transect numbers or lengths)
- Increase the frequency of surveys.

9.2 Community-Based Adaptive Resource Management

Once a community collects its monitoring data, and has analyzed it, they need to review it and see what the data is telling them. If monitoring indicates that a particular resource or habitat is increasing or decreasing, then a community should have a management strategy to address this.

Ideally, any monitoring undertaken by communities will be part of a larger encompassing management plan. This links back to the objective of the monitoring as described previously. Communities, with the assistance of SILMMA or a partner organization need to develop meaningful management strategies for the resources they have selected to monitor. Some examples are discussed below.

A community-based resource management strategy that WorldFish use is an indicator-dashboard approach as detailed in (Schwarz et al 1997). WorldFish work with communities and assist them in selecting an indicator threshold for a species of interest to the community (for example a community may wish to monitor *bêche de mer*). If while monitoring the stocks of that indicator species, they drop above or below the pre-set threshold range (defined by the community), then the information (illustrated through a dashboard) is taken to the AGM of the community organization, so that a decision can be made. A decision for example, may be to place a *tambu* - a type of ban under customary law - on fishing for that resource for a given time.

There are various ways to develop thresholds for community-based resource management. A threshold can be any value defined by a community regarding a particular resource. It may be, for example, that baseline surveys indicate that coral cover in an area is 60 percent, if coral cover drops below a threshold range of say 40 percent - 50 percent in subsequent surveys then this will trigger a response from the community. The same would hold for fish stocks - a community may know that within a given area there is approx 200kg of fish per hectare at a certain time of the year based on monitoring data, if monitoring indicates it has dropped below a range of 175kg - 150 kg (at a similar time of year) then this may also be a trigger for a management response. Likewise an increase to 250 kg may mean the community agree to lift a temporal *tambu* area. These thresholds can be used by the community to trigger meaningful management decisions about their resources, based on the monitoring being done.

Another example of using thresholds for management comes from the TDA. They used coconut crab data collected from monitoring to illustrate to the community that although stocks of coconut crabs were healthy in the MPA, stocks were depleting outside of the protected area to below an acceptable level (a threshold). As a result the community made a decision to establish some additional/temporal no-take areas around Tetepare to help to protect coconut crab stocks.

While these are good examples of community-based adaptive resource management in the Solomon Islands, there are still many communities who are not well resourced or trained to undertake this important step of monitoring and management.

There are few communities (with or without NGO or Government support) that have been able to maintain statistically valid monitoring. It is extremely challenging and proving difficult to attain in many areas of the world. It would seem more feasible and cost effective for communities to focus on Type 1 monitoring at the community level, and for SILMMA, NGOs, and Solomon Island Government to invest time into Type 2 monitoring which may be less regular but would have more scientific rigour. It is recommended this becomes a priority area for conservation organizations and SILMMA.

9.3 Data Sharing

Currently within the Solomon Islands there are large amounts of data being collected by community and partner organizations, however sharing is on an ad-hoc basis and not well co-ordinated. Currently the Ministry for Environment, Conservation, Meteorology and Disaster Management are working with SILMMA to better improve data sharing and Knowledge Management.

It is recommended that all community groups and partner organizations provide monitoring data (and management decisions) back to SILMMA. By using a more standardized approach to monitoring in the Solomon Islands – it will improve data sharing and comparisons across areas.

Communities and parent organizations should also endeavour to provide monitoring data to the GCRMN (ReefBase), to facilitate better regional data sharing.

Community monitoring plays a significant role in both national and regional resource management. Data collected from community monitoring can be used by the MECMDM to measure against the community based management targets set within the NPoA. This linkage will continue to be developed through the NCC and the CTI NPoA.

Likewise, community data can also link into the SILMMA Management Effectiveness Model (currently being developed), as a tool to help assess the biophysical effectiveness of Marine Protected Areas in the Solomon Islands.

10. Summary and Recommendations

The objective of this report was to identify and recommend the most efficient and appropriate internationally recognized monitoring methods which can be used in the field, and applied by local communities. It was evident however, that there is no one-size fits all monitoring approach suitable for communities in the Solomon Islands. Rather a divide between community groups that have partner support and those that do not is necessary. In addition, the monitoring objective of the community will also determine which method is most suitable.

This document provides guidance and a framework for SILMMA and communities and partner organizations to use when selecting appropriate monitoring protocols for community-based resource management. It does this by providing three questions to help communities determine which monitoring methods are most appropriate for them:

- 1) Most importantly - what is the management objective of the monitoring?
- 2) What resources/support from partner groups is available? and
- 3) What are the skill levels (knowledge/ability) of monitors to complete the task?

The recommendations for standardized monitoring protocols in Section 6 of this report are based on this framework. Detailed methods for various monitoring techniques are provided in the Additional Resources of this report.

There are a number of species and habitats that are not commonly being monitored by communities, that are being heavily harvested. These should be considered by SILMMA and raised with the network members as important resources to monitor. They include:

- Clams
- Crayfish
- Mangroves and mangrove resources

In addition, it appears that very little (if any) baseline climate change data is being collected in the Solomon Islands. Basic data collection (water temperatures, bleaching) could be incorporated into existing monitoring programs with ease. However, this is another area where training would be required to assist communities to understand what they are monitoring for and managing against.

Ideally, any monitoring undertaken by communities will be part of a larger encompassing management plan. Communities, with the assistance of SILMMA or a partner organization, need to develop meaningful management strategies for the resources they have selected to monitor. These guidelines can assist communities on how to monitor their resources, as part of a larger management approach. SILMMA in

can provide further support and education to assist communities (particularly with no partner support) in making the decisions on how to manage and monitor their resources.

There are few communities (with or without NGO or Government support) that have been able to maintain statistically valid monitoring (Type 1 or 2). It is extremely challenging and proving difficult to attain in many areas of the world. It would seem more feasible and cost effective for communities to focus on Type 1 monitoring at the community level, and for SILLMA, NGOs and Solomon Island Government to invest time into Type 2 monitoring which may be less regular but would have more scientific rigour.

While it can be argued that partner supported projects are not a sustainable approach to community-based resource management, it is maintained that it can still be successful and sustainable in the longer term by providing the community with the skills to undertake surveys, analyze data, and make resource management decisions. Through preparation of this document, it was evident that many communities lack the skills and knowledge to do this adaptive management. **It is recommended this becomes a priority area for conservation organizations and SILMMA - to facilitate better use of resource data in community based resource management.** It is proposed that the best form of resource investment in community-based management and monitoring is in building both SILMMA and local capacity to undertake this type of work.

Community monitoring plays a significant role in both national and regional resource management. Using Type 1 (lower resource) community monitoring, to meet the Solomon Island Governments (NPoA) 25 percent target of improved community-based marine management, is perhaps more achievable simply due to the lower resource requirements. However, the value in Type 2 data should not be undermined. It can be used for comparisons across locations, and for a more scientifically rigorous assessment of the effectiveness of Marine Managed Areas. It is probable that this would require NGOs, SIG, or researchers to complete these surveys.

By applying a range of standardized monitoring protocols, it can facilitate better data sharing, site comparisons, and more effective assessment of marine management throughout Solomon Islands. It is recommended that all community groups and partner organizations provide monitoring data back to SILMMA to generate a better national database on marine resources and community managed areas.

While this document provides guidelines on monitoring species or habitats against a management objective, a management plan and community-based organizations should also have a mechanism to assess their own effectiveness too. This is to be developed by SILMMA & CTI NCC MPA Technical Working Group.

Finally, while this document provides guidelines for biological and ecological monitoring, it should be noted that socio-economic monitoring is also an important part of any resource management plan.

References

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Fletcher, W.J., Brown, I.W. and Fielder, D.R., 1990b. Growth of the coconut crab *Birgus latro* in Vanuatu *Journal of Experimental Marine Biology and Ecology* 141: 63-78.

NPoA (2011) Solomon Islands National Plan of Action. Coral Triangle Initiative on coral reefs, fisheries and food security. Solomon Islands Ministry for Environment, Climate Change and Disaster Management.

Schwarz, A., D. Boso, and C. Ramofafia (1997). Improving sustainability and profitability of village sea cucumber fisheries in Solomon Islands. Final Report. World Fish Centre. ACIAR, Canberra.

Additional Resources

The additional resources below can be useful for communities that are conducting community-based marine monitoring and can be found at www.coraltriangleinitiative.net.

1. SILMMA UVS
2. SILMMA CPUE
3. Notes on Underwater Visual Surveys
4. SICRMN Reef Surveys
5. SPGs
6. Ellison 1997 - Mangrove
7. Baited Transects - Coconut Crab Surveys
8. Reef Check
9. Timed/Area Counts - Trochus/Green Snail
10. Seagrass Watch Methods
11. TDA/TNC Turtle Monitoring
12. RCF - Mangrove bivalve surveys
13. WorldFish data analysis for CPUE methods

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