parfish

PARTICIPATORY FISHERIES STOCK ASSESSMENT

GUIDELINES

S. WALMSLEY, C. HOWARD & P. MEDLEY

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Contents

Glossary

Adaptive Learning	A management approach that explicitly recognises that uncertainties exist and seeks to reduce them at the same time as managing the resource. Learning and reducing uncertainties about the resource system being managed are important components of management itself.
Bayesian statistics	A statistical approach for calculating the probability of an unobserved event based on earlier probability estimates which have been derived from empiric data (based on samples or observations). Bayesian methods make explicit use of probability for quantifying uncertainty.
Binf	See Unexploited biomass.
Bnow	See Current biomass.
Catch per unit effort (CPUE)	The quantity of fish caught (in number or in weight) with one standard unit of fishing effort e.g. number of fish taken per 1000 hooks per day or weight of fish, in kgs, taken per day of fishing. Also referred to as catch rate.
Catchability (q)	A measure of fishing mortality generated on a stock by one unit of effort. The factor (q) which in fisheries models relates abundance to stock size (x = q.N) and fishing mortality to fishing effort (F = qf).
Control	A means of managing a fishery and restricting resource exploitation. Examples are: effort controls (restricting the amount of fishing effort); quota controls (restricting the amount of fish that can be caught); and closed area controls (restricting the area available for fishing).
Control level	The magnitude of a particular control, for example, the recommended control level for an effort control might be 1000 boat days per year.
Current biomass	The current biomass of a fish stock, as a proportion of the unexploited biomass.
Decision Theory	A principle that implies the best decision is that which maximises the expected utility, balancing the risk of losses and gains. It combines the chance of something happening with the expected utility from its occurrence.
Facilitating institution	The institution, organisation or agency that takes the lead in implementing ParFish, coordinating the activities of other institutions involved in the process.
Fish(eries) stock	The living population from which catches are taken in a fishery, and usually implies that the particular population is more or less isolated from other stocks of the same species and hence self-sustaining. In a particular fishery, the fish stock may be one or several species of fish, crustacean or mollusc.
Fishers	The people that catch fish.
Fishery	The extent of a fish stock and the fishing activities that exploit it.

Fishing area	The spatial area where people fish in the fishery.
Fishing gears	The equipment and methods used to catch fish.
Growth rate	The rate at which a fish population increases in weight over time, calculated as the increase in weight per year (or season), divided by the initial weight.
Indicator	A variable used to provide an indication of the condition or status of the fishery.
Institution	An established organisation or agency.
Limit control	The control level that would result in a specified probability (10% as default) of the stock being overfished.
Management system	The management structures and decision-making arrangements in place for defining and implementing controls on a fishery.
Management unit	The fish stock and fishing activities which are under a management regime.
Maximum sustainable yield (MSY)	The highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing (average) environmental conditions without affecting significantly the reproduction process. (FAO).
Optimal fishing mortality (Fopt)	The fishing mortality which maximises the expected overall preference score.
Optimum fishing effort	The desired inputs that will produce a desired level of outputs (e.g. a set of target fishing mortality rates, target yield or target stock size for the species being harvested). (adapted from FAO).
Overfished	A fish stock that has been exploited beyond an explicit limit beyond which its abundance is considered 'too low' to ensure safe reproduction. This level is defined by the current biomass as a proportion or percentage of the unexploited biomass. The default level used in ParFish is 50% of the unexploited biomass remaining, but this can be altered by the user.
Overfishing	A level of fishing effort which is higher than the fishing effort that would be required to achieve the maximum sustainable yield.
Parameter	A component in a model formula.
Parameter frequencies	Repeated estimates of the value of a model variable.
ParFish approach	The overall theory and methodology involved in ParFish.
ParFish assessment	The stock assessment carried out using the data collection tools provided in ParFish and the ParFish software for analysis.
ParFish Guidelines	The guide that provides details on implementing ParFish, accompanied by Tools and Concepts to support implementation.
ParFish process	The stages involved in implementing ParFish.
ParFish Software	The software for carrying out data analysis for the ParFish stock assessment.
ParFish Software Manual	The user-guide that accompanies the software.

ParFish Toolkit	The ParFish Software, ParFish Software Manual and ParFish Guidelines.
Participatory approaches	Methods and ways of working that seek to actively involve and value the inputs of stakeholders.
Preference	How much a person would like a possible outcome. The same as utility.
Probability	The likelihood or chance that a specific event will occur, or that a specific state is observed, measured either as a proportion of 1, or as a percentage.
Probability Density Function (PDF)	A graph where the sum of the area under the graph from 0 to a specific value represents the probability of that value being true. The total area under the graph is equal to 1.
q	See Catchability.
r	See Growth rate.
Reference point	A particular state of a fishery indicator corresponding to a situation considered as desirable or as undesirable and requiring immediate action.
Resource users	The people that exploit, or are dependent on the exploitation of, a particular resource.
Stakeholder	Someone affected (positively or negatively) by an activity, or someone who can influence the process of impact of an activity. Broadly defined, stakeholders in fishery regimes include fishermen, the fishing industry and institutions involved in the management system, all those who rely on fishery habitats for a living, and those interested in conservation of fishery resources and habitats.
Target control	The control level that would result in catch and effort rates with the highest overall preference amongst the fishers.
Uncertainty	The estimated amount (or percentage) by which an observed or calculated value may differ from the true value. (FAO)
Unexploited biomass	The total weight of a stock of living organisms (e.g.fish) in an area.
Unit of catch	A quantity of fish catch used as a standard, in which the magnitudes of other quantities can be stated, for example, kilogram, bunch or basket.
Unit of effort	A measure of fishing effort that constitutes the amount of fishing of a certain gear type over a given unit of time.
Unit of time	A period of time over which a fisher's catches and effort are measured, for example, week, month or year.
Utility	A measure of the level of satisfaction a person gets from consuming a good or undertaking an activity (FAO).

Introduction to ParFish

What is the ParFish approach?

ParFish is based on the following principles:

Participatory

Values local knowledge

Adaptive

Rapid

Rigorous

Precautionary

Explicitly states degree of certainty

ParFish is a rapid and participatory approach to stock assessment that assists fishers and other stakeholders to enter a cycle of learning, evaluation, management planning and implementation (see Figure 1). The approach is based on adaptive learning (Garaway & Arthur, 2004) where the impacts of management actions are assessed and periodically evaluated to reformulate management plans and actions.

The ParFish approach covers six stages that take the user from understanding the context (Stage 1), agreeing objectives with stakeholders (Stage 2) through carrying out the data collection and stock assessment (Stage 3), the interpretation and communication of the results (Stage 4), to participatory management planning (Stage 5) and evaluating learning and re-starting the cycle (Stage 6).

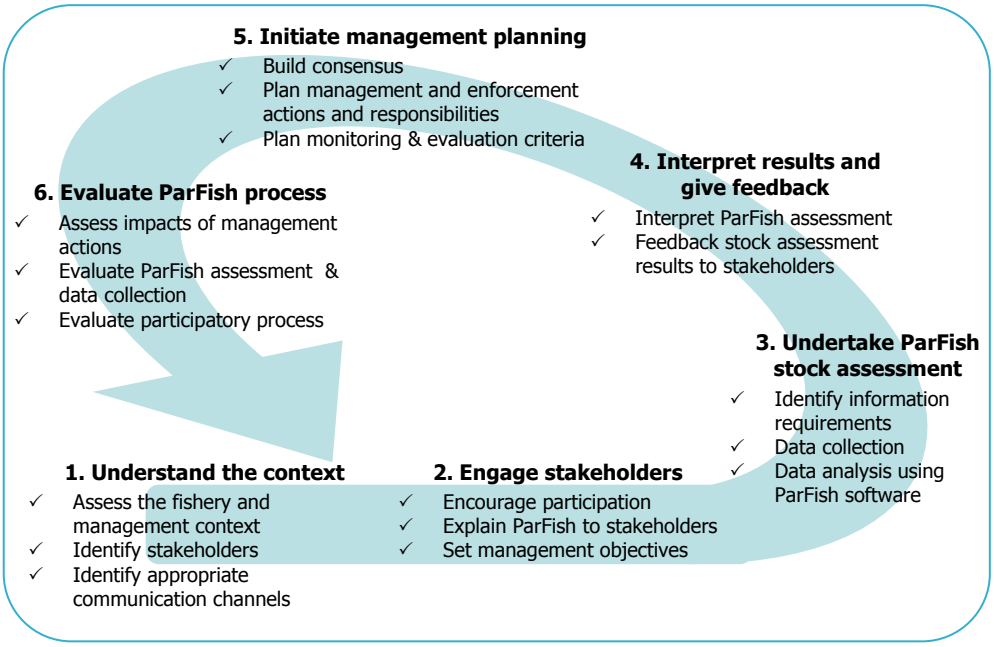


Figure 1: Stages involved in the ParFish approach

What are the objectives of ParFish?

The key objectives of ParFish are to understand more about the fishery resource and to develop management actions based on this knowledge involving the resource users.

The outputs expected from the ParFish process are an improved understanding of the fishery and the status of the stock, and improved methodologies for agreeing management actions amongst stakeholders, such as:

- Effort, quota or closed area controls;
- Monitoring plans; and
- Pilot schemes to test management options or improve data collection.

What are the principles of the ParFish approach?

ParFish is based on the following set of principles:

- **Participatory:** encourages engagement of all stakeholders who should be involved in identifying and implementing management options;
- **Values local knowledge:** incorporation of local knowledge on the resource into the stock assessment, and of resource users' preferences for different management outcomes;
- **Adaptive:** recommends management actions based on the best available data, allowing reassessment to measure the impacts and revise management actions accordingly, and also uses management actions to generate information which can subsequently inform management;
- **Rapid:** allows a stock assessment to be carried out in a short time frame, and does not require prior data on the fishery;
- **Rigorous:** based on accepted stock assessment models and able to provide as rigorous a stock assessment as any other methodology if the data are available;
- **Precautionary:** recommends that undesirable outcomes are identified and avoided and irreversible actions are not taken;
- **Explicitly states degree of certainty:** results are expressed as probabilities, allowing the certainty or uncertainty to be known.

Precautionary Approach

The FAO Code of Conduct (FAO, 1996) defines application of the precautionary approach in fisheries management. The precautionary approach can be summarised as 'it should be assumed that fishing activities are harmful unless proved otherwise' and 'be careful when making decisions that you do not make choices that lead to unacceptable harm, such as overfishing'. Setting out to prove whether current fishing activities are harmful or not and allowing informed careful decision-making is at the centre of the ParFish approach. However, it is encouraged that the following is taken into account in developing a management system:

- Priority in making decisions should be given to conserving the productive capacity of the resource;
- Management should identify undesirable outcomes and how to avoid them;
- There should be no delay in applying any corrective measures;
- Any action taken by management should be reversible; irreversible decisions should be avoided;
- Harvesting and processing capacity should be equal to the estimated sustainable productivity of the resource;
- Apply adaptive management and research procedures to find out more about the productivity of the resource and reduce uncertainty;
- A management control system should be established and all fishing activities should be subject to management control.

What is the ParFish stock assessment?

The stock assessment component of ParFish takes place in Stage 3 and involves data collection and the use of the ParFish Software and Software Manual. The assessment requires certain data inputs and gives recommendations for fishery controls such as quotas, effort limits or closed areas.

Scientific background

ParFish uses Bayesian statistics and decision theory

The assessment is based on the logistical biomass growth model which describes fish populations using four parameters:

- Current biomass (Bnow) (as a proportion of Binf);
- Unexploited biomass (Binf);
- Growth rate (r); and
- Catchability (q).

The assessment is based on Bayesian statistics which allows a number of different sources of information to be combined. See the ParFish Software Manual and the Software Help File for further background on the scientific basis to ParFish. Even under great uncertainty, a management action can be identified that would produce catch rates preferred by fishers. This allows you to proceed with management actions rather than wait until better information becomes available. Proceeding with management will not only improve the state of the fishery in the long term, but also will help decrease the uncertainty.

Inputs

The ParFish assessment can make use of the following data sources:

1. Stock assessment interviews with fishers and other people;
2. Catch and effort time series data;
3. Fishing experiment data;
4. Other data in the form of parameter frequencies;
5. Preference interviews with fishers.

Different types of data can be combined in one assessment

The ParFish Software allows data from sources 1 – 4 to be combined to produce an assessment of the state of the fishery resource and its potential growth rate. Not all of these data sources are required but it is recommended for all assessments that the interviews are used, which incorporate stakeholder knowledge on the resource. The interviews are inexpensive, rapid, simple to carry out and help involve fishers in the stock assessment and resource management process. They provide initial estimates of the parameters which can then be updated with data from other sources. Other information on the four parameters can be included if it can be expressed as parameter frequencies (see the Software Manual).

Data source 5, preference interviews with fishers, enables the software to recommend a control level that would have the highest overall preference (and therefore likely to have the greatest acceptability) amongst the fishers.

Outputs

The **key outputs** from the ParFish Software include:

- Recommended control levels for the fishery that would maximise the average preferences of fishers (= **target** control level), and would reduce the probability of the resource being overfished to a user-defined level (= **limit** control level);
- Standard stock assessment indicators and reference points;
- The uncertainty surrounding estimates of resource exploitation.

The ParFish Guidelines

These Guidelines are part of the Participatory Fisheries Stock Assessment (ParFish) Toolkit that assists users to undertake participatory stock assessments. The full ParFish Toolkit consists of:

- **ParFish Software:** provides the software to enter data and produce analysis and recommendations;
- **ParFish Software Manual:** provides a step-by-step guide on using the software;
- **ParFish Guidelines:** provides guidance on all the stages in the ParFish process along with tools, concepts and case study examples.

Who are these Guidelines for?

These Guidelines are intended to be used by fisheries research or management institutions in order to undertake participatory stock assessments and improve management of small-scale fisheries.

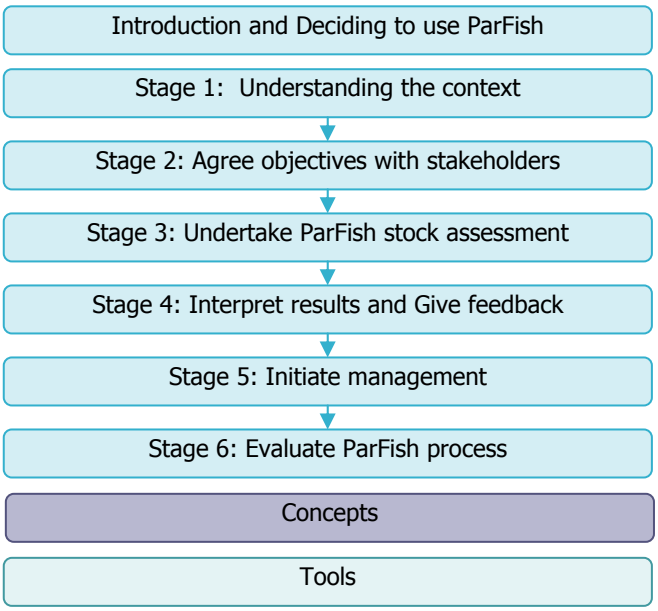
Aims of the Guidelines

The aims of these Guidelines are to:

- Provide guidance on the process of carrying out a ParFish assessment;
- Provide a series of tools and techniques for implementing ParFish.

Structure of the Guidelines

The Guidelines are set out in 6 Stages (in addition to this Introduction) which take you through the process of undertaking a participatory fisheries stock assessment. Concepts and Tools are referred to throughout the 6 Stages and are located after Stage 6.



Features of these Guidelines

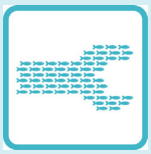
Within each Stage of the ParFish Guidelines there is a description of the activities you will need to undertake. Case studies provide examples of how it has been applied in practice. Concepts and Tools are referred to throughout, and are found after Stage 6.

Case studies provide:

- Examples of how different stages have been applied in practice.

Concepts, indicated by the concept icon on the left, are provided with an explanation of:

- What concepts are to be communicated;
- Ways of communicating the concepts.



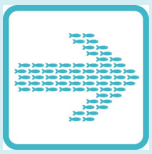
Tools, indicated by the tool icon on the left, are provided with an explanation of:

- What it is;
- Why use it;
- How to do it.

Where tools and concepts are referred to in the main text, they are written in **bold text** to highlight them. Where different sections and stages are referred to, for you to cross-reference, they are written in ***bold italic text***.

In addition ***key points*** in the text are highlighted in the left-hand column.

To aid navigation, tabs on the edge of the right-hand pages indicate the different Stages, Concepts and Tools.



Where you need to refer to different parts of the Toolkit, such as the ParFish Software or Software Manual, in order to complete the activity, this is indicated by the arrow icon on the left.

Adapting the Guidelines

You should adapt the ParFish approach to the specific situation where it is being applied

The way in which ParFish is applied will vary in different contexts. No two places are the same, and the way in which things are approached and the techniques used will be specific to each place. Refer to the section ***Deciding to use ParFish*** to review if it is an appropriate methodology for the fishery you are considering assessing.

These Guidelines aim to be flexible, providing a variety of tools that can be used and combined in different ways depending on your need. Although some of the tools provided are essential to provide information for the assessment (e.g. data collection in Stage 3), it is not expected that all tools will be used in all assessments.

Different ways of working with fishers, different ways of communicating concepts and different political, social and environmental contexts will influence the way you approach things. You should therefore be flexible, use the tools provided where you think they are useful, and adapt things to the specific situation where possible.

Deciding to use ParFish

Why use ParFish?

ParFish is rapid and participatory and can help promote co-management

There are many different stock assessment methodologies available for assessing fisheries and it is worth taking time to consider if ParFish is the most appropriate.

ParFish has a number of advantages over standard stock assessments: it is rapid; is not dependent on long-term data (such as catch and effort or length-weight data); and, can be scaled to the resources available. In addition, ParFish is participatory and involves fishers at each stage of the process so that they gain a better understanding of the fishery and how their actions affect it, and are involved in setting management actions based on this knowledge.

Advantages of ParFish include:

- Rapid assessment
- Long-term data not required
- Participatory methodology
- Resource efficient
- An adaptive approach

In this sense ParFish is particularly appropriate for developing country fisheries where there is often a lack of data, and also a growing trend to increase the involvement of fishers in the management of their own resource. ParFish is unique in its ability to incorporate the fishers' knowledge of the stock status and behaviour in the assessment, and the fishers' preferences for outcomes of different management controls. It also promotes participation through the involvement of fishers and other key stakeholders in establishing a common understanding about the fishery and the planning of management actions.

When and where is it suitable to use ParFish?

The current version of ParFish is appropriate for small and medium scale fisheries

ParFish can be used to assess any appropriate fisheries stock, including fish, crustacea and molluscs. For convenience, the ParFish Toolkit refers to all of these as 'fish' or 'fish stock'. While the general approach is arguably appropriate in all fisheries, this release of ParFish is specifically for small to medium scale fisheries, and supports existing or developing co-management structures.

It is important that the fishery in question can be spatially defined as a 'management unit' and you are able to carry out the ParFish assessment across the whole management unit. The primary attributes of a management unit are the fish resource and fishing activities which are under a management regime; most importantly, a management unit can be controlled effectively by the regime; the management unit must cover the part of the fishery responsible for the majority of fishing mortality in the fishery. A management unit could be a clearly defined area of coral reef (as illustrated by the case studies in Tanzania and the Caribbean), banks, lakes and other well-defined spatial areas. Examples of inappropriate fisheries would include, for example, a village exploiting an offshore tuna resource which has an ocean-wide stock. In this case, the villagers would only be taking a small part of the stock and therefore any action they take would have a negligible impact on the fishery.

Any number of villages or fishing communities can be included in a ParFish assessment, depending on the resources and personnel available to carry out the data collection and participatory workshops. The model assumes that the fishery is homogenous across the

villages involved in the assessment. As this is an approximation, results may need some adjustment based on knowledge of the details of the fishery.

The ParFish approach works best where there is a concern to manage fisheries resources sustainably and a willingness to implement collective management decisions. Ideally the demand for ParFish should come from the fishers or a co-management body that want to manage their resources, although a fisheries agency or an outside organisation may also be involved.

Ideally, there will be some or all of the following that initiates the use of ParFish:

- A desire to manage resources sustainably to ensure continued benefits;
- A request for help with making a management plan;
- A willingness to implement collective management controls;
- A willingness to implement regular monitoring and hold management meetings.

However, even if not, ParFish provides a stock assessment where no previous data exists, can increase the interest in managing the resource, and identify who needs to be involved in the process to achieve the required management remit for the fishery.

ParFish requires a certain level of financial and human resources (see **Tool 1**). Effectively involving fishers in the management process is time-consuming and requires commitment for carrying out data collection and to conduct meetings with stakeholders. However, because a ParFish assessment can be completed within a relatively short period of time (3 – 5 months), this reduces the demand for resources.

The **minimum requirements** for ParFish are resource assessment staff, facilitation staff to work with the fishing communities, computers to run the software and materials to undertake data collection and management action planning. **Tool 1: Resources Required for ParFish** provides details of the resources required to implement each stage of the ParFish approach. It should be noted that inputs are no greater than, and often less than, those required for any co-management and stock assessment initiative, with the added advantage that results and recommendations can be obtained very quickly.

The **checklists** below indicate the characteristics, conditions and resources that may be required to implement ParFish. ***Stage 1: Understand the Context*** also gives guidance on gathering background information on the fishery, and will further help you decide if ParFish is suitable.

Characteristics of a fishery suitable for ParFish:

- ☐ Small or medium scale fishery [1];
- ☐ Spatially well defined fishery (e.g. coral reef, lake or inshore fishery);
- ☐ Resource users (fishers) that fish the area can be identified and contacted.

Favourable conditions for undertaking ParFish:

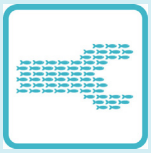
- ☐ Government fisheries management institutions are committed to a participatory approach to fisheries management;
- ☐ Stakeholders involved, particularly resource users, have an interest in managing the fishery, and in participating in determining management options;

[1] In principle, ParFish can be applied to large scale industrial fisheries. However, this release of ParFish is tailored to meet the needs of small scale fisheries and in particular those with little data.

- ☐ A working relationship can be built up between the fishers and the implementing institutions.

Resources required to undertake ParFish (for the implementing institutions):

- ☐ Research and facilitation staff;
- ☐ Computer resources to run the ParFish Software (Windows 2000 or later);
- ☐ Time commitment of at least 3 months (actual time required will depend on the size of the fishery, the data to be collected, and the stakeholders involved;
- ☐ Materials to assist with data collection and management action planning stages.



See tool:

➔ Tool 1: Resources Required for ParFish.

Considerations and Assumptions

The model used assumes the stock is a closed, homogenous population. Although this is usually not the case, this is an approximation. If you want to consider more complex situations, such as differentiating between life history stages, you will need to develop a different model for this. For further questions please contact the ParFish team (see contact details at the front of these Guidelines). As the model is an approximation, you may need to adjust the advice based on knowledge of the reality of the fishery.

The ParFish approach uses fisher knowledge, captured through interviews, to provide information on the parameters of the stock assessment model. It is recognised that not all fishers will necessarily have the 'correct' knowledge about stock behaviour for each parameter, but their knowledge provides a starting point to estimate the parameters, which is then updated with data from other sources. Uncertainty is made explicit in the assessment through the use of probability density functions (see Software Manual for more details). If you have catch and effort data for the fishery, you can carry out the stock assessment based just on the traditional catch and effort data, without the use of the fisher interview data, and compare the results with including fisher interview data. Additionally, the range of answers from the fishers in the interview can highlight any potential areas of agreement or disagreement over proposed management options, depending on how resource users believe the stock will behave.

The ParFish stock assessment identifies the control level that would have the highest overall preference amongst the fishers (the **target control level**). The target control identified in the analysis therefore will not necessarily produce conditions in the fishery that would be preferred by all fishers, and there may be some fishers that would be worse off under the target control compared to the current control. The preferences can be weighted, according to a user-defined weighting factor. For example, you can use a weighting factor that gives higher priority to the preferences of fisher that are more dependent on the fishery, or you can create your own weighting factor which takes into account broader issues, such as poverty levels, livelihoods and other social and economic issues.

How does ParFish compare with other stock assessment methodologies?

Overall Methodology

You may want to review other stock assessment tools that are available

FAO has recently produced a manual that assists in selecting the most appropriate stock assessment methodology, 'Stock Assessment for Fishery Management – A Framework Guide to the use of the FMSP Fish Stock Assessment Tools' (Hoggarth et al. 2005), and it is worth referring to this to check which methodology is most suited to your circumstances. In essence there are effective methodologies available if you have reliable long-term data such as catch and effort data in the case of 'Catch-Effort Data Analysis' (CEDA) or long-term fish length measurements in the case of 'Length-Frequency Data Analysis' (LFDA). Many other methods and packages exist, such as Virtual Population Analysis (VPA) and FAO FiSAT, which offers a range of analysis techniques. You may wish to experiment with your data in a number of different packages and compare the results that they give.

Like CEDA, the ParFish Software can also incorporate long term catch and effort data, but its real value compared to any other approach currently available is its ability to develop an assessment rapidly when no time series data exist and to maximise the involvement of fishers in the assessment process.

Interpretation of Target and Limit controls

In ParFish, the **target control level** is the level of control that would produce conditions in the fishery most preferred by fishers. This is the point that management should aim towards, although it may be necessary to take a step-by-step approach, altering the control level by a small amount and monitoring at each step, and re-evaluating the target control level each time taking into account the new information that has been generated. Sometimes, the target control can be unduly high, due to a lack of data resulting in high uncertainty.

The **limit control level** is the level of control that would result in a 10% chance of the stock being overfished[2]. Normally, management recommendations would not exceed the limit control level. However, in the case of ParFish, because the results are influenced by the uncertainty in the data, the limit control acts more as an indication of the certainty of the data. For example, an effort or quota limit control much lower than the target control would indicate high uncertainty in the data, and should lead to the conclusion that more data on the fishery needs to be collected, rather than all fishing must be ceased immediately!

[2] If you wish to be precautionary, 50% of the unexploited biomass is an acceptable limit for the stock being considered overfished. It is recommended you use this level unless you have evidence that less is appropriate.

Additional sources of information

FAO 1996. Precautionary approach to capture fisheries and species introductions. Elaborated by the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6-13 June 1995. FAO Technical Guidelines for Responsible Fisheries No. 2. 54p. Rome, 1996.

Food and Agriculture Organization of the United National (FAO) fisheries website online at http://www.fao.org/fi.

Hoggarth, D.D. et al. (in press, 2005) Stock Assessment for Fishery Management – A Framework Guide to the use of the FMSP Fish Stock Assessment Tools. FAO Fisheries Technical Paper. Rome, FAO.

Garaway, C.J and Arthur, R.I. 2004. Adaptive learning: A practical framework for the implementation of adaptive co-management. Lessons from selected experiences in South and Southeast Asia. MRAG Ltd. 44 p. Available online at www.fmsp.org.uk.

Gayanilo, F.C. Jr., Pauly, D. (eds). 1997. FiSAT: FAO-ICLARM stock assessment tools. (FiSAT). Reference manual. Rome, FAO.

STAGE 1: Understand the Context

The fishers are the most important stakeholders and should always be involved in ParFish

Stage 1 of the ParFish Guidelines explains how to assess the context of the fishery in order to frame the stock assessment. It is a preparatory stage before undertaking the assessment and involves four main activities:

1. Understanding the fishery;
2. Identifying stakeholders;
3. Developing a stakeholder engagement plan;
4. Identifying appropriate communication channels.

The process of understanding the context also assists in further clarifying whether ParFish is the most suitable tool for the fishery in question.

1. Understanding the fishery

Understanding the resource system requires an understanding of the biological and technical nature of the **fishery** and of the **management system**. In this Section and related Tools, the information that is necessary for use within the ParFish Software (Stage 3) is indicated. In addition the information necessary to understand the background is indicated. Having an understanding of the background will help ensure that data collection and the interpretation of the assessment results are relevant and that discussions on management options are appropriate and involve the right people.

As well as the notes below, see **Tool 2: Background Information to Compile** for **what** information needs to be collected and **Tool 3: Checklist of Potential Sources of Information** for **where** to look for this information.

The fishery

Understanding the fishery helps the data collection phase and provides data inputs for the Software

The first step is to identify the fishery of interest (e.g. inshore reef fishery, offshore fishery, lake fishery, single-species fishery etc.) and deal only with that fishery during the course of ParFish data collection and implementation. The fishery should encompass a management unit, and approximately conform to the behaviour of the logistic biomass growth model. The different gears used to exploit the fishery need to be identified. The origins of the fishers that exploit the stock should also be identified (i.e. the villages, islands and areas the fishers come from, and therefore where you should carry out the meetings and data collection for ParFish, and with whom).

Definitions:

- **Management unit**: the fish resource and fishing activities which are under a management regime. Most importantly, a management unit can be controlled effectively by the regime, that is, when a control such as effort is decreased, the population increases and vice-versa. The management unit must cover the dominant part of the fishery to be effective.
- **Fishery**: Often the same as the management unit, but may also include parts of the fish resource and fishing activities not under management control.
- **Fishing area**: the spatial area where people fish in the defined fishery.
- **Fishing gears**: the equipment and methods used to catch fish.
- **Fishers**: the people that catch fish in the fishing area.

Background information on the fishery assists in designing the sampling system for data collection such as how many fishers to interview, and is important in estimating totals to input into the software, such as total catches or total effort. This information will also form the basis for adapting the stock assessment questionnaire (see Stage 3), to direct the relevance of particular questions.

Background information can be gathered from existing information sources and using participatory tools. For example information collection can form part of the initial stages of contacting and involving stakeholders in the process. See the sections on ***Identifying and engaging stakeholders*** (in this stage), and ***Agreeing objectives with stakeholders*** (Stage 2). The more contact you have with the relevant stakeholders, the more you will understand about the fishery.

Ideally you should gather all such information into a management plan (see the example outline for a management plan in **Tool 26**).

The management system

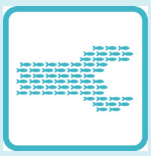
Understanding the management system helps identify how recommended measures can be implemented

The management system of a fishery refers to the management structures and decision-making arrangements. Understanding how decisions affecting the resource are made is important for ParFish as it ensures that the assessment provides outputs relevant to the context. For example in Zanzibar an understanding of the recent creation of Fishermen's Associations at the local level ensured that their representatives were involved in management discussions as they will have a key role in encouraging the enforcement of fisheries management controls.

Issues to consider about the management system include:

- Who has roles and responsibilities for management, who will be affected by management decisions, and therefore who should be included in the process (See also ***Identifying and engaging stakeholders***);
- The current problems with the resource and management and what issues the ParFish process could usefully address; and
- The limitations of the current management arrangements and an understanding of the management framework ParFish needs to work within.

To analyse and understand these interactions it is useful to use **Tool 3: Institutional Analysis and Design (IAD) framework**.



See tools:

- ➔ Tool 2: Background Information to Compile;
- ➔ Tool 3: Checklist of Potential Sources of Information;
- ➔ Tool 4: The Institutional Analysis and Design Framework;
- ➔ Tool 14: Sampling Catch Units.

2. Identifying stakeholders

Carrying out a Stakeholder Analysis helps ensure you involve the right people in the process

An important step during the preparatory stage is to identify who are the individuals, groups and organisations that may be affected by and that may influence fisheries management. The success of the ParFish process will be increased by engaging the right people during the different stages of the process, to collect information, understand the assessment results and plan feasible management actions.

A **stakeholder** is:

- someone ***affected*** (positively or negatively) by the impact of an activity; or
- someone who can ***influence*** the process or impact of an activity.

The activity, in this case, is fisheries management

Conducting a Stakeholder Analysis can help you do both of these. It helps you identify who will be affected by and who may influence the process. This is an important step, as in many fisheries fishers that are not involved in co-management structures and processes (e.g. visiting fishers, non-resident fishers) can often be key to whether co-management measures are viable or not. Correct identification of these groups (which often have as legitimate a right to fish in the area as the resident fishers) and their involvement in the process can help consensus-building result in an implementable solution. An example of a stakeholder analysis from Kizimkazi, Zanzibar, is provided in Table 1.

The use of participatory methods can increase understanding of the fishery and assessment results by stakeholders and can increase the chance of management plans based on the assessment being agreed and acted upon. Participatory approaches and tools are dealt with in more depth in **Stage 2**, and should be considered together with this stage as a means of gathering background information.

Table 1: Stakeholder Analysis for Kizimkazi fishery in Zanzibar

Stakeholder group	Interests & roles	Possible impact of ParFish	Influence – Priority*
Primary			
Fishers	-Continue fishing -Participate in management -Fish sustainably -Data collection	+ / – (positive in long term but may require short-term reductions in catches)	H-H
Beach recorder (fisheries)	-Help coordinate/intermediary -Measure fish / collect data -Ensure enforcement -Has background info on fishery	+ / –	H-H
Boat owners	-Profits, more fish -Tourist activities	+ / –	L-L
Fishmongers/Buyers (individual / bulk)	-Continuous supply of fish	+ / –	L-H
Consumers	-Continued availability of fish at good price	+ (–)	L-H
Divers/Tourists	-See pristine reefs -Eat fish	+	L-L
Sport fishers	-Catch fish and sustainability	+ / –	L-L
Gear & Boat Makers / Repairers	-Continued / sustainable fishing activities	+ / –	L-L
Dolphin Boat Operators	-Pristine areas	+ / –	L-L
Fishermens Associations	-Sustainable management -Fishers rights and participation	+	L-H

Secondary			
Credit facilities	-Fishers continue to catch fish to repay loans	+ / –	L-H
Restaurant owners	-Supply of good quality fish	+	L-H
Dept of Fisheries	-Fisheries management -Participation of fishers	+	H-H
She ha	-No conflict between fishers -Management enforcement	+ / –	H-L
Menai Bay Conservation Area	-Fisheries management -Sustainability -Community participation	+	H-H
Min. Natural Resources & Agriculture	-Fisheries management -Sustainability -Community participation -Conservation	+	H-H
Dept. of Environment	-Sustainable fisheries management -Community participation -Conservation	+	L-H

* H-H = High influence, high priority; H-L = High influence, low priority; L-H = Low influence, high priority; L-L = Low influence, low priority.

See tool:

➔ Tool 5: Stakeholder Analysis.

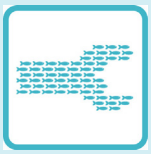
3. Developing a stakeholder engagement plan

Once you have a clear idea of the stakeholders it is useful to put together a plan for how you want different groups or individuals to be engaged in the ParFish process.

An example of a stakeholder engagement plan for Zanzibar is given below:

Stakeholder	**Skills / Assets**	**Potential involvement**
Fishers within Kizimkazi region	Knowledge of and day-to-day contact with the resource,	Stages 2 – 6: Involvement in interviews, meetings and assessing management options.
Fisheries Dept for Zanzibar	Staff includes beach recorders. Responsible for fisheries management and approval of management plans.	Stages 3 – 6 and kept informed: Beach recorders assist data collection (interviews & fishing experiment). Fisheries Statistician involved in collating catch and effort data Involvement in approving and implementing a management plan. Need to be kept informed of process to assist buy-in.
Research Institute – Institute of Marine Science	Computer hardware and stock assessment skills.	Stages 3 – 4: Involvement in coordinating fishing experiment and carrying out the analysis and interpretation of the results. Also due to relationship with fishing communities able to facilitate community meetings.
Menai Bay Marine Protected Area	Responsible for fisheries management in the area and local patrols.	Stages 3 – 5: Involvement in supporting implementation of management plans. Involvement in data collection to increase support for process and outcomes.

Different stakeholders will be able to contribute different skills at different stages of the process. For example consider who can take part at each stage of the process, who can facilitate workshops, who can collect data and undertake the analysis and who should be informed of the results?



See tool:

➔ Tool 6: Developing a Stakeholder Engagement Plan.

4. Identifying appropriate communication channels

Identifying communication channels will help get messages across and raise awareness and support

After identifying your stakeholders and drawing up a stakeholder engagement plan you will need to think about how information can be shared among the different stakeholders directly engaged in the process, and with others that you want to keep informed.

There may be a wide range of people involved with different backgrounds that you want to communicate with. For example, in Zanzibar some of the main communication stakeholders included the fishers, the government fisheries officials, environmental managers and NGOs, such as the World Wide Fund for Nature (WWF). Different materials and approaches were required to communicate with different stakeholder groups.

First consider the objectives of communicating with different stakeholders. Although communication objectives will be specific to the context, there are a number of generic communication objectives for fishers and other stakeholders:

Communication objectives help you define the messages you want to get across to each stakeholder group

Generic communication objectives for fishers:

- Understand why it is useful to undertake assessments;
- Understand concepts related to estimating stock size and controls;
- Understand how ParFish works and the potential benefits;
- Engage in data collection and management;
- Understand results of the assessment and management recommendations;
- Engage in management planning.

Generic communication objectives for other stakeholders directly engaged in the process:

- Understand the benefits of undertaking a stock assessment;
- Understand how ParFish works and the potential benefits;
- Engage in data collection and management;
- Understand results of the assessment and management recommendations;
- Engage in management planning.

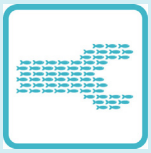
Objectives for communicating with wider communication stakeholders:

- Understand how ParFish works and the potential benefits;
- Give support for ParFish as a methodology.

Your stakeholder engagement plan will outline who you want to get on board to be directly involved in the process. Your communications plan will outline how you are going to get these stakeholders involved using different messages and materials. You will also want to consider objectives of communicating with stakeholders who are not directly involved in the process but should be kept informed or who can provide support such as funding or political backing (i.e. wider communication stakeholders). Ideas on communicating concepts to fishers and other stakeholders are provided in **Stage 2**.

Going through the process of drawing up a communications plan will help you to prioritise communications activities and identify ways you can monitor your activities. A **communications plan** provides the opportunity to record what needs to be communicated to each group of stakeholders and how.

An example of a communications plan developed for the Zanzibar case study is given in Table 2.



See tool:

➔ Tool 7: Developing a Communications Plan.

Table 2: Summarised communication plan for Kizimkazi case study

Prioritised Stakeholders	**Communication objective**	**Media/Channels (Promotion activities)**	**Monitoring and Evaluation Indicators**
Fishers	Engage in data collection and discussions on management options based on assessment results.	Community meetings organised through local chiefs (*Shehas*) Meeting held in Swahili	Monitor numbers at community meetings
Fishermen associations	Endorse ParFish approach and assist in the coordination of data collection & management	Community meeting Meeting held in Swahili	Monitor numbers at meetings
Beach recorders	Assist with data collection and facilitating information feed-back to fishers. (Important connections with communities)	Community meetings Meeting held in Swahili	Monitor attendance at meetings
Department of Fisheries	Support the use of ParFish and engage in discussion of management options	Involvement in the ParFish process Presentation to the department	Numbers involved in process Numbers present at meeting
Menai Bay Conservation Area	Support the use of ParFish and engage in discussion of management options	Involvement in management discussions	Attendance to meeting Statements of support
Ministry of Natural Resources and Agriculture	Support the use of ParFish. Offer support to Department of Fisheries	Flyers/Briefs	Number of briefs disseminated

Additional sources of information

Garaway, C.J and Arthur, R.I. 2004. Adaptive learning: A practical framework for the implementation of adaptive co-management. Lessons from selected experiences in South and Southeast Asia. MRAG Ltd. 44 p.

Norrish, P., Lloyd Morgan, K., and Myers, M. 2001. Improved communication strategies for renewable resource research outputs. Socio-economic Methodologies for Natural Resource Research. Best Practice Guidelines (GPB 8). Natural Resource Institute (NRI) Chatham, UK.

STAGE 2: Engage Stakeholders

Stage 1 explained how to assess the fishery and the management context, identify stakeholders and appropriate communications channels. Stage 2 takes you through agreeing objectives for the ParFish process with the stakeholders, encouraging their participation in the process and introducing them to ParFish.

Stage 2 involves the following activities:

1. Encouraging participation in ParFish;
2. Explaining ParFish to stakeholders;
3. Collecting information through participatory approaches;
4. Setting management objectives with stakeholders.

The first activity, encouraging participation in ParFish, provides the overall framework for this Stage, providing a suggested schedule for meetings, hints for how to set up meetings and participatory tools you can use. Activities 2 – 4 deal with specific aspects in more detail.

1. Encouraging participation in ParFish

Participation of stakeholders helps gain support for ParFish

One of the principles of ParFish is that it is participatory. Participation is important so that key stakeholders have a role in the assessment. This will include resource users such as fishers, as well as those that influence the management of the resource such as government management institutions and co-management bodies. Having a role in the assessment will help stakeholders understand the results and take an active role in management planning. Different stakeholders may need to participate at different stages in the ParFish process. You should have identified the stakeholders, their capacity and potential roles in the process through **Tool 5: Stakeholder Analysis** in Stage 1. You should have further identified ways of engaging with the stakeholders in **Tool 6: Developing a Stakeholder Engagement Plan**. This Stage provides an opportunity to review the roles and obtain commitment from stakeholders.

Fishers are priority stakeholders and the ParFish approach aims to actively involve them in the stock assessment process by incorporating their knowledge and priorities through consulting with them, encouraging their participation in data collection activities, and actively encouraging their participation in developing and implementing a management plan for the fishery. Meetings and workshops with stakeholders will form a key part of this, therefore guidance on setting up meetings and a suggested schedule for the meetings with fishers are provided, based on the experiences in the Zanzibar Case Study. Remember that fishers are not always homogenous as a group – there may be differences depending on gear type, wealth class etc.. You should have identified this in your stakeholder analysis.

See tools:

- ➔ Tool 8: Setting up Meetings with Interested Groups;
- ➔ Tool 9: Schedule for Meetings;
- ➔ Tool 10: Facilitation Techniques.

The tools selected here are based on Participatory Rural Appraisal (PRA) methodologies, and are those considered valuable for implementing the ParFish methodology. However, a wide range of other participatory tools and techniques are available, and you are encouraged to develop other forms of facilitation to achieve your communication

objectives. A selection of additional sources of information on participatory tools and approaches is provided at the end of this Stage.

2. Explaining ParFish to stakeholders

An important part of encouraging participation of stakeholders is to give a clear explanation of what ParFish is and what it can achieve.

Stakeholders need to understand the concepts behind ParFish and its objectives

Your communications plan will give you guidance on which stakeholders you need to communicate with and what messages you want to get across. It is likely that meetings will be one of the most important ways of getting messages across and that fishers will be one of the key stakeholders to engage with. In this Stage, both tools and concepts are provided. Refer to the section ***Encouraging participation in ParFish*** and the recommended tools for guidance on setting up meetings, and **Tool 9: Schedule for Meetings** for an outline of what concepts may be communicated to fishers.

The concepts provide ideas on how to interpret information in a way that is understandable to fishers, illustrated in the table below.

Concepts	Information to convey
➔ Concept 1: **Introduction to ParFish and Fisheries Management**	• There are benefits in managing our fisheries more effectively
➔ Concept 2: **Fish Stock Dynamics**	• Stock sizes are limited • Fishing effort has an impact on stock size • There is an optimal[3] level of exploitation • Fishing beyond the sustainable level can result in reduced fish catches
➔ Concept 3: **Fisheries Monitoring and Assessment**	• Assessments help us to find out what level of fishing is optimal
➔ Concept 4: **Uncertainty**	• There will always be a level of uncertainty in assessments • You should always take a precautionary approach to management • Management should always be adaptive, monitoring the outcome of management measures and reviewing plans
➔ Concept 5: **How ParFish works**	• ParFish helps us to incorporate fisher's knowledge and preferences into the assessment • It helps us to know levels of uncertainty and therefore plan further data collection

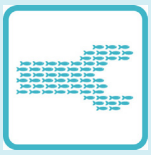
[3] 'Optimal' means reducing the chance of the stock being overexploited (less than a certain %, usually 50% as the default, of the unexploited biomass remaining), while maximising the overall preferences of the fishers for the resulting catch rates.

3. Collecting information through participatory approaches

Participatory approaches are a useful way of involving stakeholders and gaining a better understanding of the resource

Stage 1 and **Tool 2: Background Information to Compile** outline what information is required for using the ParFish Software, and what is useful for understanding the context of the fishery. **Tool 3: Checklist of Potential Sources of Information** suggests possible sources of that information, including collecting it through participatory approaches. Information collected through participatory approaches can include understanding historical changes in the fishery, mapping the fishing grounds and information on the context through key informant interviews. As well as providing information, participatory approaches can assist in developing a relationship between those undertaking the assessment and the primary stakeholders. For example, in Zanzibar the process resulted in an improved relationship between the fishers and the facilitating institution (IMS). However, information collected through participatory approaches is subjective and should be compared with other sources where possible.

Tool 11: Participatory Mapping of Fishing Grounds is important, as it will help identify the areas that are used for fishing and the overall size of the fishing grounds. It is strongly recommended that you carry this out.



See tools:

- ➔ Tool 10: Facilitation Techniques;
- ➔ Tool 11: Participatory Mapping of Fishing Grounds;
- ➔ Tool 12: Key Informant Interviews.

4. Setting management objectives with stakeholders

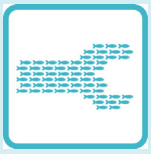
Before initiating a ParFish assessment it is necessary to agree management and assessment objectives with stakeholders. This will ensure that stakeholders agree on what they hope to achieve as an outcome for the fishery and understand how the assessment will support their efforts in achieving this.

There are a number of objectives that a well-managed fishery can fulfil such as income generation, employment, sustainable benefits and conservation. Different stakeholders in the fishery are likely to have different objectives (as illustrated in **Tool 13: Agreeing Objectives with Stakeholders**) but not all objectives can be achieved at the same time, and there will be trade-offs. Examples of different possible priorities are:

- Fishers: maximise income or catch rates;
- Subsistence fishers: maximise catch rates, achieve subsistence yield;
- Ministry: maximise production, income or foreign investment;
- Donors or projects: promote the interests of a particular group e.g. poor fishers, resident fishers; or promote sustainable fishing practices and resource conservation;
- Tourists: maximise biodiversity or numbers of fish in diving areas.

The different priorities and management objectives will determine what action is taken. For example if the priority is to maintain the stock size then controlling effort may be a priority action. Alternatively one of the objectives may be to increase income from the fishery, in which case ensuring good catch rates will be important but it may be necessary to also keep discussions open to broader issues such as market access.

It will be important to discuss these objectives at this stage in the ParFish process and return to them when feeding back the results of the assessment and planning management options (**Stage 5**).



See tool:

➔ Tool 13: Agreeing Objectives with Stakeholders

Additional sources of information

Bunce, L. Townsley, P. Pomeroy, R. & Pollnac, R. 2000. Socioeconomic Manual for Coral Reef Management. Australian Institute of Marine Science, Townsville, Australia.

Deguit, E.T., Smith, R.P., Jatulan, W.P., & White, A.T. 2004. Participatory Coastal Resource Assessment Training Guide. Coastal Resource Management Project of the Department of Environment and Natural Resources. Cebu City, Philippines 134 p.

FAO participation website: http://www.fao.org/Participation particularly the 'field tools' pages under 'Resources'.

International HIV/AIDS Alliance. 2001. A Facilitator's Guide to Participatory Workshops with NGOs/CBOs Responding to HIV/AIDS. International HIV/AIDS Alliance, Brighton, UK.

Pretty, J. & Hine, R. 1999. Participatory Appraisal for Community Assessment: Principles and Methods. Centre for Environment and Society, University of Essex. Available online at http://www2.essex.ac.uk/ces/CommParticipation/ComPartPrinciplesnmethods.htm#part

Pretty, J.N., Guijt, I., Thompson, J. & Scoones, I. 1995. *A Trainer's Guide for Participatory Learning and Action.* IIED Participatory Methodology Series. IIED, London, UK.

Rietbergen-McCracken, J. & Narayan, D. 1998. *Participation and Social Assessment: Tools and Techniques*. The World Bank, Washington, D.C., U.S.A.

Srinivasan, L. 1990. *Tools for Community Participation: a Manual for training Trainers in participatory techniques.* PROWESS / UNDP technical series. PROWESS/UNDP, New York, U.S.A.

CASE STUDY:
Meeting with fishers to discuss ParFish and introduce fisheries management concepts

This meeting with the fishers at Kizimkazi aimed to remind them of the ParFish assessment (which had been carried out the previous year), introduce them to some fisheries concepts, raise their awareness of how information about the fishery can be useful for them, and start a series of meetings to discuss what we know about the fish stock from this information, how the information can help us, and what management actions might be appropriate.

Remind the fishers of ParFish

Because this case study formed part of the development of the techniques and methodologies for ParFish, this meeting took place some time after the actual data collection, so it was necessary to refresh the fishers' memories of what they had done the previous year:

- **interviews** were carried out with them about their fish stock, to obtain information about their catches, effort and how they think the fish stock might behave, and to obtain their preferences for different outcomes of management actions; and,
- they carried out **fishing experiments**, where they fished in a designated area for 9 days to try to deplete it, and their catches and effort were recorded during this period, in order to find out more about the fish stock.

Fishing experiments

The results of the experiment were presented as a pictoral graph representing the total catch for each day (see Figure 2). The decreasing catch each day (and catch per unit effort) was noted, and used to highlight that the fishers can and do have an impact on the fish stock. The fishers discussed what they remembered from the fishing experiments and how they noticed that over the course of the experiment, their catches decreased.

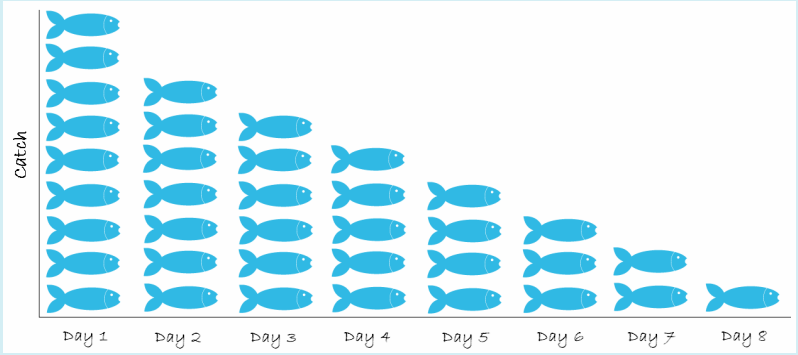


Figure 2: Example of a pictoral graph showing the results of the fishing experiment, similar to the one used in Kizimkazi.

Fisheries Concepts

Some fisheries concepts were explained, using the ideas provided in the Concepts section of these Guidelines, specifically:

- **Fish stock dynamics**, sustainable fishing and overfishing concepts using the bau board example (see Figure 3).
- **How information is useful in fisheries management**: if we know more about the fish stock: how many fish are out there and how fast they reproduce, we can get an idea of how many we can catch sustainably.
- **Uncertainty and estimating**, fishers estimated the number of oranges in a tub (see example in **Concept: Uncertainty**, and Figure 4). The range of estimates was smaller, and there was more certainty around the true value, when the fishers could see the oranges compared to when the oranges were covered. This was related back to information about the fishery – we can estimate the number of fish out there but there will always be some uncertainty. The more information we have the more certain we will be about the fish stock size and the level of catch that we can get.

Figure 3: Explaining fish stock dynamics using the bau board example

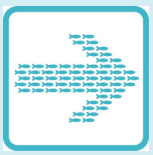
Figure 4: (a) The oranges in a tub for the fishers to estimate how many there were, and (b) explaining the graph of their estimates

What are their concerns about the fishery?

A problem census was carried out with the fishers (see **Tool 10: Facilitation Techniques**). Individually, they wrote their concerns on pieces of paper, which were grouped together according to theme. The most common concerns raised included: visiting fishers, the numbers that come, and whether they pay the required fees or not; conflicts between different gear types; illegal fishing and the use of destructive fishing techniques and gears.

Figure 5: Grouping together fishers' concerns on the fishery

STAGE 3: Undertake ParFish Stock Assessment



Stage 3 of the ParFish process gives guidance on identifying the information requirements for the assessment and how to undertake the necessary data collection in order to run the ParFish analysis using the ParFish Software. This follows on from the initial stages of deciding to use ParFish, assessing the management context (Stage 1), encouraging participating and deciding on the assessment and management objectives with relevant stakeholders (Stage 2). You should also refer to the **ParFish Software** and **Software Manual** during this stage.

In this stage guidance is given on:

1. Deciding what data needs to be collected;
2. Carrying out your data collection;
3. Inputting data into Excel;
4. Analysing your data;
5. Collecting monitoring data.

1. Deciding what data needs to be collected

As discussed in the Introduction, ParFish supports several different data sources:

1. Catch and effort time series data;
2. Fishing experiment data;
3. Stock assessment interviews with fishers and other people;
4. Other data in the form of parameter frequencies;
5. Preference interviews with fishers.

At this stage you should review the data you have available and what information you still need to collect.

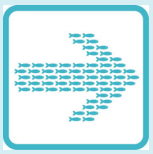
An initial ParFish assessment can use just interview data but you should use other supported data types too

The more data you have the more reliable your assessment will be. The ParFish Software allows data to be added in to improve the assessment as it becomes available. Therefore, an initial ParFish assessment can be carried out, to provide information as a starting point for setting management goals and developing an action plan. Further data and monitoring data from implementing the management plan can be incorporated subsequently into the software to improve the assessment and reconsider management actions in an adaptive learning framework.

In all cases the Stock Assessment Interviews and Preference Interviews should be carried out as these are fundamental to the ParFish approach and methodology.

What other data you will need to collect will depend on the data that already exists for the fishery, its quality and quantity. For example, if you have a good time series of catch and effort data (for the past 20 years, for example) then this, together with the stock assessment interview and preferences interview, may be sufficient for the analysis to be performed with an acceptable level of uncertainty. In other cases, if catch and effort data

Decide what data you need to collect



is limited, and other information does not exist, it is advisable to conduct fishing experiments and surveys (see **Tool 18**) to be able to model the fishery better in terms of its biomass, growth, and catch rates.

The diagram in has been constructed to help you decide what data should be used and what new data needs to be collected. If you have data, you may need to carry out analyses using your data in the **ParFish Software** to see if it is possible to fit a model using the data and if the level of uncertainty is acceptable or not. The **summary check list** below also illustrates what information is necessary and what is optional for the assessment.

Once you have carried out the initial data collection you can input your data into the stock assessment software to check if the models fit (this is explained in more detail in the Software Manual). If they do not fit, you may need to return to this diagram to consider collecting other data. Alternatively, data that do not fit the models in the ParFish Software can still be used if it is possible to fit them to a model in another program and generate parameter frequencies, which can then be imported into the Software. This is explained in more detail in the Software Manual. If you have data that do not quite fit the models provided, you could contact the ParFish team to explore options of tailoring the Software to your particular needs.

For the interviews, you will need to raise the interview sample to the whole fishery using an estimate of the **last years' effort**. You should have an estimate of this from compiling background information on the fishery. You will also need an estimate of the **weight of the catch units** that fishers measure their catches in and refer to in interviews, so that the assessment units can be standardised.

See tools:

- ➔ Tool 2: Background Information to Compile;
- ➔ Tool 14: Sampling Catch Units.

If you carry out fishing experiments, you will also need an estimate of the **size of the fishery area**. This is used for scaling up the results of the fishing experiments to apply to the area of the whole fishery. You will need to raise the total catch in the experiment to the expected total over the whole fishing area, as though the experiment were conducted for the entire fishery instead of just a small section. **Tool 15** explains how to map and calculate the area of the fishing ground. If you are not going to carry out fishing experiments, an estimate of the size of the fishery area will still be useful, but not essential. Carrying out participatory mapping of the fishing grounds (see Tool 11) prior to mapping can help identify the extent of the fishing grounds and / or which areas to map.

See tools:

- ➔ Tool 11: Participatory Mapping of Fishing Grounds;
- ➔ Tool 15: Mapping and Calculating the Fishing Area**.**

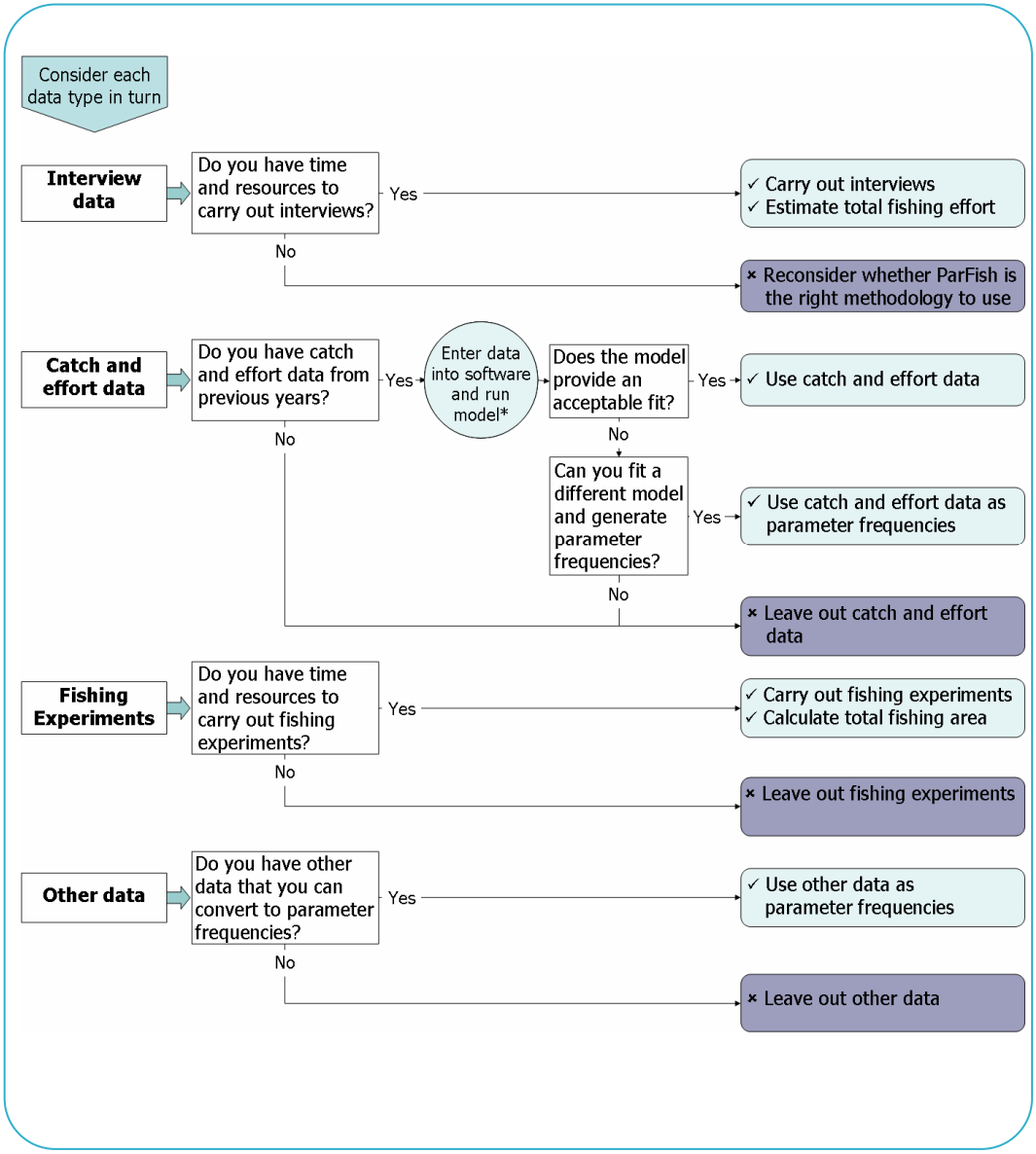


Figure 6: Data Requirements Decision Tree

Summary check list of data requirements:

The list below shows which data are essential for ParFish and which are optional.

Minimum ParFish requirements

- ☐ Fisher stock assessment interview ⇨ captures fisher knowledge about the stock and provides a starting point for the assessment.
- ☐ Fisher preference interview ⇨ obtains information on fishers' preferences for different outcomes in terms of catch and effort.

A partial ParFish assessment can be carried out with just interview data but it is recommended to include at least one other type of additional data.

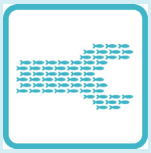
Additional data

- ☐ Catch and effort data ⇨ provide information on stock status and behaviour based on long-term catch and effort data.
- ☐ Fishing experiments ⇨ provide rapidly collected information on stock behaviour (See **Tool 18: Fishing Experiments** for guidance on when fishing experiments are appropriate).
- ☐ Population index data (e.g. visual counts from underwater surveys) ⇨ provide further information on stock behaviour in conjunction with fishing experiments.

2. Carrying out your data collection

Once you have determined what data needs to be collected for ParFish, you need to plan your field work for data collection, and inform and involve the fishers in this stage. You will need to introduce the fishers to the techniques and objectives of each data collection activity, which is described in further detail for each data collection tool. You may find it useful to refer to the sections in **Stage 2** about ***Encouraging participation in ParFish*** and ***Setting management objectives with stakeholders***.

When planning and carrying out data collection, refer to Stage 2 about engaging stakeholders, and Tool 1 for what resources are required



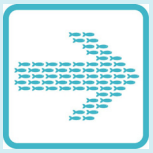
It is essential that you carry out both the Stock Assessment and the Preference Interviews as they are fundamental to the ParFish approach. The two interviews are presented here as separate tools. It is recommended that for each interviewee, both interviews are carried out together (stock assessment interview immediately followed by preferences interview).

See tools:

- ➔ Tool 16: Stock Assessment Interview;
- ➔ Tool 17: Preference Interview;
- ➔ Tool 18: Fishing Experiments;
- ➔ Tool 19: Using existing Catch and Effort Data.

3. Inputting data into Excel

To store your data it should be inputted into a spreadsheet file such as Excel, which is used by the ParFish Software to import data. An Excel template is provided with the Software for you to enter your data in the correct format so that it can be easily imported into the ParFish Software for modelling and analysis. At this stage you can either enter your data directly into the Excel template, or enter it into a separate spreadsheet file and transfer it across to the Excel template when you start using the Software.



To enter your data into Excel you need to install and open the **ParFish Software** and complete Steps 1 and 2. Refer to the **Software Manual** for guidance. Step 1 requires some basic background information on the fishery. Following this it is possible to go to Step 2 which will open an Excel template to enter your data. The template can be saved for later use when carrying out the ParFish analysis (using the Software), and is recommended as a format for storing your data.

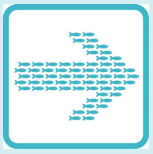
4. Analysing your data

Use the ParFish Software with the Software Manual to carry out data analysis

Once you have collected your stock assessment and preference interview data, compiled catch and effort data if it exists, and carried out fishing experiments and survey indices where appropriate, you are ready to analyse your data using the ParFish Software.

Install the software on your computer if you have not done so already. You should have received a copy of the Software on CD-Rom or downloaded from the internet. If not, you can obtain it from the internet from http://www.fmsp.org.uk.

Full instructions on using the software, loading and analysing your data are included in the ParFish Software Manual, which you should have received together with the Software in hard copy or .pdf from the CD-Rom or internet. Please refer to this when using the software.



➔ See the **ParFish Software** and **ParFish Software Manual.**

5. Collecting monitoring data

Monitoring data can be incorporated into a future ParFish stock assessment

Although ParFish can be used with limited data, results can be improved if the assessment is updated with additional data. This will both reduce the uncertainty of the assessment and illustrate any changes that have occurred in the fishery over the time elapsed.

Following the initial assessment you should look for opportunities to collect monitoring data. This will need to take into account the resources available for data collection and commitment from stakeholders. It therefore needs to be discussed when feeding back results to stakeholders in **Stage 4**, and when agreeing management options in **Stage 5**.

Ongoing data collection is an opportunity to involve fishers in the monitoring of their fishery. However, the costs and benefits of data collection should always be considered, and the involvement of fishers should not just be seen as a ways of off-loading the costs of data collection from a government fisheries institution to the resource users.

See tools:

➔ Tool 20: Guidance for Monitoring
➔ Tool 21: Monitoring the Recovery of a Closed Area

Additional sources of information

In addition to these, other sources specific to certain tools are given within the tools themselves.

Gelman, A., J.B. Carlin, H.S. Stern, and D.B. Rubin. 1995. Bayesian data analysis. Chapman and Hall, London. 526p.

Grenier, L. 1998. Working with Indigenous Knowledge. A Guide for Researchers. The International Development Research Centre, Ottawa, Canada. http://web.idrc.ca/en/ev-9310-201-1-DO_TOPIC.html

Hilborn, R. & Walters, C.J. (1992). Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman & Hall, New York.

Press, S.J. 1989. Bayesian statistics: principles, models and applications. Wiley and sons, New York.

Salm, R.V. & Clark, J.R. 1984. Marine and Coastal Protected Areas: A Guide for Planners and Managers. 302pp. IUCN, Gland, Switzerland.

Walters, C.J. & D. Ludwig. 1994. Calculation of Bayes posterior probability distributions for key population parameters. Canadian Journal of Fisheries and Aquatic Sciences 51: 713-722.

STAGE 4: Interpret Results and Give Feedback

This Stage gives guidance on interpreting the results of the ParFish assessment for different audiences and feeding back the results to stakeholders.

By now, you should have:

- Gone through Stages 1-3 of the Toolkit and collected data;
- Inputted your data into the ParFish Software and carried out some analyses;
- Obtained a range of results and scenarios from the software about the state of the stock and recommended and preferred control levels for the fishery.

Stage 4 gives guidance on:

1. Interpreting the outputs of the ParFish Software;
2. Communicating the results to government fisheries officials;
3. Communicating the results to fishers.

The first section, ***Interpreting the outputs of the ParFish Software***, outlines the main points that should be drawn out from the assessment. The associated tool (**Tool 22: Guidance Notes for Interpreting the ParFish Analysis**) provides detailed guidance on how to do this from the outputs from the Software.

It will be necessary to communicate the results to various stakeholders in different formats. You should have identified this in your plan for engaging with stakeholders (see **Stage 2** and **Tool 6: Developing Stakeholder Engagement Plan**). Based on the Zanzibar experience, there are two important stakeholder groups for communicating the results of the assessment back to: fishers and fisheries managers from government, such as Fisheries Department staff, referred to here as 'government fisheries officials'. Parts 2 and 3 give guidance on packaging the results for these two groups. However, you will also need to consult your Stakeholder Analysis (see **Tool 5**), Stakeholder Engagement Plan (see **Tool 6**) and Communication Plan (**Tool 7**), which may have identified other important groups and ways of communication that are not included here, such as policy makers and NGOs.

1. Interpreting the outputs of the ParFish Software

The analysis carried out using the ParFish Software provides information on the current and unexploited resource state, as well as recommended control levels for management. These outputs need to be interpreted into useful information on the state of the stocks and advice on what control options could be implemented.

Guidance is given here on how to determine the following from the outputs of the software, covering the current situation and the management recommendations:

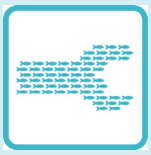
Current situation

- **The state of the stock**: the estimated current stock biomass, as a proportion of the unexploited biomass, and the chance it is overfished (i.e. less than 50% (as default, but can be defined by the user, see footnote on p9) of the unexploited biomass remaining);
- **The level of fishing effort and fishing mortality**: the likelihood that current fishing effort is higher than the effort needed for the maximum sustainable yield (MSY), current levels of fishing mortality (F) and how this compares to F at MSY and F at Optimum (Fopt, the fishing mortality which maximises the fishers preferences);
- **Maximum sustainable yield (MSY) and catch rates**: MSY for the stock and expected catch rates from an unexploited stock;
- **Recovery time (r):** the time required for the resource to return to an un-exploited state.

Management Recommendations

The analysis in the Software can be run for different 'scenarios', so you can change what data are used in the analysis, whether fisher preferences and discount rate are used or whether the defaults are used, and what controls are implemented. The different types of scenarios that can be run are:

- **Baseline Scenarios:** use all the information available in the assessment to determine the control level predicted to have the highest overall preference amongst the fishers (here defined as the ***target*** control), and the control level predicted to reduce the chance of the stock being overfished to below a user-defined level (i.e. the ***limit*** control) (the default is 10%);
- **Closed area scenarios:** explore the recommendations for closed areas;
- **Comparative scenarios:** compare the recommended level of controls for different scenarios (i.e. the influence that different data sources, and the use of fisher preferences have on the results and recommendations);
- **Management advice:** the management options and recommendations based on the results of the scenarios and other knowledge on the fishery, and other similar fisheries.



See tool:

➔ Tool 22: Guidance Notes for interpreting the ParFish analysis.

2. Communicating the results to government fisheries officials

A summary of the results and recommendations of the assessment should be provided to government fisheries officials

It is important to interpret the outputs into useful information for different audiences, for example government fisheries officials will require the information in a different format from fishers. This can be done by a research institution or other stakeholder as defined in the Stakeholder Engagement Plan (see **Tool 6**).

For government fisheries officials, guidance is given on writing a short summary of the situation and the recommendations for management controls. Although government fisheries officials might be involved throughout the whole ParFish process, they may need assistance in developing a summary of the assessment results for future reference and for circulation around their institution.

Feedback to government fisheries officials should include:

- State of the stock;
- Level of fishing effort;
- Levels of control;
- Scientific background;
- Management advice.

Within the feedback to government fisheries officials it should be stressed that the summary provides recommendations, and that management options should be negotiated among all the relevant stakeholders, and most importantly the fishers. The results of the first assessment may have a relatively high level of uncertainty, depending on the amount and quality of data available for the assessment. Two key questions are:

- What management options are there with the level of uncertainty?
- How can the uncertainty be decreased?
    - Implement a change in fishing effort, quota or closed area, and monitor the results;
    - Collect more information through other means, such as monitoring a closed area.

See tool:

➔ Tool 23: Outline for writing a summary of the ParFish analysis for government fisheries officials.

3. Communicating the results to fishers

Results and recommendations of the assessment should be presented to fishers in an appropriate way

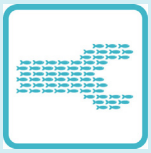
The results and recommendations from the analysis need to be communicated to the fishers to help them evaluate the options they have for managing their fishery and participate in defining management actions.

A number of fisheries management concepts (e.g. fish stock dynamics, overexploited stock, why stock assessments are necessary and uncertainty) should have been explained to the fishers during previous stages (e.g. during the meetings with fishers to introduce ParFish and during the interviews). However, it is a good idea to go over these concepts again and use them to feed-back results of the assessment to fishers. See **Tool 9: Schedule for Meetings** for further information.

Importantly, the fishers should recognise that they have an impact on the stock (which can be emphasised from the results of the fishing experiment, if one was carried out), and therefore can play a role in its management.

Other points that you should get across at this point include:

- Is the resource over-fished?
- The level of fishing effort: Are we over-fishing?
- Recommended controls: What controls could we put on the fishery to meet our objectives?



See tools:

➔ Tool 9: Schedule for Meetings;
➔ Tool 24: Communicating the Results of the ParFish Analysis to Fishers.

CASE STUDY: Meeting with fishers to discuss the results of the assessment

Two meetings were carried out with the fishers of Kizimkazi, in Mkunguni and in Dimbani villages, involving fishers from the respective villages. The aims were to provide feedback on the results of the ParFish stock assessment to the fishers and to discuss possible actions that the fishers could implement to start being actively involved in management.

The ParFish process and how the assessment works were reviewed, using a diagram similar to the one in Figure 7. It was explained that the information used (interviews and fishing experiments) was combined with the fishers preferences (collected through the Preference Interview), to determine the state of the stock and possible management options for the fishery, including recommended control levels that would be most preferred by fishers.

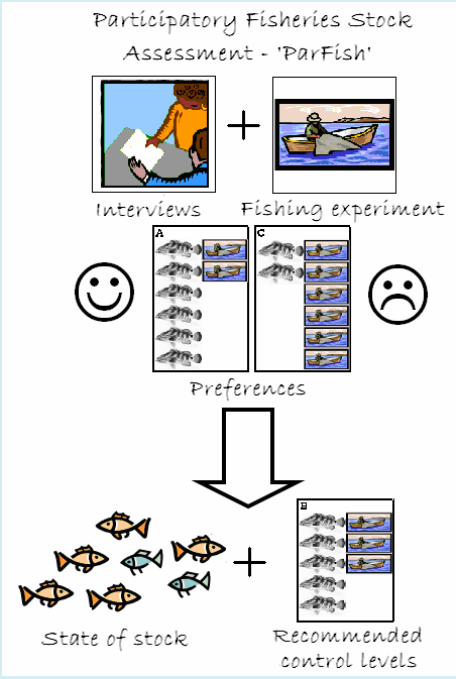


Figure 7: Illustration summarising the information used and the results ParFish provides

Results of the Assessment

The results of the assessment were explained to the fishers by Dr Jiddawi and Dr Medley, in particular the following points:

- The current state of the stock is unknown. There is a high uncertainty in the results, and we need more information to be more certain about the stock (here the oranges in a jar example was referred back to – our knowledge on the fishery is equivalent to the stage when we couldn't see the oranges).
- There is about a 50% chance that it is overfished (less than half of the unexploited biomass left). This was equated to the idea that in a room full of people, half would believe the stock is overfished, and half would disagree. If the stock is overfished, then catches may go down in the future. This was demonstrated using the scenario cards I, Q & P:

Management Options

The following were suggested to the fishers as possible options for management:

- If we **reduce effort** then catches may increase. Fisher preferences indicate that they would prefer this situation, which would reduce the risk of overfishing and increase CPUE. This was demonstrated with scenario cards I, H & K:

I H K

- We could **collect more information** to improve what we know about the fishery and our decisions for management, for example, monitor catches and effort, carry out another fishing experiment, or monitor the recovery of a closed area.
- We could close an area to fishing (preferences indicate 5% of the fishing area would be acceptable), which would reduce the chance of overfishing and may contribute to increasing catches in the fished area. Monitoring the closed area will give us more information about the resource. It was stressed that this would not be permanent – fishers would monitor its effects and impact on their catches, and later decide whether to maintain it or not. A fishing experiment could be conducted there later.

Discussion

The fishers agreed with the results and recommendations in principle. They thought there was too much effort in the fishery, and believed it would be better if effort was restricted. The problem would be how to implement this, as the fishers in each village were not willing to act unilaterally, because fishers from other villages and visiting fishers would continue to fish in the same areas and with the same or greater intensity, therefore their restriction on effort would have no overall effect and they would be losing out.

The fishers agreed that the next step should be to bring representatives of the fishers together from the different villages, together with the Fisheries Department, Menai Bay Conservation Area staff, and others, to discuss the issues in the fishery, the problems they face, and what actions might be implemented to improve the situation. The resulting multi-stakeholder workshop is described in more detail in the **Case Study** in **Stage 5**.

STAGE 5: Initiate Management

This Stage gives guidance on initiating management by building consensus for management actions and initiating management planning. By now you should have gone through the initial stages of ParFish, carried out a stock assessment and fed back the results to the stakeholders.

Stage 5 gives guidance on:

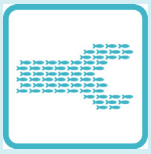
1. Prioritising issues for management;
2. Initiating management planning.

There are a number of other resources and sources of guidance that can be drawn upon to support this Stage. Some references are given at the end of this section.

1. Prioritising issues for management

Prioritising the issues should involve all relevant stakeholders

Once the ParFish assessment has been carried out and recommendations made for management, it is important that the process continues and plans for management are discussed amongst stakeholders and agreed on. Undoubtedly there will initially be some disagreement amongst different groups with respect to the best action to take. Here we provide the outline of a process that can be undergone in a workshop (or several workshops if necessary), to build consensus amongst stakeholders and to identify the priority issues that will be focussed on for an initial management plan. In Zanzibar, this process was used in a multi-stakeholder workshop involving fishers from three different villages, village chiefs, Fisheries Department and other institutions involved in management, to identify the major problems in the fishery and suggest possible solutions. This is detailed in the Case Study below.



See tool:

➔ Tool 25: Prioritising Issues and Developing an Action Plan with Stakeholders.

2. Initiating management planning

A management plan should be a living document that is implemented and regularly reviewed

Once priority issues have been identified, solutions for each issue can be discussed and agreed upon. It is important to set roles and responsibilities, such as what needs to be implemented and who will carry out each point. If appropriate, this can be documented and developed into a management plan. An outline of the possible structure of a management plan and the points you might cover is provided in **Tool 26**, if you feel that this is an appropriate way to record the results of the process.

In Zanzibar the suggested solutions have not yet been developed into a management plan. Participants at the multi-stakeholder workshop recommended further workshops in order to take forward the suggestions and obtain approval for the recommendations. Development of a management plan may be a step in this process, to gain commitment from each one to fulfil their responsibilities. A lesson from Zanzibar is that this process requires long-term commitment and may require facilitation to keep the momentum going.

See tool:

➔ Tool 26: Example of an Outline Management Plan.

Additional sources of information

Dixon, P., Barr, J. & Lewins, R. 2001. Best practice guidelines for consensus management of common pool resources. Newcastle: Centre for Land Use and Water Resources Research, University of Newcastle.

Brown, K., Tompkins, E. & Adger, W.N. (2001) Trade-off Analysis for Participatory Coastal Zone Decision-Making. Norwich: Overseas Development Group, University of East Anglia.

Berkes, F., Mahon, R., McConney, P., Pollnac, R. & Pomery, R. 2001. Managing Small-Scale Fisheries. Alternative Directions and Methods. International Development Research Centre, Ottawa, Canada. http://web.idrc.ca/en/ev-9328-201-1-DO_TOPIC.html

Cochrane, K.L. 2002. A Fishery Manager's Guidebook. Management Measures and their Application. FAO Fisheries Technical Paper No. 424. Rome, FAO. 231 pp.

CASE STUDY: Multi-stakeholder workshop - issues raised and solutions

Jiddawi, N.S. and Amir, O.

The following issues were identified as priorities in a workshop involving fishers, village leaders, headmasters, representatives of womens' committees and fishermen's committees, Department of Fisheries and Marine Resources (DFMR), Department of Environment, Menai Bay Conservation Area (MBCA), District Fisheries Officers and Beach Recorders. The workshop was facilitated by Dr Narriman Jiddawi and Omar Amir from the Institute of Marine Sciences, who also provided English-Swahili translation. Each group of 6 people prioritised the issues, identified the stakeholders involved and how to implement the solutions, and the timescale of each issue. Representatives of fisheries institutions (DFMR, Dept. of Environment, MBCA, IMS and District Fisheries Officers etc.) formed one group, and 5 groups were made up of fishers, village leaders and other representatives from the villages. Feedback from each group was given to the other workshop participants in plenary and the solutions discussed (Figure 8). The solutions identified are still at the planning phase and will require further time and facilitation to take forward.

Figure 8: Participant giving feedback on priority issues and solutions

Priority issues and solutions identified by Institutions (Fisheries Dept, Conservation Area managers, District Fishery Officers, Department of Environment)

Issue	Stakeholders involved	How to implement	Timescale
Education on sustainable use of marine resources	DFMR Dept of Environment Dept of Cash Crops, Fruits and Forestry IMS Ministry of Education	Meetings and workshops in villages Distribute leaflets and brochures Programmes on radio & TV Calendar, Drama and films	Immediately
Community participation in management of marine resources	Community residing close to resources and other stakeholders	Follow established guidelines Enact bylaws Carry out patrols	Long term Immediately Long term
General management plan	All stakeholders	Evaluation of resources Meetings Workshops Report on general management plan and distribute to all stakeholders	18 months
Implementation of the plan	All stakeholders	Monitoring & Evaluation Data collection Review implementation	Ongoing Long term Five years

Zoning of areas	All stakeholders	Recognition of areas according to importance Put boundaries/buoys of zoned areas Advertise the areas Manage areas	3 months 3 months 3 months Short term

Priority issues and solutions identified by fishers and other village representatives:

Issue	Stakeholders involved	How to implement	Timescale
Control number of visiting (camping) fishers	Village leader (Sheha) Fishermen Committees Visiting fishermen Fisheries Beach Recorders Environmental Committees MBCA	Provision of information from management committee Plan fixed number of vessels to be allowed Awareness-raising of Fisheries Laws & regulations for fishers	Immediately and long-term
Control illegal fishing and strengthen patrols	MBCA Coast Guard (KMKM) Village Environmental Committees Fishermen Committees Fishermen	Well equipped and ready Participate in patrols Patrol and report any illegal fishing once they notice it Change patrol teams after a certain period of time to avoid corruption (e.g. 2 months) Prosecute patrol members and fishers involved in bribes	Immediately and long-term
Education on sustainable use of marine resources	DFMR Dept of Education Dept of Environment MBCA IMS Community	Provide awareness on sustainable use of marine resources Advertise on radios, magazine, leaflets etc. Books, Workshops, TV Educate students on sustainable use of fisheries resources	Immediately / 2 years
Prohibit the use of certain gears (purse seining, artificial bait for squids, scuba dive fishing, spear fishing)	DFMR Dept of Environment Community District Government Village Patrol guards Environmental Committees Fishermen Committees	Cooperation	Long-term
Revive traditional management methods (e.g. for squid, octopus, sea cucumber)	Sheha Community Fishermen District Government	Plan, manage and implement	Immediately
Provide fishing gears on loan	DFMR	Seek assistance from donors	Immediately
Evaluation of condition of the sea, and reporting of research results	IMS Community DFMR Dept Environment Researchers	Research Media, Leaflets and other methods	Every 3 years

STAGE 6: Evaluate the ParFish Process

Evaluation is all about learning - any problems should be dealt with positively and seen as an opportunity to improve rather than as a failure to be hidden

Evaluation is a chance to step back from implementing ParFish and ask questions on the progress of the assessment, management actions and improvements to the fishery. This is not only useful to be able to measure the success of any activities, but also enables the team to learn from the experience and make adjustments to the process and methods for future activities.

Stage 6 gives guidance on when evaluation should occur, who should be involved and what sort of questions need to be asked, divided into two parts:

1. Evaluating the process;
2. Evaluating the outcomes.

1. Evaluating the process

Fishers and other stakeholders should be consulted for the evaluation

Evaluating the process allows the extent to which the process was successful to be assessed, and what improvements need to be made. It involves the evaluation of the data collection phase, participatory and communication methods and should be an on-going process within the team (e.g. every 2 – 6 months), but could also be broadened out within a consultative workshop after reaching Stage 5.

You should involve the ParFish team facilitating the process but should also gather feedback from fishers and other stakeholders, which can be done through consultative workshops or meetings. In Zanzibar, this involved sitting down with the facilitating team which included IMS, Fisheries Department and the State University of Zanzibar, and running through questions outlined in **Tool 27** and defining required actions and lessons learned from the process.

You can ask a series of questions and consider how successes can be replicated and challenges addressed. You may want to design your own questions based on your specific experience, but some ideas are provided in **Tool 27: Evaluation Framework**.

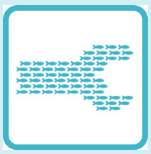
The questions fall into the following categories:

- Context;
- Participation;
- Objectives;
- Data collection;
- Assessment;
- Communication;
- Management Planning.

2. Evaluating the outcomes

Evaluating the outcomes allows us to measure the impacts of ParFish including the impacts of the management actions and changes in the fishery, and plan the next steps.

The outcome of ParFish can be investigated through questioning key stakeholders and repeating the assessment



You can evaluate the success of management actions following the completion of a ParFish cycle. It may then be advisable to evaluate the outcomes and impacts on the fishery by re-doing the assessment annually or as defined in the management plan.

Evaluation of the outcomes can be done by undertaking another ParFish assessment. This will answer the question as to whether there have been any changes in the fishery since the ParFish approach was initiated, for example: What impact have management actions had on the state of the stock and the likelihood of exploitation? Or, have there been any changes in the preferences of fishers since the last assessment?

You can also consider the series of questions given in **Tool 27** covering:

- Management actions;
- Improved fishery.

A summary of the results of the evaluation of the Zanzibar process are outlined in Table 3.

See tool:

➔ Tool 27: Evaluation Framework

Table 3: Summary of the evaluation of the ParFish process in Kizimkazi

Context	• The context was well understood through ongoing work by IMS in the area, although further issues in the fishery were identified through the ParFish process.
Participation	• There was an expectation that fishers would remain interested and continue to attend meetings; • Closer links have been created between the institutions and the fishers, this has made difficult issues easier to discuss; • Other organisations that could be involved in ParFish assessments in the future were identified.
Objectives	• The initial aim of the Kizimkazi case study was to develop the data collection methods, as a result objectives were not discussed with fishers before carrying out the assessment; • Discussing objectives for the assessment with the fishers beforehand would have enabled planning to provide specific recommendations on issues of concern, e.g. for Kizimkazi it could have been agreed that the assessment would indicate how many visiting fishers could be allowed to fish whilst preventing overexploitation.
Data Collection	• Data collection methods were successful in gaining information on the fishery to carry out a stock assessment.
Assessment	• Further training needs were identified for Software use.
Communication	• Methods used for communicating concepts and results to the fishers were successful, such as 'estimating numbers of oranges in a jar', 'bau game' and participatory mapping.
Management Planning	• A number of management recommendations were agreed on in the multi-stakeholder workshop, although these will need to be further detailed and endorsed before implementation; • Future data requirements for monitoring have not been assessed in detail yet, but it was considered that it would be possible to continue collecting catch and effort data.

Additional sources of information

Garaway, C.J. & Arthur, R.I. 2004. Adaptive learning: A practical framework for the implementation of adaptive co-management. Lessons from selected experiences in South and Southeast Asia. MRAG Ltd. 44p. Available online at http://www.fmsp.org.uk.

http://www.mande.co.uk – a website about monitoring and evaluation methods relevant to development projects and programmes with social development objectives.

http://www.parcinfo.org – a website that provides resources and guidelines for performance assessment.

Concepts

Concept 1

Introduction to ParFish and Fisheries Management

What is it?

This concept suggests ways of explaining:

1. Why manage fisheries?
2. What is ParFish?
3. How ParFish involves fishers.

1. Why manage fisheries?

- It is important to manage our fisheries so that they are sustainable, so that in the future we will still be able to continue fishing.
- There are benefits to managing our fisheries more effectively. Without management, it is possible that over-exploitation of the stock will occur, leading to declining catch rates, changes in the composition of catches and possibly collapse of the fishery (see also **Concept 2: Fish Stock Dynamics**).
- Because it is impossible for us to know exactly how many fish are in the sea, we need to monitor and assess fisheries, for example by collecting catch and effort data, to give us an indication of the stock size and status, so that management decisions can be made based on best estimates of stock status (see also **Concept 3: Fisheries Monitoring and Assessment**).

2. What is ParFish?

- The ParFish stock assessment is a way of finding out the state of our resources, whether we need to implement any management measures, and what these should be.
- ParFish involves all stakeholders in the assessment, particularly fishers, and incorporates fishers' knowledge and preferences on the stock in the assessment.
- ParFish also includes fishers' preferences for different catch and effort levels in its recommendation of control levels, so that we can identify which option would be most preferred by the fishers. See also **Concept 5: How ParFish works**.

3. How ParFish involves fishers

- The ParFish assessment will involve collecting information from the fishers, and from existing sources. This may include: interviews with the fishers to obtain their views on the stock; interviews with fishers to understand their preferences for different catch rates; fishing

experiments where the fishers go fishing and record their catches for a short period to help inform the assessment, and existing catch and effort data.

- The process for analysing the data requires a computer, so most fishers or fisher groups will not be able to carry out the analysis themselves. So, the information will be taken away, but then the results of the assessment will be explained to them.
- You should have identified communication pathways in your communication plan (see the section on ***Identifying appropriate communication channels*** in Stage 1, and **Tool 7: Developing a Communications Plan**, which will indicate appropriate channels and formats for communicating with fishers. Ask the fishers how they would like the information gathered to be returned to them.

Concept 2

Fish Stock Dynamics

What is it?

This concept suggests ways of explaining that:

1. Stock size is finite and fishing removes a proportion of the stock biomass;
2. The stock is over-exploited if it is below half the unexploited stock;
3. Overfishing leads to an over-exploited stock and to reduced fish catch rates.

1. Stock size is finite and fishing removes a proportion of the stock biomass

The fish stock can be thought of as a finite resource that has a specific biomass, or number of fish. From this stock, fish are caught and removed from the population, and the fish remaining in the stock breed, producing eggs and young which contribute to population growth.

Water jug concept

For example, we can imagine a fish stock as a bucket of water (see Figure C1), where water is being poured in the top (growth and reproduction of the fish stock), and a tap is taking water out of the bottom (natural mortality and fish catch).

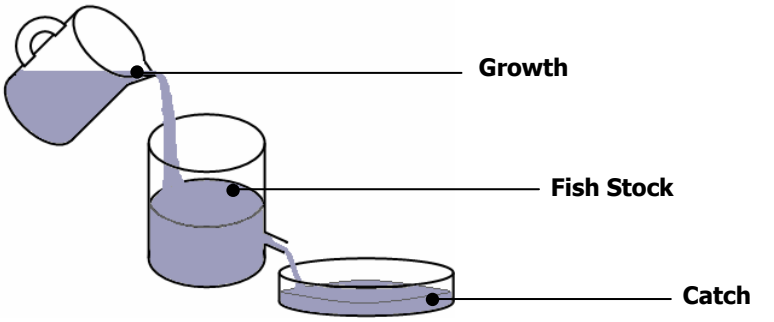


Figure C1: Using the water jug concept to explain fish stock dynamics

Note that 'growth', or the water being poured in to the fish stock at the top, could be from any source, depending on the fishers' understanding. For example, it could be the adult fish reproducing, it could be the rains that bring new fish, or it could be some all-powerful force that puts fish in the sea for the fishers to catch. The key is that the more fish are in the sea (fish stock), the more will be added by reproduction, the rains, or the 'force'.

The Bau game concept

A fisheries stock can also be demonstrated to the fishers using beans, pebbles or seeds in a series of holes (see Figure C2). There is a game in East Africa that uses a set of holes in a piece of wood known as the 'Bau' game. However you could also carve out holes in the ground or draw circles on the ground or on a piece of paper.

Arrange two rows of holes with the top row representing the stock size and the bottom row representing fish catch. Growth is represented by beans entering the top row and as you move across from left to right you are moving from one year to the next.

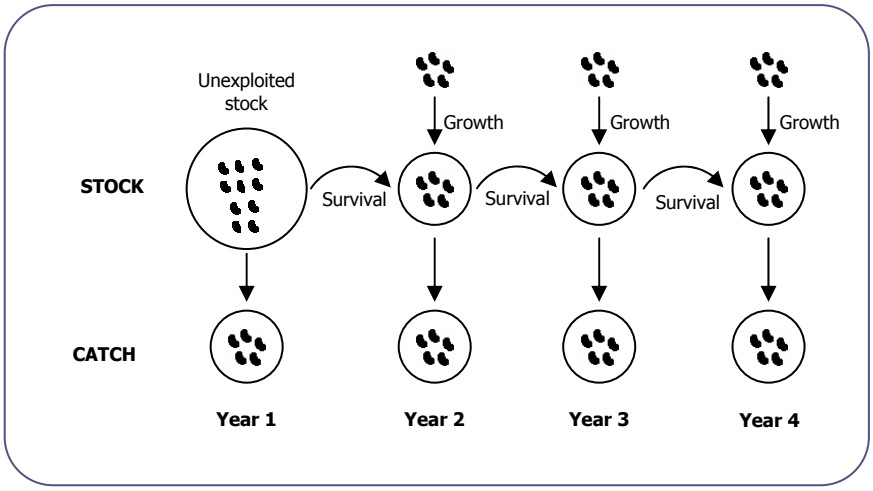


Figure C2: Illustrating fish stock dynamics using the bau game

In this example the unexploited stock was originally equivalent to 10 beans. If the catch is equivalent to 5 beans each year there are 5 beans of 'fish' remaining. In this simplified version it is assumed that growth is proportional to the remaining stock so that an additional growth of 5 beans and a catch of 5 beans lead to the survival of 5 beans the next year, and so it continues.

This example also illustrates how at a certain level of fish catch the stock remains stable with growth and catch balancing each other out. This concept can also be used to describe the impact of fishing effort when it removes over 50% of the stock. This is explained below.

2. The stock is over-exploited if it is below half the unexploited stock

Stock size is considered as a proportion of the unexploited stock size. If there is at least 50% of the stock remaining it is likely to be sustainable. If there is less than 50% of the unexploited stock remaining the stock is likely to be over-fished.

If a stock is over-fished growth will decrease and resulting catches will decrease. This can be illustrated using both the water jug and the bau-bau game concepts.

In the water jug example the reduction in the fish stock reduces the fish catch, especially when the fish stock falls to below 50% of the unexploited stock size (see Figure C3).

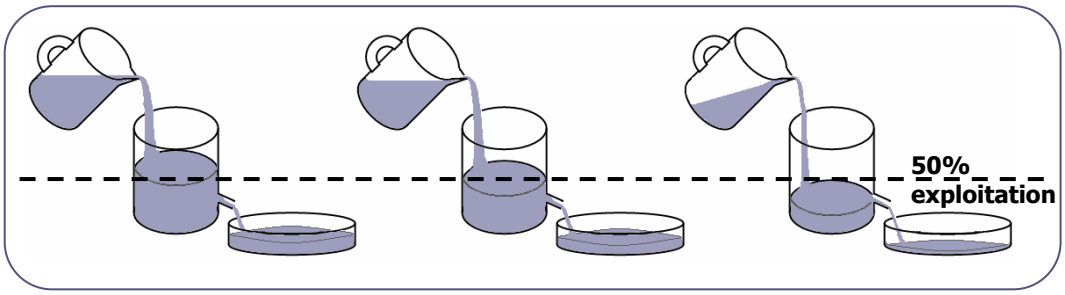


Figure C3: Illustrating reducing fish catches with reducing stock size

In the bau-bau example a reduction in the stock below 50% of the unexploited stock leads to reduction in fish catches (see Figure C4).

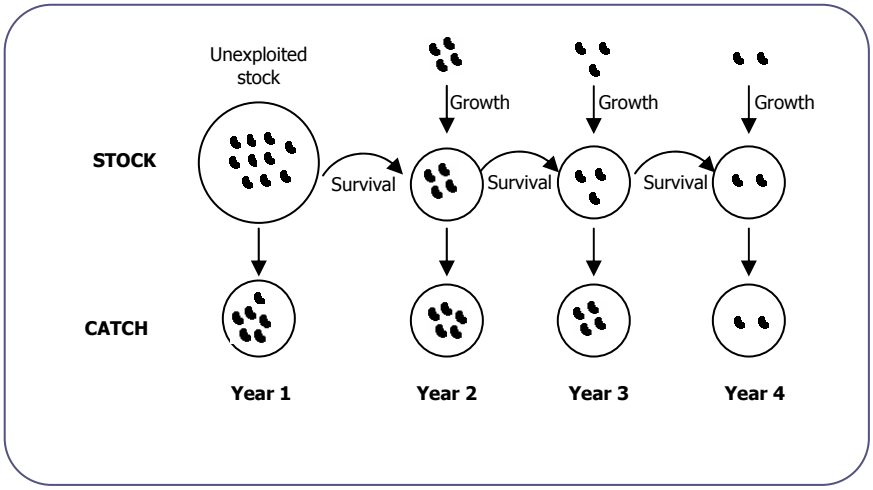


Figure C4: Illustrating reducing fish catches and growth with reducing stock size

3. Overfishing leads to an over-exploited stock and reduced fish catches

Overfishing is when we remove too many of the fish from the stock, leading to an over-exploited stock. This was illustrated in Figure C3 and Figure C4 above, but can also be illustrated using scenario cards.

Scenario cards

The scenario cards are used in Stage 3 during data collection via the preference interview. They consist of a series of cards with pictures of fish and boats side by side. The fish represent the fish catch and the boats represent fishing effort.

The first card in the series has four fish and four boats. This represents the current levels of effort and catch in the fishery (see Figure C5). Following on from this, differences in the number of fish

relative to the number of boats illustrate changes in catch rates. The scenario cards can therefore be used to illustrate changes in fish catch with changing levels of effort (see Figure C6).

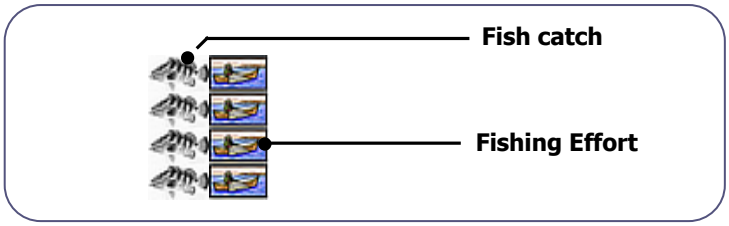
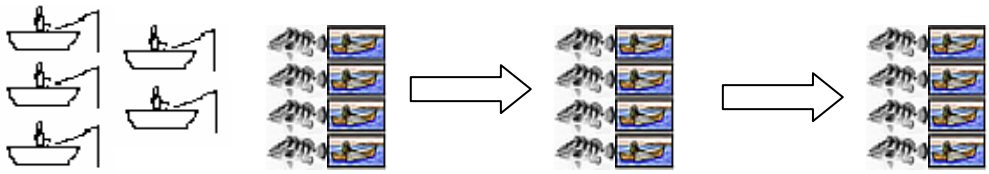


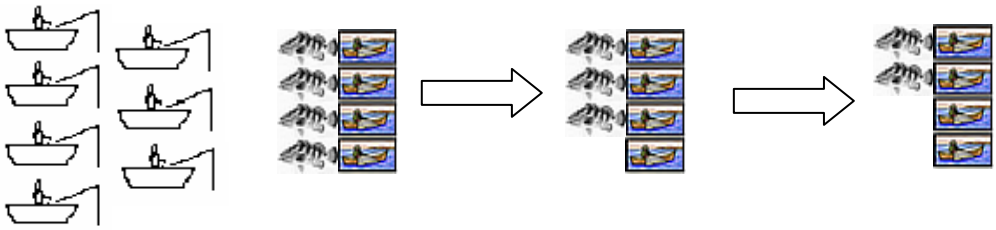
Figure C5: The reference scenario card

1) The right amount of boats



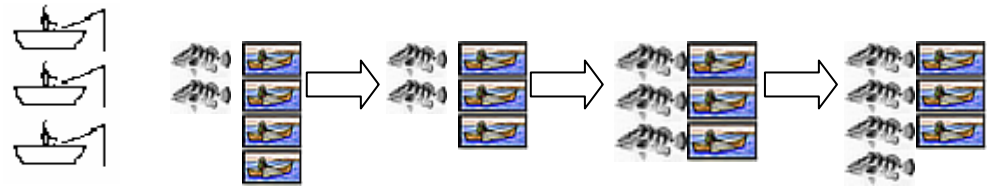
In this scenario the stock is not being over exploited and catch rates remain stable.

2) Too much fishing effort



In this scenario over 50% of the stock is being removed so that the stock becomes over-exploited and catch rates decline over time.

3) Reducing the amount of fishing effort



In this scenario catch rates start to increase as fishing effort is reduced.

Figure C6: Illustrating the impact of over-fishing on catch rates using the scenario cards

Concept 3

Fisheries Monitoring and Assessment

What is it?

This concept suggests ways of explaining:

1. Why do we need a stock assessment?
2. Why do we need to collect data?

1. Why do we need a stock assessment?

Having reviewed some of the concepts of fish stock dynamics with fishers it should be clear that we want to manage our fishery so that we make the most of the resource without over-exploiting the resource and reducing catch rates.

If we are too cautious, we might not take advantage of the fish that are there, if we are too optimistic, we might overfish and end up with low catch rates. We also have to remember that nature and the environment are variable, and even if we maintain the same effort, stock growth, recruitment and reproduction may vary from year to year with environmental or other factors, so we need to be precautionary in our actions to avoid overexploiting the stock.

Stock assessments are very useful to assist management as they can help answer questions such as:

- What is the state of the stock – is it over or under exploited?
- What is the recommended level of control on a fishery – how can we control fish catches and maintain a healthy fish stock that will continue to provide us with fish next year and in the years to come?

2. Why do we need to collect data?

As it is not possible to count the number of fish in the sea we need to use indicators. One such indicator is the amount of fish that are caught in a fixed amount of time, or with a fixed amount of effort. This is known as the **catch rate** or **catch per unit effort**. When there are lots of fish, we can catch plenty of fish with a small amount of effort. When there are fewer fish, we have to fish harder to catch the same amount.

Other indicators we use include:

- The results when we undertake fishing experiments (i.e. fish heavily in one area for a period of time);
- Fishers knowledge of the fishing stock i.e. recovery times, how the stock has changed over time etc.

Concept 4

Uncertainty, Adaptive and Precautionary approaches

What is it?

This concept suggests ways of explaining:

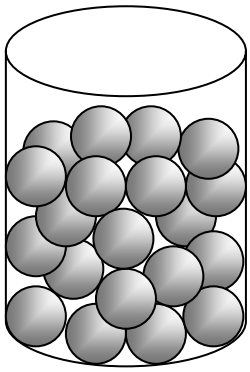
1. Uncertainty in stock assessments;
2. Adaptive and precautionary approaches.

1. Uncertainty in stock assessments

As it is not possible to count the number of fish in the sea there will always be uncertainty in our estimations. However the more data and information on indicators we can collect, the less uncertainty there will be. This can be illustrated using the concept of estimating the number of oranges in a jar.

Estimating oranges in a jar

This exercise can be carried out practically in a workshop. Take a jar or pot, and fill it with a number of similar items. For example, depending on the size of the jar, you could use pebbles, stones, oranges or bread rolls.



There should be between 10 and 20 items, to ensure that the range of estimates is not too large. Ask the fishers to guess how many items they think are in the pot. They can either say what they think, and the facilitator notes down the guesses on a flipchart (although they may change their guesses depending on what others have said), or they can individually write down how many they think on small squares of paper, which can then be used to construct a chart as in Figure C7 like the ones in Figure C8 and should illustrate a range of values.

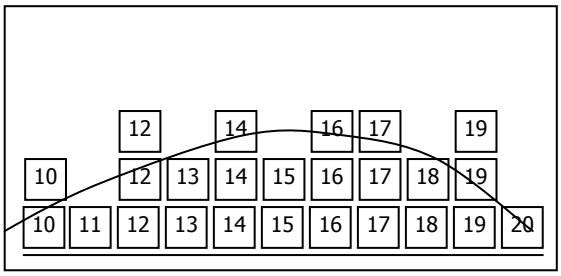
Afterwards, empty the jar and count the number of items in it. You should find the guesses are spread around the real value.

If the pot or jar is transparent (e.g. plastic/glass), this exercise can be done twice: the first time, with paper around the sides of the jar so that people can't see the items inside, and the second time without the paper, so that everyone can see the items, and get a better estimate of the number (see Figure C8) .

The two estimates (before and after seeing the items) can be used to explain how, with more information, our estimates are more accurate, as the range of estimates is smaller, and the estimates are more closely grouped around the correct value. This can be related to our estimates of stock size or the number of fish – the more information we have, the better our estimates are.

Figure C7: Arranging estimations of the number of oranges onto a graph in a workshop in Zanzibar

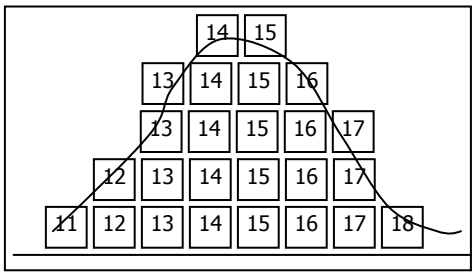
1. Without seeing the items inside the jar



Points to note:

- Larger range of estimates (10 – 20)
- More spread out, flatter curve – less agreement about the number of oranges

2. After seeing the items inside the jar



Points to note:

- Smaller range of estimates (11 – 18)
- Higher curve – more agreement around middle values

Figure C8: Differences in the estimations between having the jar covered and uncovered

2. Adaptive and precautionary approaches

The exercise above illustrates that there is likely to be uncertainty around estimation where we cannot directly count the number of items. You can explain that there will be uncertainty with initial estimates of fish stocks because they will be based on limited information. Where there is uncertainty in the results, you can either:

- Take a precautionary approach, taking action based on the initial understanding of the fishery, implementing a small change to reduce fishing mortality if necessary, and collect further information to reduce the uncertainty, such as carrying out a further fishing experiment (see **Tool 20: Guidance for Monitoring**).
- Take an adaptive approach and implement a change in management with the aim to observe and monitor a change in the fishery which will give us further information on the fishery. However, the change may have to be quite substantial to result in measurable changes in the fishery.

Concept 5

How ParFish works

What is it?

This concept suggests ways of explaining:

1. How ParFish estimates stock size, growth and potential catch;
2. How ParFish uses interviews to collect information.

1. How ParFish estimates stock size, growth and potential catch

ParFish is a type of stock assessment that uses data from a number of different sources and gives us information on:

- The state of the stock – is it over or under exploited?
- The recommended level of control on a fishery – how can we maintain a healthy fish stock that will continue to provide us with fish next year and in the years to come?

ParFish uses data from a number of different sources to provide answers to these questions as illustrated in Figure C9. These include:

- Fishers knowledge of the fishery (Stock Assessment Interview);
- Fishers preferences on outcomes for the fishery (Preference Interview Parts 1 & 2);
- Catch rates: measured amount of fish that are caught in a fixed amount of time, or with a fixed amount of effort;
- Fishing experiments: changes in catch rates when we fish heavily in one area.

As it is quite complex, we need the help of scientists to combine the different indicators and provide fishers with feedback on the results.

2. How ParFish uses interviews to collect information

ParFish uses interviews to gather fishers' knowledge on the fish stock, and to incorporate their opinions and preferences into the assessment. This means that when assessing management options, the outcomes of management in terms of catch and effort, are assessed according to how much the fishers would like them or not. The assessment will give us a first indication of what the fishers would like or not like, and then the fishers will have a chance to review the results and see if they agree or not.

The first part of the interview, the stock assessment interview, asks a series of questions about fishers' catch rates and the amount of time they spend fishing. It is important that you only talk about the specific fishery that is being considered in ParFish. This information is used to help calculate how much fish there is, and how much we can catch sustainably.

The second part of the interview involves fishers choosing between different scenarios of possible catch and effort levels, compared to their current catch and effort rate. They will be asked to choose lots of times, until they have an order from best to worse of all the scenarios. Then they will be asked to give a score for how much they like one scenario over the next. They can give a score from 0 to 4, 0 being no difference or no preference, 4 being that they like one scenario much more than the other, and 1 to 3 being in between.

Including fishers' preferences ensures that the recommendations for controls to the fishery result in catch rates that are agreeable to fishers on average. It will be possible to give the feedback on the assessment results including information from fishers and only using scientific data to illustrate the impact the fisher's views have on the assessment.

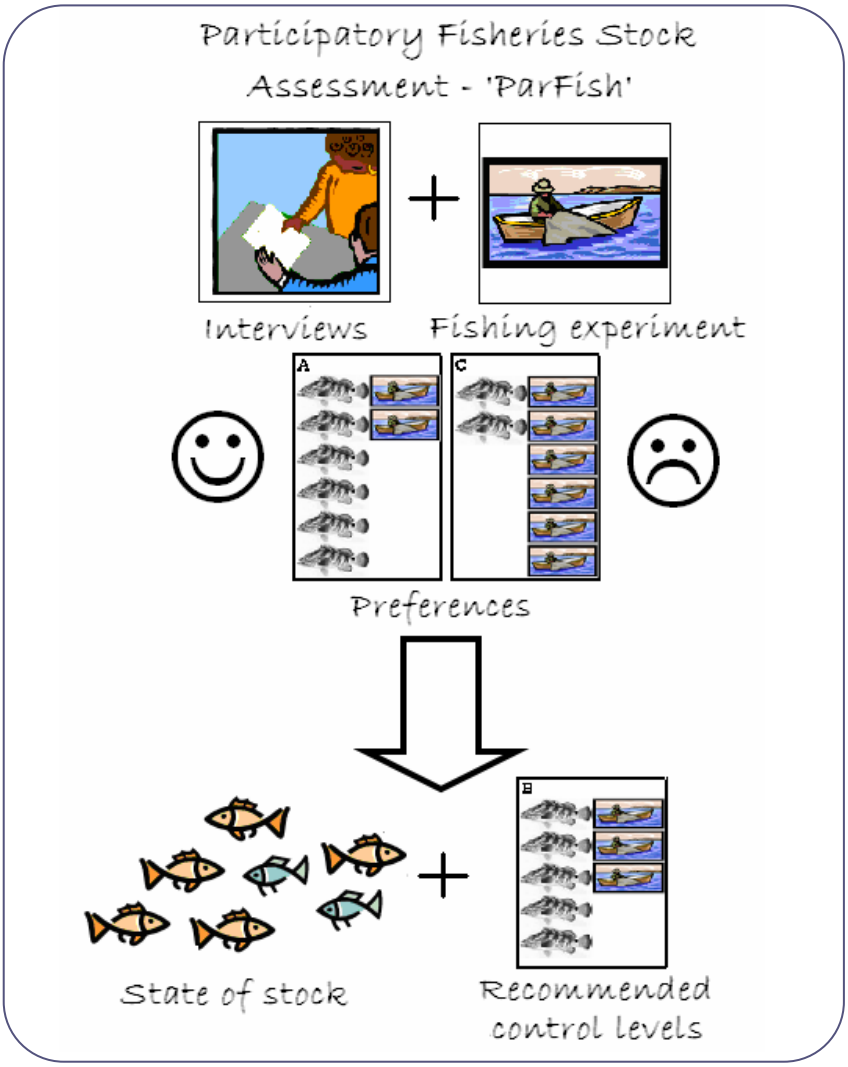


Figure C9: A visual summary of a ParFish assessment carrying out interviews and a fishing experiment

Tools

Summary of Tools

*= Deciding to Use ParFish

Tool No.	Stage No.	Name	Importance	Comments	Page
1	*	Resources Required for ParFish	☐ Essential ☑ Highly Recommended ☐ Recommended	Indicates the resources you may require for each stage of ParFish	61
2	1,3	Background Information to Compile	☑ Essential ☑ Highly Recommended ☐ Recommended	Outlines the essential background information and other useful information for the ParFish process	63
3	1	Checklist of Potential Sources of Information	☐ Essential ☐ Highly Recommended ☑ Recommended	Provides possible sources for the information in Tool 2	65
4	1	Institutional Analysis and Design Framework	☐ Essential ☑ Highly Recommended ☐ Recommended	Assists understanding of the management system	67
5	1	Stakeholder Analysis	☑ Essential ☐ Highly Recommended ☐ Recommended	Identifies people and institutions that have a role or interest in ParFish	69
6	1	Developing a Stakeholder Engagement Plan	☑ Essential ☐ Highly Recommended ☐ Recommended	Helps you define how stakeholders can be involved in ParFish	73
7	1	Developing a Communications Plan	☑ Essential ☐ Highly Recommended ☐ Recommended	Helps you define how you communicate with stakeholders	75
8	1,2	Setting up Meetings with Interested Groups	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides guidance for setting up meetings with stakeholders	79
9	2,4	Schedule for Meetings	☐ Essential ☐ Highly Recommended ☑ Recommended	Provides a schedule of the issues to cover in meetings at each stage of the ParFish process	81
10	1,2	Facilitation Techniques	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides possible techniques for facilitating meetings and encouraging participation	83
11	1,2,3	Participatory Mapping of Fishing Grounds	☐ Essential ☑ Highly Recommended ☐ Recommended	Enables fishers to indicate the areas where they fish, to help identify fishing grounds and the fishery area.	85
12	1,2	Key Informant Interviews	☐ Essential ☐ Highly Recommended ☑ Recommended	Provides advice on preparing and conducting interviews with people who can provide background information	87
13	2	Agreeing Objectives with Stakeholders	☐ Essential ☑ Highly Recommended ☐ Recommended	Assists the definition and agreement of management and assessment objectives	89

14	1,3	Sampling Catch Units	☐ Essential ☑ Highly Recommended ☐ Recommended	Will be required to convert or standardise units if kg are not used as standard	91
15	3	Mapping and Calculating the Fishing Area	☐ Essential ☑ Highly Recommended ☐ Recommended	This is essential if you carry out fishing experiments, and useful even if you do not	93
16	3	Stock Assessment Interview	☑ Essential ☐ Highly Recommended ☐ Recommended	Provides and explains the questions for the Stock Assessment Interview	95
17	3	Preference Interview	☑ Essential ☐ Highly Recommended ☐ Recommended	Provides and explains the questions and scenario ranking for the Preference Interview	103
18	3	Fishing Experiments	☐ Essential ☐ Highly Recommended ☑ Recommended	Explains how to design and carry out a fishing experiment to obtain more information on the stock	117
19	3	Using existing Catch and Effort Data	☐ Essential ☐ Highly Recommended ☑ Recommended	Explains how to find and incorporate existing catch and effort data in the ParFish assessment	125
20	3	Guidance for Monitoring	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides guidance on what monitoring can be undertaken to gather more information and reduce uncertainty	127
21	3	Monitoring the Recovery of a Closed Area	☐ Essential ☐ Highly Recommended ☑ Recommended	Explains how to monitor a closed area to provide more information for a further ParFish assessment	129
22	4	Guidance Notes for interpreting the ParFish Analysis	☑ Essential ☐ Highly Recommended ☐ Recommended	Explains how to interpret the outputs of the software into useful information on stock status and management recommendations	131
23	4	Outline for a Summary of the ParFish Analysis for Government Fisheries Officials	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides a framework that can be used to present the assessment results to government fisheries officials	143
24	4	Communicating the Results of the ParFish Analysis to Fishers	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides ideas on how to communicate the results and recommendations of the analysis to fishers	145
25	5	Prioritising Issues and Developing an Action Plan with Stakeholders	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides a process to prioritise issues and develop an action plan, an important step towards implementing some assessment recommendations	149
26	5	Example of an Outline Management Plan	☐ Essential ☐ Highly Recommended ☑ Recommended	Provides an outline management plan that can be used as a basis for developing one for the fishery.	151
27	6	Evaluation Framework	☐ Essential ☑ Highly Recommended ☐ Recommended	Provides a framework for evaluating the ParFish process and outcomes	155

Tool 1

Resources Required for ParFish

What is it?

This tool gives an indication of the resources you may require to undertake each stage of the ParFish process. This is only a guide as the actual days required will depend on your context, the partners involved in the process and the tools and especially data collection activities that you implement.

Why use it?

This tool helps you to determine if the ParFish process is feasible and what additional resources or partners you will need to mobilise to begin.

How to do it

Use the table below as a guide to the resources required when planning activities. Refer back to the table as you read through the Guidelines and Tools and plan data collection and other activities. All Stages should be carried out, but you will not necessarily implement all components of each Stage, especially data collection tools in **Stage 3**.

Guidance to the resources required to undertake the ParFish process

ParFish stage	Activities	Skills	Person days
1. Understand the context	◦ Literature Review ◦ Participatory approaches (e.g. stakeholder analysis)	◦ Fisheries researchers or managers	◦ 5 person days
2. Engage stakeholders	◦ Meetings ◦ Participatory approaches (e.g. problem census)	◦ Community facilitators	◦ 5 person days
3. Undertake ParFish Stock Assessment	◦ Training of data collection personnel	◦ Trainers	◦ 1 person day
		◦ Data collectors	◦ 4 x 1 person days
	◦ Data collection	◦ Data collectors ◦ Community facilitators	See totals below for each *data collection method*
	- *Fisher Interviews* (required) (Tools 16 & 17)	◦ Interviewers	◦ 4 x 5 person days

	- *Fishing experiments* (optional) (Tool 18)	◦ Divers ◦ Fishers ◦ Data recorders	◦ 4 x 10 person days
	- *Collation of existing catch & effort data* (optional) (Tool 19)	◦ Data collators	◦ 5 person days
	◦ Data input	◦ Data inputers	◦ 5 person days
	◦ Analysis & interpretation	◦ Software user ◦ Fisheries researchers or managers	◦ 5 person days
4. Interpret Results and Give Feedback	◦ Meeting and presentations to stakeholders ◦ Workshops	◦ Community facilitators ◦ Fisheries researchers or managers	◦ 10 person days
5. Initiate management planning	◦ Define roles & responsibilities ◦ Design long-term data collection system ◦ Undertake further assessments	◦ Community facilitators ◦ Fisheries researchers or managers	◦ 10 person days
6. Evaluate the ParFish Process	◦ Evaluate process and outcomes	◦ Fisheries researchers or managers	◦ 5 person days
Total			***70 – 110 person days*** ***3 – 5 months***
Continuation	◦ Ongoing monitoring and/or repeat ParFish assessment		◦ Depends on monitoring plans

Tool 2

Background Information to Compile

What is it?

This tool gives you guidance on what information may be gathered about the fishery prior to and during the implementation of ParFish. It also indicates what information is required specifically for the ParFish Software.

Why use it?

Some data are required by the ParFish Software in order to carry out the stock assessment; other information help you understand the fishery, the factors that influence it, the forces that act upon it, and the processes that regulate it. This tool indicates what information is required and recommended for each of these purposes.

How to do it

Think through and compile existing information on the following issues:

1. The fishery;
2. The fishery management system:
    - General background to the area;
    - Management context.

This will give an overview of the fishery, people, organisations and processes involved. We provide potential sources of information in **Tool 3: Checklist of Potential Sources of Information** and tools to gather information in **Stage 2**. You can also refer to **Tool 4: Institutional Analysis and Design Framework** when thinking about the management system and to **Tool 5: Stakeholder Analysis** to identify the organisations and people involved. All the information you collect should be compiled into the management plan so that it is available for future reference.

1. The Fishery

- What is the current fishing effort for each gear, or what was last year's effort? *[Essential: needed in the ParFish Software to scale up the interviews from a sample of fishers so the results apply to the whole fishery].*
- What are the most important fish species caught? *[Essential for deciding to use ParFish: indicates the most important fishery and whether it is suitable for ParFish].*
- What are the main fishing gears and fishing vessels used? How many are there? *[Essential: gear type is required for the ParFish Software, and the range and number of gears used indicate the diversity and size of the fishery].*
- What other fisheries resources are there (fish and invertebrates); what is known about their distributions and abundances? *[Recommended: indicates the variety of resources available].*
- Where are the boundaries of the fishing area? Is it possible to map the fisheries resources (i.e. the productive areas such as reefs) or fishing area? (See also **Tool 11: Participatory Mapping**) *[Essential for Fishing Experiments: knowledge of the fishing area is required for refuge controls and scaling up fishing experiments].*

- How many fishers are there? *[Recommended: helps in sampling fishers for interviews].*
- What is the annual catch by species or species group? *[Recommended: indicates total catches].*
- Where do the fishers come from that fish in the area? How can they all be included in the process? *[Recommended: involvement of all fishers that use the area will be important for the design, implementation and acceptance of management measures, see also* **Tool 7: Developing a Stakeholder Engagement Plan***].*
- In which seasons is fishing activity greatest and for which species? What are the driving forces for this (e.g. weather, fish availability, fish demand)? *[Recommended: indicates seasonal variations in effort and catches, helps inform data collection especially Fishing Experiments and helps decide when to time ParFish activities e.g. when fishers are not too busy].*

In summary, the information necessary for the ParFish Software is:

- ☐ Current effort for each gear;
- ☐ The type of fishery being assessed including gears used and species targeted;
- ☐ The area of the fishery in question;

2. Fisheries management system

General background

- How important is fishing and associated activities to people's livelihoods in the area? What are their main livelihood activities: fishing, agriculture, trade? *[Recommended: indicates people's dependency on fishing]*.
- What is the socio-economic context and the cultural issues involved? For example, what are the predominant religious beliefs? How is the community organised and how does the community organise meetings and take decisions? You may need to examine this at the sub-community level if the community is made up of a number of factions or has multiple livelihoods profiles. *[Recommended: indicates how to approach the community and how to communicate with the fishers]*.
- What are the historical resource use issues and present and past conflicts in the area? *[Recommended: indicates underlying issues that may influence the process].*

Management Context

- Policy environment – What are the main policies that impact on fishing? What are the fishing regulations in the area? Which government body controls fisheries? Are there any other organisations involved in fisheries management? *[Recommended: indicates the policy forces acting on fisheries].*
- Decision making arrangements - Who is responsible for management of the fisheries resources, and are there any ongoing changes in these arrangements? *[Recommended: indicates who has responsibility and authority for implementing fisheries management measures and who to involve in the process. See also* **Tool 5: Stakeholder Analysis***].*
- Responsibilities - What are the responsibilities of various levels (e.g. national government, district, community) in fisheries management? Do the fishers have any authority for implementing fisheries management measures? What are their potential roles and responsibilities in the future? *[Recommended: indicates which groups and institutions need to support the process].*

Tool 3

Checklist of Potential Sources of Information

What is it?

This tool provides some ideas of potential sources of the information outlined in **Tool 2: Background Information to Compile** on the fishery. Both primary sources (collected by you) and secondary sources (already existing data, collected by someone else) are provided. An indication of participatory methods (requiring active input by stakeholders) is also given here and covered in more detail in **Stage 2**.

Why use it?

The checklist gives a selection of places to look for information, types of information to look for, and ways of collecting information yourself. The information you collect from these sources will give you a background to the fishery and fishers that you will be working with and will inform the ParFish process.

How to do it

Try to collect the information outlined in **Tool 2** in the following ways:

1. Assemble previous work;
2. Primary data collection;
3. Participatory techniques.

1. Assemble previous work

Assemble previous work on the fishery from:

- ☐ Government agencies
- ☐ Fisheries Department
- ☐ Research institutions
- ☐ Population census
- ☐ Fisheries policy documents (e.g. fisheries regulations, co-management arrangements)
- ☐ Local government policy (e.g. devolution of authority to local level)
- ☐ Scientific research papers – University or independent researchers
- ☐ Fisheries frame survey and fisheries census
- ☐ Fisheries catch and effort surveys by Fisheries Department or research institute
- ☐ Information from other fisheries with similar species, gears or management issues
- ☐ Donor or aid organisations
- ☐ Internet search engines (e.g. www.google.com)
- ☐ Other reports, planning documents and legal documents
- ☐ Maps
- ☐ Satellite images
- ☐ Aerial photographs
- ☐ Old photographs

2. Primary data collection

The following data can be collected through sampling or observations, as they can also be obtained through discussions with the fishers and other people involved in the fishery (see ***3. Participatory Techniques***, below). You may wish to compare information from different sources.

Collect primary data of:

- ☐ Brief sampling of fish catches to identify main species groups caught.
- ☐ Sampling of weights of catch units if catch is measured in anything other than weight (see **Tool 14: Sampling Catch Units**).
- ☐ Observations of the fishery to gain priority information such as:
  - gears used;
  - fish or resource species targeted by each gear;
  - number of boats and fishers (if not available from frame survey, or if data are not reliable);
  - estimate of total effort per year.
- ☐ Observations of the fishery to gain further context information such as:
  - type of boats used;
  - power used for boats (motor, sail, oars etc.);
  - availability of refrigeration facilities;
  - marketing and post-harvest issues.

3. Participatory techniques

Key informant interviews

Interviews with:

- ☐ Head fisherman and fishers;
- ☐ Community and traditional leaders;
- ☐ Government agencies e.g. Fisheries Department and fisheries officers;
- ☐ Research institution staff;
- ☐ Non government organisations and projects in the area.

See also **Stage 2** and **Tool 12: Key Informant Interviews**.

Participatory Mapping

See **Stage 2** and **Tool 11: Participatory Mapping of Fishing Grounds**.

Brainstorming, Historical Time Lines, Story Telling etc

See **Tool 10: Facilitation Techniques**.

Tool 4

Institutional Analysis and Design Framework

What is it?

The Institutional Analysis and Design Framework is a framework that assists understanding of the management system and background context of the fishery.

Why use it?

The IAD framework helps us to understand the relationship between people, the resource and the decision making arrangements.

How to do it

Use the diagram below (Figure T1) as a framework and ask questions about the fishery as you move through the diagram from right to left.

A useful way to approach the framework in practice is to work back through it (from right to left), asking at each step what is happening, who is involved, why is this happening and how does it occur?

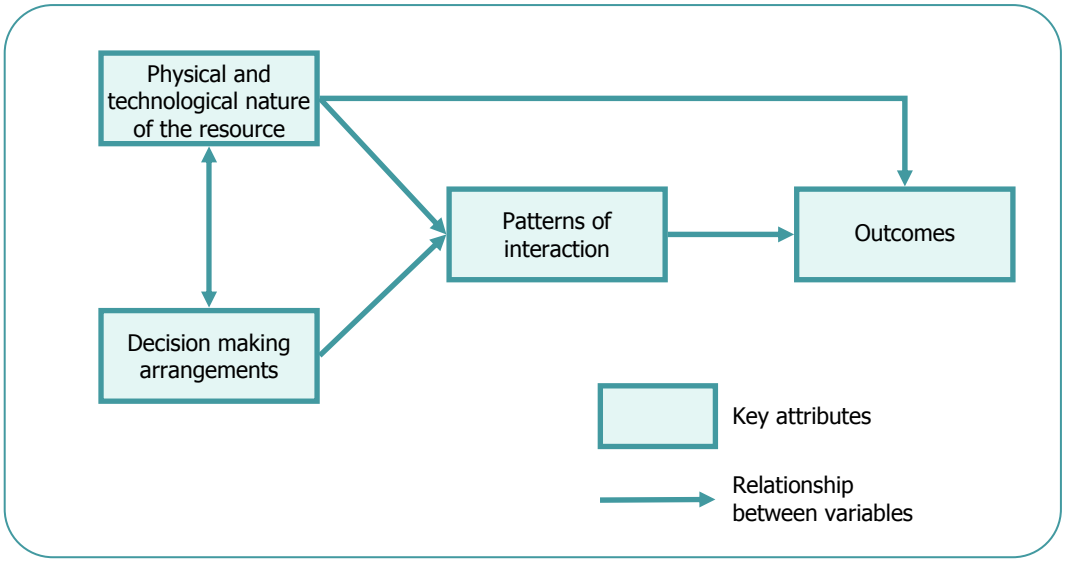


Figure T1: The Institutional Analysis and Design framework

The first step is to examine the outcomes of management, whether these outcomes are considered satisfactory and by whom, and how outcomes are constrained by the physical, biological or technical nature of the resource.

The next step is to examine what resource users are doing, including whether they are following regulations or not, and from this develop an understanding of why this is the case by looking at the rules, the resource and how together they influence the actions of users.

At the end of this activity you should be able to identify:

1. Key features of the resource;
2. A definition of the management roles and responsibilities;
3. Interactions between decision making arrangements (people) and the resource;
4. Any problems in the fishery management system.

Tool 5

Stakeholder Analysis

What is it?

Stakeholder Analysis is a way of identifying groups of people and organisations that have a role or an interest in a process, and describing what their involvement or interest is.

Why use it?

The aim of ParFish is to be participatory. Therefore it is important that you understand who the key stakeholders are in the fishery in question. A Stakeholder Analysis gives a clear picture of who is, or should be, involved in the process and what influence different groups might have on the process and its impact. Identifying and involving stakeholders at an early stage increases the chance that stakeholders understand and accept the recommendations and can build consensus on improving management of the fishery.

How to do it

A Stakeholder Analysis could be undertaken as a desk based activity or within a group. It is best to involve lots of people using a participatory approach. The main steps of a stakeholder analysis are:

1. Draw up a list of all potential stakeholders and classify them (primary or secondary);
2. List each group's interests;
3. Assess the potential impact of the process on each stakeholder;
4. Indicate their relative priority and influence of each stakeholder;
5. Record your results.

1. Draw up a list of all potential stakeholders

Brainstorm about who is involved in the fishery and fishery-related activities. Write down each stakeholder type on a separate piece of paper. The pieces of paper can then be arranged, grouped together or separated as you consider their relationships and roles.

You can brainstorm in a group or individually. The members of the group could include the facilitating institution, fishers, key informants and other people you have engaged with. You could undertake a stakeholder analysis with different groups at different times in the ParFish process, and compare and collate the results.

A **stakeholder** is:

- someone ***affected*** (positively or negatively) by the impact of an activity; or
- someone who can ***influence*** the process or impact of an activity.

Think through the whole fishery chain from boat and gear-building, to fishers, fish processors, traders and consumers. Include community groups, such as fishers' cooperatives or the village council. A check list is provided below to assist this task.

Remember to consider in particular the specific roles that women play in the fishery and related activities such as processing and selling fish. Think about other groups that use the same area or resources, such as hotel owners, tourists and boat operators. Include government agencies and other organisations, such as the Fisheries Department, local government representatives, marine parks and non-governmental organisations such as conservation organisations or projects. Locally powerful individuals who might also influence the process should be included. Remember to include those who may oppose the process as well as those who are likely to support it.

Finally, consider sub-dividing some groups, for example, fishers could be divided up according to the main gear they use, or the fishery resource they exploit. This is important, as they may have different interests and the recommendations from the ParFish process might affect one group differently from others.

1. The community

☐ Fishers (of the target fishery)
☐ Fishers (of other fisheries)
☐ Fishers split into groups by interest e.g. gear type
☐ Local leaders
☐ Influential individuals
☐ Boat builders
☐ Gear makers and repairers
☐ Fish processors
☐ Fish sellers
☐ Fishermen's Cooperative, Committee or Co-management group
☐ Other community committees or groups

2. Organisations

☐ Government fisheries departments
☐ Fisheries research institutes
☐ Local government representatives and elected officials
☐ Fisheries and community extension workers
☐ Projects involved in resource management
☐ Non governmental organisations
☐ Donors
☐ Government planning and finance departments

3. Others

☐ Hotels and restaurant owners
☐ Tourists
☐ Divers

Classifying Stakeholders

Stakeholders can be divided into two main groups:

1. **Primary stakeholders** are those directly affected by changes in the fishery and management arrangements e.g. those that benefit from or are adversely affected by an activity. Usually they live in or very near the resources in question.
2. **Secondary stakeholders** include all other people and institutions with an interest or intermediary role in the fishery or area being considered.

Classify each stakeholder group according to whether they are primary or secondary stakeholders.

2. List each group's interests

For each stakeholder group, list their interests in relation to the process and its objectives. Remember that each group may have several objectives and roles in the process.

3. Assess the potential impact of the process on each stakeholder

Assess whether the process will potentially have a positive or negative impact on each stakeholder group. Try using the following symbols:

+	potential positive impact
–	potential negative impact
+/–	possible positive and negative impacts in different circumstances
?	uncertain

4. Indicate the relative priority and influence of each stakeholder

Take a large sheet and divide it into four squares as in Figure T2. Write each stakeholder on a separate piece of card or paper, and position them on the paper according to their priority in the process and the influence they may have on the process and its resulting impact. From bottom to top is from low priority to high priority; from left to right is from low influence to high influence.

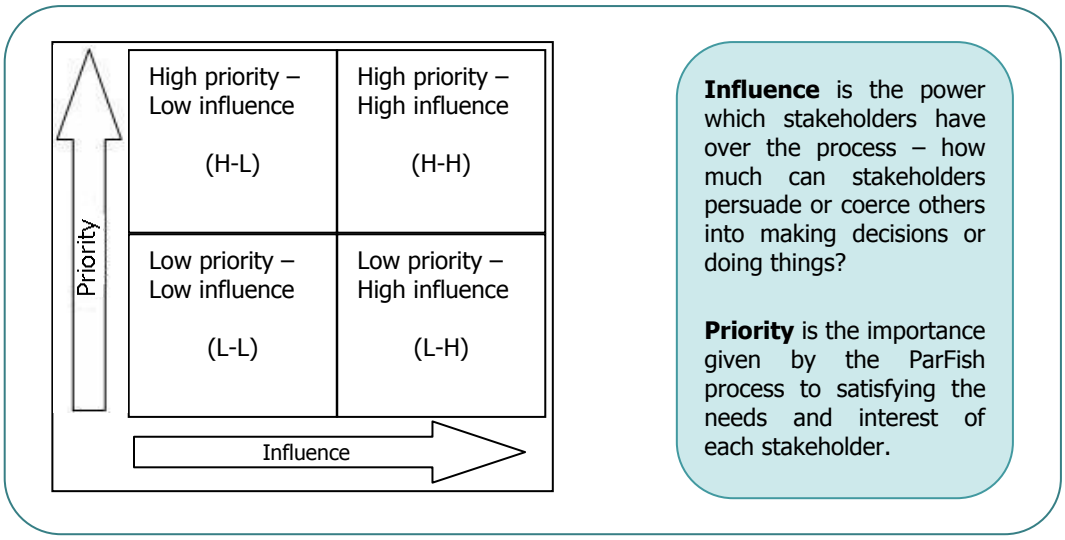


Figure T2: Priority and Influence matrix for the Stakeholder Analysis

The issues to consider for the stakeholders that fall into each 'box' are as follows:

Top right-hand square - high priority and a high influence. It will be important to build good working relationships with these stakeholders to ensure an effective coalition of support for project implementation.

Top left-hand square - high priority and low influence. These stakeholders are most important to consider. The process may need to make a special effort to keep them involved and to consider the impacts on them. Examples could include poorer fishers who rely on other boat owners or fish buyers.

Bottom left-hand square - low priority and low influence. These groups should be kept informed, but are not a priority to be actively involved.

Bottom right-hand square - low priority and high influence. These remain relatively unaffected themselves by the process and its impacts. If supportive, they may be very useful in building support, but if not then care should be taken to avoid these stakeholders diverting or disrupting the process, with negative impacts for primary stakeholders.

5. Record your results

An example of a table that can be used to record the Stakeholder Analysis is given below. This example is taken from the Zanzibar case study, carried out by members of the Institute for Marine Sciences, the facilitating institution.

Stakeholder	**Interests**	**Likely impact of ParFish**	**Priority - Influence**
Primary Stakeholders			
Fishers	• Continuing to catch fish in the future • Having a say in how the fishery is managed • Not all fishers may benefit from management action • Management may recommend reduction of effort which would have negative impact in short term	+/–	H-L
Other community members	• Being able to buy fish	+	L-L
Secondary Stakeholders			
Ministry of Fisheries	• Achievement of targets • Better fisheries management • Co-management	+/-	H-H
Donors	• Promoting good management practices	+	H-L

Tool 6

Developing a Stakeholder Engagement Plan

What is it?

A Stakeholder Engagement Plan defines how different stakeholder groups can be involved in the ParFish process

Why use it?

A Stakeholder Engagement Plan is useful to assess how different groups can be engaged in the process. It can help to answer questions such as:

- What are the potential roles of stakeholders in the process?
- At what stages of the process should different stakeholders be involved?

How to do it

After drawing up a list of all potential stakeholders (see **Tool 5: Stakeholder Analysis**), use this tool to consider who needs to be involved at each stage. This process will inform your communication plan which will set out how to get different groups or individuals involved. Follow these steps:

1. Assess stakeholders' assets, abilities, skills and experience;
2. Assess stakeholders' potential engagement in the process;
3. Record your plan.

1. Assess stakeholders' assets, abilities, skills and experience

You should assess the assets, abilities, skills and experience of each stakeholder in the ParFish process. Think about their skills in relation to data collection, community facilitation, knowledge on the fishery and role in the management planning and implementation process.

This exercise will not apply to wider communication stakeholders i.e. those not directly involved in the process, but whom you would like to keep informed, for example, potential donors and the wider fisheries research and management community. These will be considered within your communications plan.

2. Assess stakeholders' potential engagement in the process

Related to the skills of your different stakeholders identify their potential engagement in the process. This will have been partly done in the Stakeholder Analysis ('Interests'), and here should focus on the role they could have.

3. Record your plan

Keep a record of who you would like to be involved in each Stage and refer to this to develop your Communications Plan (See **Tool 7: Developing a Communications Plan**).

You can adapt the following format to your needs:

Stakeholder	Skills / Assets	Potential involvement

Tool 7

Developing a Communications Plan

What is it?

A communications plan defines how different stakeholder groups can be engaged with the ParFish process either through being informed, taking part in or supporting the process. The communication plan considers how information is passed between different groups and can be built on a stakeholder analysis.

Why use it?

A communications plan is useful for you to assess the needs for communicating with different stakeholder groups. Communication will be required throughout the ParFish process in order to engage fishers and other stakeholders (e.g. NGOs) in the assessment but also to communicate planned management actions to policy makers. The assessment can determine the best communication material to use and whether there are intermediaries that can be used to pass on information. A communication plan can also find better ways of exchanging information between stakeholders, which is often as useful as generating new information. Working through a communications plan will help answer the following questions:

- Which stakeholders need to be communicated with during the ParFish process?
- What are the objectives of communication?
- What are the most effective communication channels?
- What are the most effective communication materials?

How to do it

Developing a communications plan can be done either individually or in a group using a large piece of flip chart paper. It should be undertaken with someone, or preferably a group of people, who understands the local context. The steps are:

1. Determine the objectives of communicating with stakeholders;
2. Create a communications map;
3. Refine communication objectives;
4. Assess appropriate communication messages;
5. Assess appropriate communication materials;
6. Summarise the information;
7. Update the plan regularly.

1. Determine the objectives

The first step in developing a communications plan is to determine the broad objectives of communicating with different stakeholder groups. Is it to inform, involve, influence stakeholders, or a combination of these?

Although communication objectives will be specific to each context it is likely that they will include:

Objectives for communicating with Fishers:

- Understand why it is useful to undertake assessments;
- Understand concepts related to estimating stock size and controls;
- Understand how ParFish works and the potential benefits;
- Encouraged to participate in data collection and management.

Objectives for communicating with other stakeholders:

- Understand ParFish works and the potential benefits;
- Encouraged to participate in data collection and management.

A useful exercise to assist this process is to think of the constraints and opportunities in undertaking the ParFish process. You can then use these to see where effective communications can help address the constraints or enhance the opportunities. It should be remembered that communication objectives are not necessarily the same as the objectives of the ParFish process but should assist in achieving these.

2. Create a communications map

Creating a communications map will help you see the links and interactions among the different stakeholders that need to be engaged with. Start by writing 'ParFish' in the centre of a flip chart. This represents the process that is being undertaken and the team involved in its facilitation.

Then start to write the key stakeholders on the flip chart but arrange them so that the stakeholders most closely associated with the assessment are positioned closer to the centre and less associated stakeholders towards the edges of the page.

Once all the stakeholders are represented on the page, identify the communication channels that link stakeholders and illustrate them by drawing lines between the stakeholders. Use one colour to represent those that the ParFish process will have direct contact with, another colour to illustrate where communication will take place between intermediaries. An example is given in Figure T3. Intermediaries identified in the communications map may also be important in passing on information. For example, communication with the wider community may be most effective through an NGO.

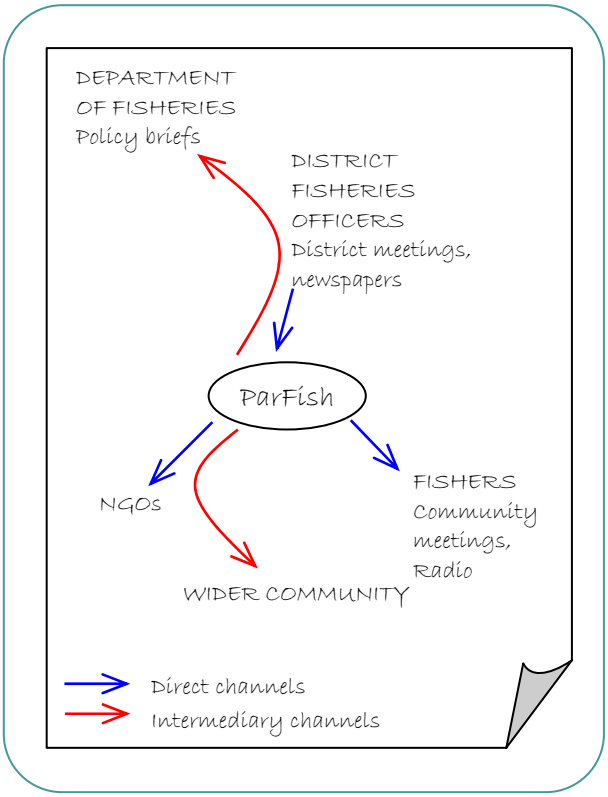


Figure T3: An example of a communications map drawn on a flip-chart

3. Refine communication objectives

It will then be necessary to prioritise the planned communications with each stakeholder. The relative priority of each stakeholder as identified in the stakeholder analysis should be used to guide prioritisation. For example, you may want to prioritise stakeholders according to how much they are affected by the process (e.g. fishers) and whether they might be able to bring about beneficial changes for the affected groups (e.g. government fisheries officials).

For each stakeholder it is necessary to ask the question of what information it is necessary to convey and what attitudes or behaviours you wish to change as a result of the communication. This will help refine communications objectives with each stakeholder.

3. Assess appropriate communication messages

For each stakeholder group consider the message or concept you want to communicate in order to achieve your objectives. In some cases the messages or concept may be similar for different stakeholders, but in other cases there may be specific messages for specific groups if you want to influence them in particular ways.

Stage 2 provides explanation of a number of different **concepts** that will be important to convey to stakeholders.

4. Assess appropriate communication materials

For each stakeholder, consider the best form of communicating your selected messages. You can start by asking them or brainstorming where they get their information from. For example consider whether local fishers use the radio or community meetings, and whether policy makers are more influenced by policy briefs or newspaper articles.

The resources available for this component will be the final consideration for this plan, for example although television may be a very effective means for some groups it may not be possible with the available resources.

5. Summarise the information

From the above exercise it should be possible to summarise a communications plan which identifies the priority stakeholders to communicate with, the objectives of this communication, the most appropriate messages and materials or channels to use in this communication. It is also useful to be able to identify means of monitoring the effectiveness of the communication. This enables you to see the impact of your communication efforts and make changes in the future if required.

Your communications plan can be recorded in a table as the example below:

Stakeholder	Fishers	Other stakeholders	
Communication objectives	The fishers understand the results of the ParFish assessment and are committed to supporting management efforts.	(add a column for each stakeholder as appropriate)	
Communication message	Inform results of ParFish and guidance on developing a management plan		
Communication material	Community meetings		
Communication channels (if different from above)	Local NGO as an intermediary during meetings		
Monitoring Indicator	Record attendance at meetings		

8. Update the plan regularly

The communications plan is a 'living document' and should be updated at regular intervals. Your initial draft may have a number of gaps but can be developed as you become more familiar with the communications context and the stakeholders involved. It is recommended that you update the communications plan once you have read through Stage 2 and have a clearer idea of the concepts you will need to convey to different stakeholders, and again following the ParFish assessment (Stage 3), as the communications plan will provide a route map for giving feedback on the results of the assessment and formulating next steps (see Stages 4 & 5).

Tool 8

Setting up Meetings with Interested Groups

What is it?

During the ParFish process you will need to meet with fishers, the community and other stakeholders, as defined in your Stakeholder Engagement Plan (**Tool 6**). Here guidance is provided on holding meetings with stakeholders and what issues should be considered, based on Srinivasan (1990) and experience from implementing ParFish.

Why use it?

The ParFish process is more likely to be successful if a good relationship is built up between the ParFish team and the stakeholders. Meetings and workshops with stakeholders are likely to be a key way of getting messages across, consulting with them and encouraging their participation. This is can be assisted by following a few guidance points on setting up meetings provided in this tool.

How to do it

How to go about setting up meetings with communities and with fishers will depend greatly on the customs of each place where ParFish is being implemented. Here guidance is given on:

1. The role of the facilitator;
2. General guidance on issues to consider.

1. The role of the facilitator

The facilitator is the person that coordinates a meeting, keeps the meeting going so that all the items on the agenda are covered in time, and ensures everyone has a fair chance to share their opinions. The facilitator should listen and be impartial, allow everyone to have their voice heard, and clarify and explain issues when anyone has any questions. He or she should also encourage participation. At the beginning of the meeting the facilitator should stress that it is everyone's responsibility to participate, speak freely and respect other people's views. Some tools that can help a facilitator encourage participation are detailed in **Tool 10: Facilitation Techniques**.

2. General guidance on issues to consider

- Meetings with the fishers should be field-based. This way, the ParFish team can get first-hand experience of fishers' reality. By organising meetings that will take place near the fishers, the number that will be able to attend the meetings is maximised, and the amount of their time that will be taken up by the process is minimised.

- Be sensitive to local customs and traditions concerning clothing, behaviour and gender issues.

- Organise meetings through traditional means and using local protocol, for example speak to the village leader or chief, the fisheries officer or spokesperson.

- Plan the meeting in advance. Consult with the village leader and allow him or her to suggest when would be convenient for the meeting. Plan a day or date and time of day when stakeholders will be available to participate – e.g. specifically for fishers, a time of day when they are not involved in fishing or other activities, or a time of year when they are available.

- Plan the meeting in a place convenient to the participants, probably suggested by someone from the community, somewhere that is accessible, suitable and comfortable.

- In some meetings and workshops it may be best to have only fishers, so that they can talk and express their concerns freely. Whereas in other workshops and meetings it may be useful to invite other people or groups such as:
    - Fishery extension officers;
    - Department of Fisheries staff;
    - Project staff;
    - Other people or institutions that have been identified in the stakeholder analysis as having a potential influence on the process.

- In some instances these other stakeholders may be invited as observers to the process; at other times you may wish to specifically ask for their views and opinions. Involving them can help raise their awareness of the process, and increase their support for it, through their involvement and their inputs being valued. This may form the basis for important support later in the ParFish process for implementing and enforcing management measures.

- It is important to be sensitive to underlying issues of power and influence when involving different groups in a single meeting, including different ethnic groups, ages and sexes from the same community or village.

- The first meeting should aim to involve as many stakeholders as possible, from a wide cross-section of ages, professions, social groups, and both men and women. This will help raise awareness about ParFish amongst the fishers and the wider community. Subsequent meetings can work with a smaller group involving just fishers and other stakeholders directly involved in the process.

- Make sure you have a clear plan for the meeting including the following points:
    - What will be the subject for the meeting? What are the objectives?
    - Who will the participants be? How many?
    - What will be the venue? When? Where?
    - What techniques and materials will be used?
    - What will be the language used? Are translators required?
    - Who will facilitate the meeting?
    - Are sufficient resources available for the meeting and any necessary facilitation for participants (e.g. to cover travel costs)?

References

Srinivasan, L. 1990. *Tools for Community Participation: a Manual for training Trainers in participatory techniques.* PROWESS / UNDP technical series. PROWESS/UNDP, New York, U.S.A.

Tool 9

Schedule for Meetings

What is it?

This tool suggests issues to cover in the different meetings you will hold with fishers during the ParFish process. Some of these meetings may involve just fishers, or other stakeholders as defined in your communications plan.

Why use it?

There are a number of **Concepts** to get across to stakeholders to ensure that they fully understand what is involved in the ParFish process and are happy to participate. Meetings are suggested as the best way of conveying these messages. A series of meetings can help introduce the process, gain understanding and then introduce data collection. The order of your meetings will depend on the context and suggestions here are based on what worked well in the Zanzibar case study.

How to do it

Define your meeting schedule and content, using the suggested issues to cover at each stage, below, as a guide.

Stage 1

Suggested meetings with: fishers and village leaders.
Issues to cover:

- Introduce yourselves.
- Explain what ParFish is and how it can assist management of fisheries? (see **Concept 1: Introduction to ParFish and Fisheries Management**).
- How the information gathered will be used and returned to the fishers (see **Concept 5: How ParFish works**).

Stage 2

Suggested meetings with: fishers, government fisheries management institutions, fisheries officers, and other projects' staff.
Issues to cover:

- Review the need to manage fisheries (see **Concept 1: Introduction to ParFish and Fisheries Management**).
- Basic fish stock dynamics – growth, reproduction, catch. Cover the concepts of catch per unit effort (e.g. 'catch per day') and overfishing (if fishing experiments are carried out (see **Stage 3** and **Tool 18: Fishing Experiments**), this can be repeated after the fishing experiments to see if and how the fishers' perceptions have changed) (see **Concept 2: Fish Stock Dynamics**).

- Why monitor and assess fisheries? Why do we need an assessment? What is uncertainty and probability? Refer back to **Tool 13: Agreeing Objectives with Stakeholders** and discuss the objectives of an assessment and how ParFish can contribute to achieving management objectives (see **Concept 3: Fisheries Monitoring and Assessment** and **Concept 4: Uncertainty and Adaptive Approaches**).
- ParFish and how it works. What information is collected, how it incorporates fishers' knowledge and opinions (see **Concept 5: How ParFish works**).
- Introduction to the interviews: stock assessment and preferences (see **Concept 5: How ParFish works**).

- What are the main concerns of the participants and their management objectives regarding the fishery?
    - Use **Tool 13: Agreeing Objectives with Stakeholders** which includes carrying out a 'problem census' and then using these problems to define objectives that can address these concerns.
    - Use **Tool 10: Facilitation Techniques** that gives guidance on using 'Idea cards' and 'Brainstorming' for discussing complex issues.
- Identify the fishing areas using participatory resource mapping (see **Tool 11: Participatory Mapping**) and gather background information on the fishery.
- Collect background information in **Tool 2: Background Information to Compile** using Key informant interviews (see **Tool 12: Key Informant Interviews**), making observations of the fishery and some initial sampling of fish catches (weight, species etc.) are useful for this.

Stage 3: ParFish data collection

Carry out Stock Assessment Interviews, Preference Interviews, Fishing experiments etc. See **Stage 3** for data collection methodologies.

Stage 4: Feedback results to Stakeholders

Feed-back the results from the assessment and discuss with stakeholders (see **Stage 4** for more detail).

Stage 5: Agree management actions

Discuss and agree management actions with stakeholders (see more detail in **Stage 5**). As discussed in Stage 5, the management planning process will involve defining management roles and responsibilities and agreeing next steps. These may involve a number of follow-up meetings. These meetings should have a good representation of all stakeholders as defined in your Stakeholder Analysis.

You might need to invite representatives of different stakeholder groups to some meetings, depending on the number of people and institutions involved in each meeting. For example, for the Zanzibar multi-stakeholder workshop, 50 participants from three villages and from government institutions were invited, made up of fishers, village leaders, headmasters, representatives of womens' committees and fishermen's committees, Department of Fisheries and Marine Resources (DFMR), Department of Environment, Institute for Marine Science (IMS), Menai Bay Conservation Area (MBCA), District Fisheries Officers and Beach Recorders.

Tool 10

Facilitation Techniques

What is it?

This tool provides techniques that can be used to encourage participation during meetings and workshops.

Why use it?

These techniques can help open up discussion on certain topics, evaluate different issues and help everyone have their opinions heard.

How to do it

The techniques explained are:

1. Brainstorming;
2. Break-out groups;
3. Idea cards;
4. Flipcharts;
5. Narratives, story telling and time-lines;
6. Talking stick;
7. Videos.

These are just a selection of the wide variety of facilitation and participatory techniques that are available. Importantly, you should use techniques that meeting participants feel comfortable with. Further techniques can be found in the references provided at the end of **Stage 2**.

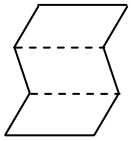
1. Brainstorming

This is a good way of generating a large number of ideas to solve a problem that has been identified. Participants are presented with a problem and asked to come up with as many ideas as possible for solving it. Idea cards (see below) or flip charts can be used.

2. Break-out groups

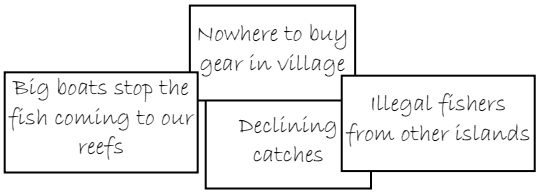
When a large group is involved in a workshop or meeting, breaking the group into several smaller groups (4 – 8 people in each) can be a good way of tackling several issues simultaneously and generating new ideas. It also gives an opportunity for people who are hesitant to speak in front of a large audience to express their views. Break-out groups can contain a mixture of people in each group, or groups could be formed according to their interest or role, e.g. hook and line fishers, seine net fishers, women, policy makers. This allows the thoughts and opinions of each group to be expressed. After the discussion, one member of each group reports its findings back to the whole group.

3. Idea cards



These are pieces of card or paper which are used by the participants to record their thoughts and ideas. A good size is an A4 piece of card cut into 3. Distribute the cards to participants and ask a question, e.g. 'what are the main problems you face in fishing?' Participants then write (in large letters), or draw on the cards. Only ONE idea or point should be made on each card. Collect the cards together and then read or interpret them one by one, allowing participants to express their concerns anonymously. Display

the cards on a board or a wall so that all ideas are clearly visible. They may be grouped together into themes as the same concern is likely to be expressed by more than one person.



Such cards can also be ranked in a group exercise to illustrate some of the priority issues for the community.

4. Flipcharts

Flipcharts (large pieces of paper e.g. A1 size) are useful for recording discussions and ideas during a workshop. The facilitator should note down the main points of a discussion, and break-out groups can use them to present their findings to the main group.

5. Narratives, story telling and time-lines

Story telling can help identify long term trends or perceived trends in the fishery based on people's experiences. Ask people to talk through their experiences in small groups, such as how they used to fish when they were young, what gears they used and other people used, how much fish they used to catch, and any factors they perceive to have influenced this over the years. Sketching out a time-line of changes people have witnessed over the years, in relation to dates or important events (e.g. independence, changes of government, weather events) can help to understand the current state of the fishery in the context of the past. See Theis & Grady (1991), http://www.fao.org/Participation/tools/Timelines.html or another source on participatory methodologies for more details

6. Talking stick

The 'talking stick' is a stick (or a ball or any available object) that gives the holder the right to speak and be heard by the others. There should be a maximum time that anyone can hold the stick, before passing it on. This can be useful to prevent a few vocal people dominating the meeting, and to help more shy people to have their views heard.

7. Videos

Videos that demonstrate a certain issue (overfishing, co-management, fisheries management etc.) can be useful to start discussion amongst the fishers on a certain theme.

Additional sources of information

FAO participation website: http://www.fao.org/Participation especially 'field tools' under 'Resources'.

Pretty, J.N., Guijt, I., Thompson, J. & Scoones, I. 1995. *A Trainer's Guide for Participatory Learning and Action.* IIED Participatory Methodology Series. IIED, London, UK.

Rietbergen-McCracken, J. & Narayan, D. 1998. *Participation and Social Assessment: Tools and Techniques*. The World Bank, Washington, D.C., U.S.A.

Srinivasan, L. 1990. *Tools for Community Participation: a Manual for training Trainers in participatory techniques.* PROWESS / UNDP technical series. PROWESS/UNDP, New York, U.S.A.

Theis, J. & Grady, H.M. 1991. Participatory Rapid Appraisal for Community Development. IIED and Save the Children

Tool 11

Participatory Mapping of Fishing Grounds

What is it?

A process where the fishers design a map of the village and surrounding land and water area showing the main features and the resource base they use including coastal, riverine, lake and marine resources, specifically highlighting the areas used for fishing.

Why use it?

This tool helps us learn about the resources the fishers use in the area, how far they go to fish and where their effort is distributed. It is also a good warm-up exercise to start building a working relationship between fishers and those facilitating the ParFish process.

This exercise can show:

- Where the main fishing grounds are for different fish resources;
- Which are the most productive or popular fishing grounds;
- Where different groups of fishers fish;
- Different fishing grounds used in different fishing seasons; and
- When and where Fishing Experiments should be done (see Stage 3).

How to do it

Focus on the particular fishery you are dealing with in ParFish. There are several different ways of conducting a mapping exercise; it can be done:

- Freehand or outline;
- Individually or in groups.

Follow the steps below:

1. Draw a central landmark or provide an outline map of the area;
2. Ask participants to mark areas where they fish;
3. Prompt them to add other areas;
4. Discuss the finished map.

Freehand or outline map?

Maps can be drawn freehand on a piece of paper or on the ground (using locally available materials), or participants can be provided with an outline map of the area.

Freehand map: mark only a starting reference point (central landmark to the village) and ask fishers to complete the map as they see it.

Outline map: prepare an outline of the area of the village, showing the coastline, roads, rivers and other nearby villages. This can be done on flipchart paper for a group map (see below) or may be done on A4 paper to be photocopied and used by individual fishers to draw on features, resources and fishing areas on the map.

Individual or group map?

Individual maps: Each participant draws their own map.

Group maps: participants can form small groups and each group prepares a map. Groups should be made up of participants with something in common e.g. gear type or vessel type, which is likely to correspond to similar fishing areas. The similarities and differences in the maps can then be discussed at the end. Groups of different people, of men or of women, or a group of fishers and a group of traders, may produce different maps depending on which resources are important to them.

1. Draw a central landmark or provide an outline map of the area

Ask participants to draw the coastline (or lake shore etc.). You may need to assist with this, and show them the locations of other villages and landmarks so that they can orientate themselves to the map.

2. Ask participants to mark areas where they fish

Ask participants to indicate on the map where they go fishing and to draw other features on the map that are important to them.

Maps should emphasise fishing areas but may also include: seagrass beds; coral reefs; estuaries; mangrove and forest areas; infrastructure (roads, buildings inc. market sites); water sites and sources; grazing areas; agricultural lands (crop varieties); and facilities (health clinics, schools, religious facilities and shops).

3. Prompt them to add other areas

When participants stop drawing, ask if there is anything else of importance that can be added and check that there are not any more distant fishing areas that they use and have not added. If you are familiar with the area,

Discuss different places with the fishers and ask if they fish there, for example 'do you fish at Kwale?' Remember that the fishers may have different names for places than those you are familiar with.

4. Discuss the finished map

Ask which areas are fished in different seasons and which areas are shared with fishers from other villages. Ask how long it takes the fishers to reach the different areas shown on the map.

Ask the participants to describe the finished map and discuss the features on it.

Tool 12

Key Informant Interviews

What is it?

A form of semi-structured interview or guided conversation to gather background information on an issue of interest. Only the topics are predetermined and new questions and insights will arise during the discussion.

Why use it?

Key informant interviews are a central participatory technique for gaining insights on a particular subject and can quickly provide important information on the fishery for ParFish.

How to do it

When carrying out key informant interviews you should follow these steps:

1. Interview preparation;
2. Carry out the interview;
3. Record details for future reference.

1. Interview preparation

Who?

Decide who you would like to interview and who will carry out the interview. The interviewer should be someone with whom the interviewee will feel comfortable discussing potentially sensitive subjects, for example, be sensitive to issues of gender, experience and profession etc.

A key informant is someone who can provide important information or views on a topic of interest. A number of different people may be key informants, for example: head fisher, other fishers, village leader or chief, government agencies and fisheries institution personnel, research institution personnel and other NGOs or projects working in the region.

The key informants that were interviewed to gather information about the Kizimkazi case study were:

Person	Discussion topics
Auctioneer/seller	Fisheries system
Village head (Sheha)	Village structure
Head teacher	Village structure
Prominent fisher	Fishing patterns, species and gears
'Mr. Chonga'	Local issues, general background

What?

Make a note of what are the key issues are that you would like to explore with them and go through these in the interview.

Where?

Decide on the location for the interview. It should be carried out somewhere where the interviewee feels comfortable discussing the issues concerned.

When?

Interviews can be carried out all in one day or over a series of visits. Consideration should be given to when the interviewee is available, and you should be careful not to take up too much of their time.

2. Carry out the interview

When conducting the interview, you should:

- Listen sensitively and intently; have an open attitude towards the interview and be respectful.
- Ask open-ended questions in a non-leading manner. For example, instead of asking if fish catches are declining, ask about how the fishing is now, and then ask about how the fishing was in the past. Use Who? What? Why? Where? When? How?
- Use visualisations or diagrams to enhance dialogue.
- Not accept the first answer you hear immediately, but apply an enquiring attitude to judge and probe the answers they hear to cross-check and verify them.

3. Record details for future reference

You should record the details of the interview for future reference. This could be done in a small notebook (rather than a large clipboard), or on tape, and permission to record the interview should be sought. Also record things that are not said but are sensed (such as hesitation or tension). Record personal impressions of the interview afterwards.

Tool 13

Agreeing Objectives with Stakeholders

What is it?

This is a tool to assist you to define management and assessment objectives with stakeholders.

Why use it?

Agreeing objectives with stakeholders will ensure that there is buy-in to the process and will help ensure that the results of the assessment help to define management objectives.

How to do it

Agreeing objectives can be undertaken within meetings with stakeholders. Guidance is given here on the following steps:

1. Agree management objectives;
2. Agree assessment objectives.

1. Agree management objectives

The most effective way of agreeing management objectives is through stakeholder workshops. It is possible to have separate workshops with different stakeholders in initial discussions, but it will be useful to bring different stakeholders together as well to ensure there is common agreement on the objectives.

Start by undertaking a 'problem census' with stakeholders divided up into their separate groups. This can be done breaking out into different groups or through each person writing their priorities on idea cards (see **Tool 10: Facilitation Techniques**). Ask the groups or individuals to prioritise which problems they would like to see addressed, for example by ranking them in order of importance.

Illustrate the variety of objectives for each stakeholder in a table (see example in Figure T4). This will indicate where there may be differences between stakeholders but also where there is common ground.

In the early stages it may be useful to concentrate on the areas of common agreement and tackle different views later in the process. You will also want to return to management objectives when you are feeding back the results of the assessment to stakeholders (Stage 4) and discussing management options (Stage 5).

Figure T4: Likely selection of management objectives by different stakeholders

	International Policy Makers	Regional Government fisheries officials	National Policy Makers	Local Communities
General Objective Sustainability (of following)	✓	✓	✓	✓
Ecological Objectives Biodiversity Conservation	✓ ✓	✓	✓ ✓	
Primary Use Objectives Food/Nutrition Ornamental fish Sport fishing	✓	✓ ✓ ✓	✓ ✓ ✓	✓
Social Objectives Income to fishers Equity of benefits Employment Poverty reduction Conflict resolution	 ✓ ✓	 ✓ ✓ ✓ ✓	 ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Government Objectives Revenue to government Contribution to GDP Export income		✓	✓ ✓ ✓	

Reproduced from: Hoggarth et al (1999) Management guidelines for Asian floodplain river fisheries. Part 1: A spatial, hierarchical and integrated strategy for adaptive co-management. FAO Technical Paper 884/1

2. Agree assessment objectives

Following a review of the problems and priorities of each stakeholder group, you can focus on the objectives of undertaking an assessment.

You can mix stakeholders into different groups and ask them to consider how a stock assessment will contribute to tackling some of the problems that have been stated. Ideas for this include:

- Understand more about the resource;
- Find out recommended control levels that will ensure sustainability of the stock;
- See the effects of closed areas on the sustainability of the stock.

Build consensus on one or two objectives for undertaking a ParFish assessment.

Tool 14

Sampling Catch Units

What is it?

This tool explains how to calculate the average weight of different catch units, such as 'bunches', 'baskets' or 'handfuls' of fish.

Why use it?

In the ParFish assessment it is important that the units used are consistent. The kilogram is usually an appropriate weight measure, although many fishers may measure their catch in a variety of different ways that relate more to numbers or volume of fish. This tool allows you to estimate the average weight of each of these units to standardise the assessment.

How to do it

Go through the following steps, detailed below:

1. Identify the different units and sizes used by the fishers;
2. Weight a sample of each type of unit;
3. Calculate the average weight of each type of unit.

During interviews and meetings with fishers, you can talk using the terms they are most familiar with, and convert units to kilograms later.

1. Identify the different units and sizes used by the fishers

By talking to fishers you should be able to identify the different measures they use to talk about the amount of fish they catch. You may have already identified this during Stage 1. You can summarise the information in a table as illustrated below. The same unit (e.g. 'bunch') may be split into different categories (e.g. small bunch, large bunch) if there are clear differences in total weight according to the size of the bunch or the number of fish on the bunch.

Fish type/ species	Size	Unit
Sardine	1-5cm	Tin
Rabbitfish	5-10cm	Basket
Grouper	10-15cm	Bunch
Grouper	15-25cm	Bunch
Various	25-50cm	Individual fish

2. Weigh a sample of each type of unit

Use an appropriately sized balance to weigh a sample of at least 10 of each type of unit, and record the weights.

Note that the larger the size of the sample you take to obtain the average, the more accurate it will be. You can consult any standard statistical text to obtain advice on sample sizes which depends on what you are trying to measure. Ten would be considered a small sample.

3. Calculate the average weight of each type of unit

Calculate the average weight of each type of unit by adding up the individual weights recorded, and dividing by the number of units weighed. See the worked example below.

Example:

Weigh ten bunches of fish of a certain size (in this case, where each fish is between 10 – 15cm in length):

Bunch 1 (10-15cm fish) = 2.8 kg
Bunch 2 (10-15cm fish) = 2.5 kg
Bunch 3 (10-15cm fish) = 2.6 kg
Bunch 4 (10-15cm fish) = 3.0 kg
Bunch 5 (10-15cm fish) = 3.2 kg
Bunch 6 (10-15cm fish) = 2.9 kg
Bunch 7 (10-15cm fish) = 2.4 kg
Bunch 8 (10-15cm fish) = 2.7 kg
Bunch 9 (10-15cm fish) = 2.8 kg
Bunch 10 (10-15cm fish) = 2.5 kg

Total weight of 10 bunches = 27.4 kg
Average weight per bunch = 2.74 kg

Therefore, if a fisher says he catches between 3 and 4 bunches of fish (sized 10 – 15cm) each day, this can be converted to 8.2 – 11 kg of fish per day.

Tool 15

Mapping and Calculating the Fishing Area

What is it?

This tool explains how to map the fishing area and calculate the area of the fishing grounds.

Why use it?

If you are carrying out a fishing experiment (see **Tool 18**), then you will need an estimate of the total area of the fishery, to be able to scale up the results of the experiment. If not, then this tool is not essential, but it can still be useful to know which areas are being fished and how large they are. This will aid discussion and understanding of the resource, and possible future discussions about the size of closed areas.

How to do it

Go through the following steps:

1. Obtain an initial indication of the fishing grounds;
2. Obtain coordinates of the outer boundaries of the fishing grounds;
3. Produce a map of the fishing grounds;
4. Calculate the area of the fishing grounds;
5. Check the map.

1. Obtain an initial indication of the fishing grounds

Observations and the participatory mapping tool (see **Stage 2** and **Tool 11: Participatory Mapping of Fishing Grounds**) provide an indication of the extent of the areas fished. In theory all fishing areas should be included in the participatory maps, but you may wish to reconfirm that all areas are covered by talking to individual fishers.

2. Obtain coordinates of the outer boundaries of the fishing grounds

You will need to hire a boat and an experienced fisher (or more) to show you the edges of the fishing grounds. If possible, take a hand-held GPS out on the boat with you to record the coordinates. Otherwise, a compass and bearings to 3 landmarks will be sufficient to plot your location on a map. Take the boat around the edges of the fishing grounds and record the coordinates as you do so.

3. Produce a map of the fishing grounds

Plot the coordinates on a map and draw a polygon to demarcate each area. This can be done by hand, or using a Geographic Information System (GIS) program such as ArcView, MapInfo or Idrisi.

4. Calculate the area of the fishing grounds

Calculate the area of each polygon representing the fishing areas. This can be done manually, but is easier using GIS software.

5. Check the map

Show the map to the fishers and ask them to confirm if this represents their fishing grounds. If they identify any missing areas you should go and map them and add them to the map. An example map showing the fishing areas for the hand line fishers in Kizimkazi, Zanzibar, is shown below. The total fishing area for this example was calculated as 11,596,632 m^2.

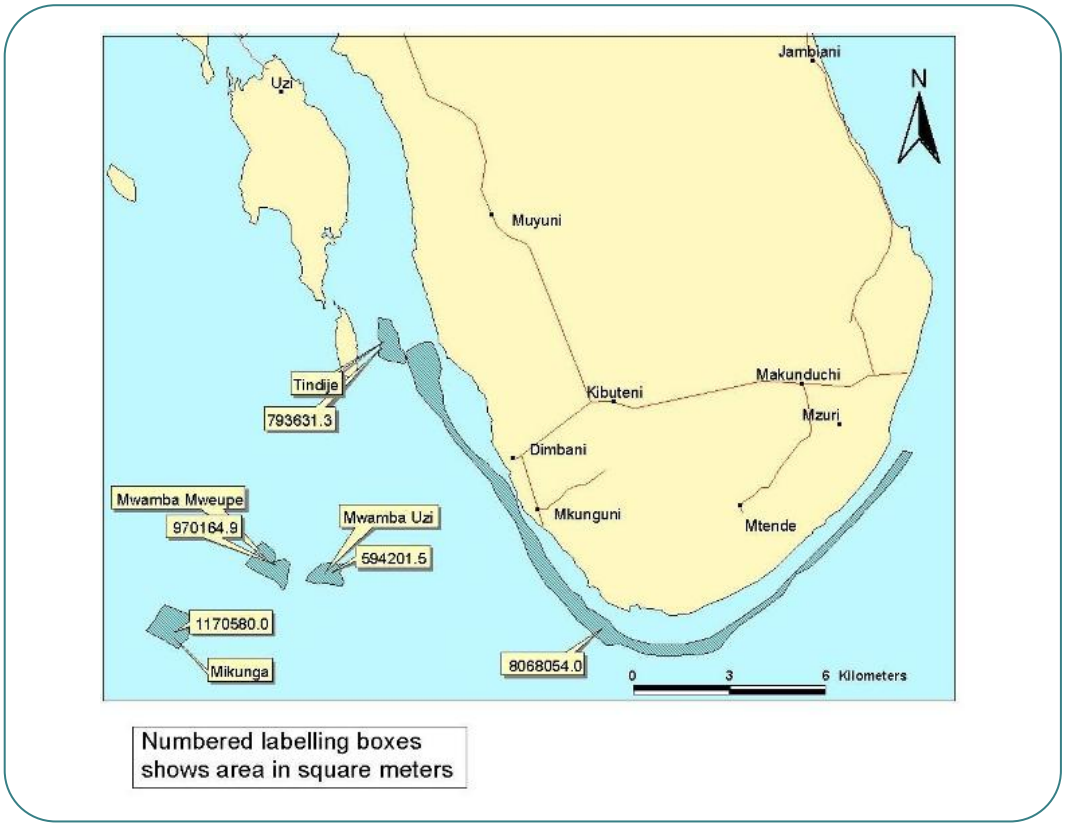


Figure T5: GIS map of the fishing area for the ParFish assessment in Zanzibar. Prepared by IMS ParFish group and Ali Haji.

Tool 16

Stock Assessment Interview

What is it?

The stock assessment interview enables us to capture stakeholder knowledge on the fishery resource, through a series of questions relevant to the stock size and status now, in the past and in the future.

Why use it?

The stock assessment interview is an integral part of the ParFish methodology, which aims to obtain information from the fishers pertinent to the stock assessment as well as involving the fishers in the process. The information is used by the ParFish Software to set the prior probabilities of each parameter for the assessment. Fisher interviews provide an important source of knowledge which is often ignored in 'traditional' stock assessment approaches. It allows us an initial assessment of the status of the fishery resource, which is then refined with data from other sources.

How to do it

A blank interview form is provided with the Toolkit that can be printed or photocopied as required. We recommend you tailor the interview form to the fishery you are assessing and take the tailored forms to the field.

1. Follow Stages 1 & 2 of these Guidelines;
2. Translate and adapt the interview;
3. Carry out trial interviews and train interviewers;
4. Plan logistics;
5. Decide which fishers will be interviewed;
6. Carry out the interviews.

1. Follow Stages 1 & 2 of this Toolkit

These will take you through the process of identifying the fishery and its stakeholders, encouraging their participation and building their understanding of ParFish. Experience has shown that interviews are more successful if the fishers have been previously introduced to the interview before data collection takes place and this ensures better participation. This can be achieved through specific meetings, or alongside other meetings or workshops that may be taking place.

2. Translate and adapt the interview

Interviews should be carried out in the local language (i.e. the fishers' first language or a common language they feel comfortable with). Someone familiar with both English and the local language should translate the interview before going to the field.

The interview should be adapted with respect to:

- Gears used, species fished and the units that catch and effort are measured in; and
- Local concepts and terms for closed areas, fishing seasons, etc.

3. Carry out trial interviews and train interviewers

Before going to the field to collect interview data with the fishers, the interviewers should be trained so they know what information they are trying to obtain. The interview should also be trialled to help the interviewers become familiar with the questions, establish their interview manner and identify the best way to ask questions to avoid potentially 'leading' or 'biased' presentations. Possible trial interviewees are people with prior experience in the fishery, such as ex-fishers, fishery officers or researchers.

4. Plan logistics

Decide where and when you will interview the fishers. This may have already been established jointly with the fishers during previous meetings with them (see Stage 2).

Where?

Interviews may take place:

- At landing sites where there is a concentration of fishers;
- In fishers' home villages when they are not fishing or involved in other activities;
- At another location, such as the market, processing plant, or dispersed landing sites.

When?

Interviews may be carried out:

- During a short, intense period of field work (e.g. by a visiting researcher or team); or
- Throughout the year (e.g. for a resident field officer);
- During fishing seasons;
- During seasons when fishing activity is reduced (e.g. rough weather or lunar phases) and more fishers are available for interviewing.

How many?

A minimum of 20 interviews per gear type is recommended, although the more interviews the better the assessment. Sampling should follow standard sampling theory. Sample sizes depend, among other things, on the population being sampled. The higher the proportion of fishers being interviewed, the more representative the sample will become of the population. However, there are diminishing returns as the proportion sampled increases. There are many techniques to improve accuracy of samples, such as stratification, which remain outside the scope of these Guidelines. Reference can be made to any of the many sampling texts which advise on improving accuracy[1].

In general, the sampling needs to be random (representative of the population of fishers), and the sample size needs to be at least equal to the square root of the population size. Hence, if there are 100 handline fishers, at least 10 should be interviewed.

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[1] *For general information on sampling see:*
Thompson, S.K. 1992. Sampling. John Wiley and Sons, New York.
For more specific suggestions on fisheries sampling see:
Stamatopoulos C. (2002) Sample-based fishery surveys. A technical handbook. FAO Fisheries Technical Paper No. 425. 132p. Rome, FAO.
Stamatopoulos C. (1999) Observations on the geometrical properties of accuracy growth in sampling with finite populations. FAO Fisheries Technical Paper No. 388. 39p. Rome, FAO.

You should be able to interview at least 20 fishers as a minimum for each gear type, which should be adequate for a population of up to 400. This should allow an accuracy of means and totals to be above 90%. Interviews will take around 30 minutes with each fisher, although they may take longer to start with when the interviewer is less familiar with the technique.

In Mtende, Zanzibar, handlines and nets were assessed for the mixed species fishery on the fringing reef. The third gear used on the reef, traps, was not included in the assessment because initial studies indicated that the traps were targeting different fish species from the handline and net fishery. There were 167 fishers, and of these, 50 handline fishers were interviewed, and 22 net fishers, which covered almost all the net fishers in the fishery.

5. Decide which fishers will be interviewed

Ideally, fishers should be randomly selected for interviewing. This could be done by compiling a list of all fishers, and randomly selecting a sample (e.g. draw names from a hat, or pick every 5th fisher from the list). Compiling a list will be useful anyway, for example to provide information on how many fishers there are. A list may already exist from previous fisheries work such as framesurveys, or from population censuses.

Where it is not possible to carry out truly 'random' sampling of fishers, fishers can be arbitrarily selected once you are in the field to carry out the interviews. Senior fishers, the village head, fisheries officers or beach recorders may facilitate contact with the fishers and identify possible interviewees. This can rapidly increase the number of fishers that agree to participate and more may become interested in being interviewed later, although you should try to avoid introducing bias into the process, such as the exclusion of fishers belonging to certain ethnic or social groups.

If fishers do not wish to be interviewed then their privacy should be respected, and their permission to record their answers should always be sought at the outset.

6. Carry out the interviews

Carry out the interviews as arranged with the fishers. Interview Proforma are provided with the Toolkit. These should be adapted for the fishery you are assessing. A worked example of an interview is provided below.

The questions apply to one fishery and one gear type only. If more than one fishery or gear is being assessed for a particular fishery, different interviews should be carried out for each one. For example: if a fishers target both inshore and offshore reefs these should be treated as separate fisheries; if both handlines and nets target the same fish species on the patch reefs, separate interviews should be carried out for each. It will help to remind fishers what fish species you are talking about when referring to different types of fisheries.

Questions referring to catch and effort should be answered only for the specific fishery area that is being considered in the assessment. So, if a fisher targets the inshore fringing reef during 12 days of the month and off-shore patch reefs for a further 12 days, in an assessment carried out just for the fringing reef, effort for that fisher should be 12 days per month, not 24. Similarly, if the fishery targets the inshore fishery with hook and line and with traps, separate interviews with the fisher should be carried out for each gear.

Worked Example:
Stock Assessment Interview in Zanzibar

This is a worked example of a Stock Assessment Interview for a handline fisher, carried out in the case study in Zanzibar. The questions are laid out as on the Interview Proforma provided in the Toolkit, with example answers filled in. Each question is accompanied by an explanation of the **purpose** of the question and ideas for its **presentation**. The ideas given also draw on experience of ParFish in the Turks and Caicos Islands, Caribbean. Alternative forms of presentation may be appropriate and you are encouraged to find other ways of presenting and interpreting the questions that are relevant to the fishery and situation.

Interview Form

Background information:

Fisher Name	Sigo Omar	Date	5th June 2004
Fishery	Reef fishery (patch reefs)	Interviewer	Juma Dan

Purpose: For reference, record the fisher's name, the date, fishery and interviewer's name.

Units:

Units of effort (e.g. days fishing)	Boat days	
Units of catch (e.g. kg, numbers, baskets etc.)	Baskets	Average weight of 1 unit (see tool 14 in Stage 2): 0.7 kg
Units of time (e.g. calendar month, lunar month, year)	Lunar month	

Purpose: This information identifies the units of catch and effort used in this fishery and in this interview. Units used should be those most easily understood by the interviewees and should be used consistently throughout the interview. If the fisher uses different units for different answers they can be converted later to a standard unit such as kg for weight for the stock assessment.

Catches may be measured in baskets, bunches, number of fish, kilograms, pounds etc. The actual unit used is not important, but should be that usually used by fishers and must be consistent throughout all interviews for each fishery. Conversion factors may need to be estimated in some cases (see **Tool 14**).

The **Time** unit should be chosen to allow easiest assessment. It should allow fishers to understand the changes in effort and catch in the questionnaire and appreciate the impact of these on their working life and income. The time unit should be no less than a week, and no more than a year.

During the interview, where '*unit of effort*', '*unit of catch*' and '*unit of time*' appear in the questions, substitute them with the units specified in the boxes above, e.g. in Q6, Normally how many *units of catch* do you catch in one *unit of effort* ?, the question should be presented as 'Normally how many *baskets* do you catch in one *boat day*?'

Effort and Catch Rates:

Question	Answer	Comments / Notes
Importance: 1. For how many years have you been fishing?	20	Since the end of the war

Purpose: This can be used as a weighting factor within the software, as older fishers have greater experience.

Presentation: Years are probably best estimated by getting the fisher to relate when s/he started fishing to major historical events. It may also help to involve land mark years to aid memory and cross-check their answers.

Gear: 2. Which is your main gear in this fishery, the one you are most familiar with and use most?	Handline	Also fishes with traps

Purpose: This gear is referenced throughout the rest of the interview. Other gears the fisher may use are compared to it.

Presentation: Focus on the gear that the fisher relies on the most when fishing in the fishery you are concerned with.

Usual effort: 3. In each *unit of time* (e.g. month), how many *units of effort* (e.g. days) do you usually spend fishing in this fishery?	20 days	Per lunar month (28days)

Purpose: This establishes the normal working activity in this fishery from this fisher. It is used as a bench mark in the assessment of preferences. Obviously, the number of effort units will be constrained by the unit of time. So, for example, you cannot have more than 28 fishing days in a lunar month.

Presentation: Substitute the unit of time and units of effort for the standards set for the fishery as before, for example: 'In a *month*, how many *days* do you usually spend fishing this fishery/area?' Or, ask how many days a month s/he does not fish. If there are high and low seasons for the fishery this should be the **overall average** for the high and low seasons. You can ask about both seasons and take an average or ask the fisher to give a value *on average* across the year. You may find seasonal calendars a useful technique to discuss the fisher's working patterns during different seasons.

Last year's effort: 4. How many *units of effort* (e.g. days) did you actually fish last year with this gear?	100	

Purpose: This is used in the stock assessment to estimate this last year's effort. This should be an estimate of the actual fishing time rather than some measure of normal activity.

Presentation: Substitute the units of effort with the standard set at the start of the interview. For example: 'How many *days* did you actually fish in the last year?' You can also calculate the number of days they fish each month and the number of months they fish a year and check with them. You can also ask when do they *not* fish.

		Catch Category				
Current catch rate: 5. For this gear, normally how many *units of catch* (e.g. kg) do you catch in one *unit of effort* ? (e.g. how many kg / day?)	17 fish (3 baskets) = 2kg	A	B	C	D	E
		1.5 = large	0.5 = medium			

Purpose: This is the current fisher's catch per unit effort (CPUE). It is used both in the preference and stock assessment. **All** catches from this gear should be included. The catch can be broken down into different catch categories (A,B,C,D etc) to reflect, for example, different size categories of catch. Even though the software does not use this information in the assessment, a breakdown of catches into sizes may provide useful information.

Presentation: Substitute in the units of catch established at the beginning of the survey, for example, 'Normally how many *baskets* of fish do you catch in one *day*?'. Note the range and average. To help the fisher define the average, you can work through the higher and lower range CPUEs. For example: 'In a good day how many baskets of fish do you catch?'; 'On a bad day, how many baskets of fish do you catch?'. This could be checked with the fisher's estimated monthly catch, divided by the number of days per month he usually spends fishing.

Trends in catch rate: 6. Over the last few years, has your catch rate been about the same, declining or increasing?	Declining	

Purpose: This allows the fisher to indicate whether the stock is at approximate equilibrium, or has been changing. If change has occurred, the next question is required to assess how much the fisher believes the catch rate has changed in one year. Changes in catch rate should be based on changes in stock size, not changes in fishing practices, so the interviewer will need to check that changes in catch rate cannot be attributed to changes in gear or fishing practices, for example.

Presentation: Make sure the fisher talks about catch ***rate*** and not total catches, e.g. catching more because he is fishing more, or catching the same amount even though he has to fish more.

Last year's catch rate: 7. *If the catch rate has been changing:* In the same season last year, normally how many *units of catch* did you get in one *unit of effort* ?	2	

Purpose: This assesses the fisher's perceived CPUE last year and is used to adjust the model to allow for changes in stock size. Long term perceptions of trends should be obtained first (Q6), then related to changes over the last year. It should be verified that changes in CPUE are not due to changes in gear, fishing practices and so on. CPUE here is being used only as an index of stock size. If practices have changed, the fisher could be asked if he had applied his current practices last year, whether he would have expected a change in CPUE.

Presentation: An answer is needed here only if the catch rate has changed. If it has, then substitute in the units of catch and effort as in previous examples. For example: 'In the same season last year, how many baskets of fish did you catch in one day?'

Catch rate for unexploited stock: 8. If you were to fish in a fresh ground (never fished before or like the old days, or a place which has been left for some time without fishing to be harvested later), how much fish do you think you would catch in one day?	Min	5	
	Max	6	

Purpose: This is used to estimate the unexploited stock size. The value is compared to the current catch rate (Question 5). The current catch rate divided by the unexploited catch rate indicates the current state of the stock assuming the CPUE is proportional to stock size. More generally, the answer indicates the fisher's perception of the state of the fishery. A **range** (maximum and minimum) is required.

Presentation: To present this question you can relate it to examples of natural closed areas, such as when fishing grounds reopen after the monsoon, or relate it to enforced closed areas if the fishers have experience of these. You can refer to an inaccessible reef or fishing area that is rarely

fished. It is important to emphasise that the ground is like the one the fisher uses now, but with lots of fish as if nobody had ever fished before, and **not** a ground that hasn't been fished because it is a poor fishing ground. The fisher's answer should always be greater than the current CPUE. For example: 'If you were to fish an area of reef where nobody had ever fished before what would be the most you think you could catch in one day? What would be the least you would expect?'

Recovery time: 9. If you were to leave an area where the fish can recover, where no-one fishes, how long do you think it would take for the fish stocks in that area to recover fully? … Or as close as possible to what it was before fishing started?	24 months	standard time units (*unit of time*) apply.

Purpose: The question aims to get an estimate of the time for complete recovery of the fishery, an indication of the rate at which the fisher expects the resource to return to an unexploited state. The higher the rate, the higher the productivity and the higher the sustainable catch. Fishers may well have direct experience of fishing ground recovery as they often leave and return to particular grounds. However, such recovery rates may be more closely related to immigration rates rather than intrinsic population growth.

Presentation: Use local concepts of leaving areas where the fish populations can recover and 'grow'. For example, fishers may have arrangements where they leave some grounds to recover while they fish others (e.g. '*kirimbika*' in Zanzibar), or during seasons when they cannot fish due to the weather. Try to get the fishers to think of how long the fish population would take to grow, rather than increasing through immigration from other areas. For example ask the fishers about spawning activities and how long after these you would expect to get new adults.

Perception of total fishing effort: 10. Do you think the amount of fishing for the size of the resource is: (Or: Do you think the area can support more fishers, are there enough, too few, or too many?)	Could be greater		
	Just right	✓	
	Too much		

Purpose: This will indicate the general concern over the fishery. If the stock assessment indicates overfishing, but fishers generally say there could be more fishing, you can expect some resistance to the stock assessment results.

Constraints:

The following 'constraints' questions define minimum and maximum constraints on the preference scores. This prevents the model identifying optimum controls outside the possible range. The exact values should not be too important, but are necessary to prevent unrealistic preference scores. Minimum constraints are related to the opportunity costs of alternative livelihoods and physical limits. However, these constraints do not define, for example, the minimum income required from the fishery to feed a family. These sorts of limits should be picked up by the preference scores.

In general, accurate estimates of the minima and maxima are not required if they are far from the current situation (i.e. greater than or less than 50% of the current CPUE or catch), as they will probably never be met, except in unlikely outcomes.

Minimum acceptable catch rates: 11. What is the minimum *unit of catch* in one *unit of effort* you would fish that is not worth you going fishing, and you would go and do something else instead?	0.5	

Purpose: This defines the minimum utility from fishing and is essentially the opportunity cost of fishing in this fishery. If there are effectively no immediate alternatives this can be set to zero as the precautionary default.

Presentation: Substitute in the units established earlier in the interviews. For example: 'What is the minimum *number of baskets* of fish you would fish in *one day* before switching to an alternative livelihood or fishery?'

Minimum acceptable catch: 12. What is the minimum *units of catch* in a *unit of time* you would accept that is not worth you going fishing, and you would go and do something else instead?	4	

Purpose: This defines the opportunity cost of the total utility from this fishery. This should be considered separately from question 11 above. For example, a very high catch rate, but only allowing one day's fishing may not match the income from some alternative employment. If there are effectively no immediate alternatives this can be set as zero by default. Similarly if a fisher can easily switch to other activities when he is not fishing, there is effectively no minimum.

Presentation: Substitute in the units of catch and time previously established. For example: 'What is the *minimum number of baskets* of fish you would accept in a *month* before switching to an alternative livelihood?' or alternatively, 'How low would your catch have to be in a month to make you consider switching to doing something else?'

Maximum catch rate: 13. What is the maximum *unit of catch* in one *unit of effort* you could cope with using your current fishing method?	5	

Purpose: This allows the fisher to define a constraint on the maximum catch he can cope with in one unit of effort. For example, limited boat storage capacity may mean early departure from the fishing grounds rather than higher catches on a good day.

Presentation: Substitute in the units as above, for example 'What is the maximum *number of baskets* of fish you could cope with catching in *one day* with your current *boat*?'

Maximum possible effort: 14. What are the maximum *units of effort* you could apply with your current gear in a *unit of time* ?	21 days / month	Involved in planting for 3 months each year, would not be able to fish more

Purpose: This defines any constraints the fisher perceives on increasing effort, and should be averaged across the year. In particular, effort may be limited by weather and season and by the length of the unit of time. For example, if the fishery operates the 2 weeks around new moon, the maximum effort would be 14 days x 13 moons per year. Management controls allowing effort to exceed 14 days per lunar month will have no effect.

Presentation: Substitute in the units of effort and time, for example 'What is the maximum *number of day*s you could fish with your current gear in *one month*?'

Tool 17

Preference Interview

What is it?

The Preference Interview enables us to capture stakeholder views on the effects of changes of catch and effort compared with the current situation. The Preference Interview is made up of 2 parts:

- Part 1 – Questions on background information and discount rate;
- Part 2 – Scenario cards.

Why use it?

The Preference Interview, like the Stock Assessment Interview, is an integral part of the ParFish methodology. It allows fishers to express their preferences for different scenarios of catch per unit effort. This is used by the ParFish Software to recommend the level of fisheries control that would have the highest overall preference amongst the fishers.

How to do it

A blank Interview Proforma is provided with the Toolkit that can be printed or photocopied as required. Follow the steps below:

1. Follow Stages 1 & 2 of these Guidelines;
2. Prepare your preferences scenario cards;
3. Follow steps 2 – 5 of the stock assessment interview;
4. Carry out the interviews.

1. Follow Stages 1 – 2 of these Guidelines

Stages 1 and 2 will take you through the process of identifying the fishery and its stakeholders, encouraging their participation and building their understanding of ParFish. Experience has shown that interviews are more successful if the fishers have been previously introduced to the technique before data collection takes place, and also ensures better participation. This can be achieved through meetings with fishers or alongside other workshops that may be taking place.

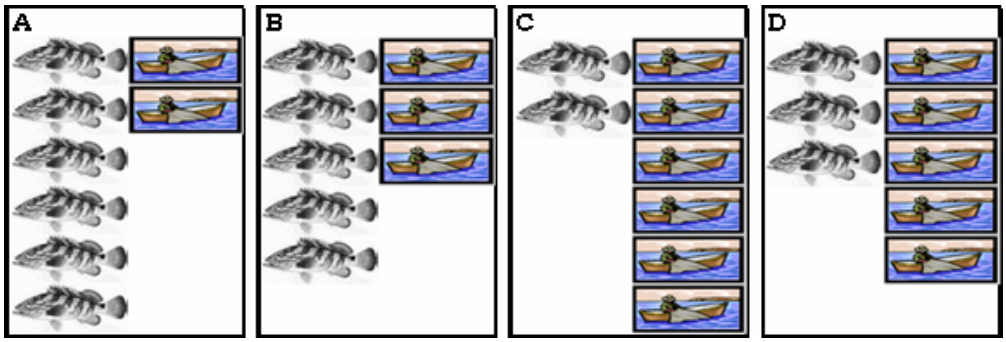
2. Prepare your preferences scenario cards

Various scenario cards (see Figure T6(a)) showing different levels of catch and effort are provided in the Toolkit. In the Preference Interview, the scenario cards are presented to the fishers who rank them according to which they prefer, and then score them according to how much they prefer one scenario over the next best one.

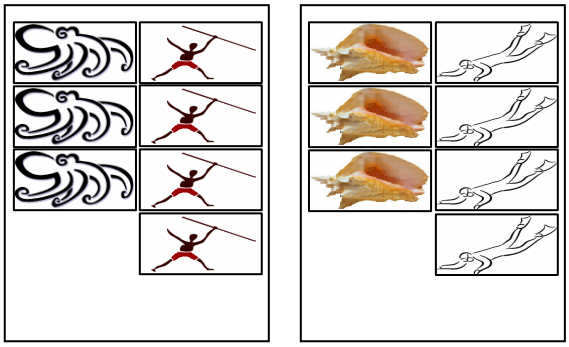
You should print and cut out the scenario cards provided in the Toolkit. You are also encouraged to develop your own cards based on the same relative catch and effort scenarios, substituting pictures or drawings that are specific to the fishery you are studying, see the examples in Figure T6(b).

Maintain the same lettering (A-Q) on the cards to facilitate data entry. Laminating the cards will make them more durable.

a) Example scenario cards provided in the Toolkit



b) Example adapted scenario cards that could be prepared for octopus and conch fisheries



Octopus and spear fisher

Conch and diver

Figure T6: Preference scenario cards

3. Follow steps 2 – 4 for the Stock Assessment Interview

As with the Stock Assessment Interview, it is important to translate and adapt the questions to the specific fishery and situation. Interview Proforma are provided with the Toolkit which can be adapted. Interviewers should be trained and the interview should be trialled. Planning of logistics will be the same as the Stock Assessment Interview.

4. Carry out the interviews

The Preference Interview should be carried out immediately following the Stock Assessment Interview with each fisher, as some information is shared between them.

There are two parts to the Preference Interview:

- Part 1 – Questions on background information and discount rate;
- Part 2 – Scenario cards.

Part 1 uses a number of questions, explained below. Part 2 looks at catch and effort preferences using pair-wise ranking and then scoring of the different scenario cards.

Part 1 - Questions

The questions in Part 1 of the Preference Interview follow on from the Stock Assessment Interview. The questions are given on the Interview Proforma and a worked example is given below. Each question is presented in turn, with an explanation of the purpose of each question, and suggestions of how the questions and concepts may be presented. The ideas given are based on experience of ParFish in the Turks and Caicos Islands, Caribbean, and Zanzibar, Tanzania.

Part 2 – Scenario cards

The scenario cards represent different combinations of effort applied and catch obtained within a defined time period. They are used to assess how much fishers like or dislike possible outcomes resulting from the application of different management options. This is then used by the ParFish Software to predict which control level fishers would most prefer.

There are 17 scenarios, labelled A – Q, with different levels of catch and effort measured as a change from the current catch and effort levels for each fisher. Scenario I represents the fisher's current catch and effort. The various catch scenarios are firstly ranked by the fisher for preference. This is done by comparing pairs of scenario cards and placing them in the binary tree to produce a ranked list. For example, comparing cards A and B in Figure T6(a), the fisher would most likely prefer scenario A, which represents a greater catch for less effort. After ranking all the scenarios, the fisher then scores adjacent scenarios depending on how much one is liked over the next.

The effort time unit used should be no less than a week, and no more than a year. In general, a month is probably the best measure as it allows more variability in effort and catch, but a unit should be chosen with which the fisher feels comfortable. The time unit defined in the Stock Assessment Interview is probably a good basis.

Comparisons are always made with current effort and catch, including a degree of variability. However, fishers will need to ignore the constraints, as these are taken into account elsewhere. For example, if a fisher cannot undertake more effort because of weather, we are still interested in his preference for doing so if this constraint was removed. This is because the preference for impractical scenarios still has an influence on the shape of the preference curve within the feasible region.

Ranking the scenarios

Ranking the 17 scenarios is most quickly done using the binary tree provided with the Interview Proforma (and illustrated in Figure T7). Certain scenarios have already been placed on the tree (I, O, N, Q and P). Start in the middle at the top of the tree with the scenarios in Bubble 1, which are not yet placed on the tree, or 'non-positioned'. Take a scenario and compare it with scenario I. If the fisher prefers the non-positioned scenario to I, then it goes down the left branch of the tree, or if is less preferred it goes down the right branch (Figure T8).

Next, compare the non-positioned scenario with the scenario in the next place on the tree (O or Q, depending on whether the fisher preferred the scenario to I or not), and move the scenario to the left or right as before, and so on. Continue comparing the non-positioned scenario with the scenarios on the tree in order until a free place in the tree is found for the non-positioned scenario. Write the letter of the scenario in the space, and start again with the next scenario from Bubble 1, comparing it with scenario I.

When you have positioned scenarios E, G, F and H from the top middle bubble, start with the other non-positioned scenarios from the other bubbles, comparing them to the scenarios in the tree as indicated by the arrow from their bubble. Scenarios M and L enter the tree at scenario Q; scenario D enters at scenario P; scenarios J and K enter at scenario O; and scenario B enters at scenario N.

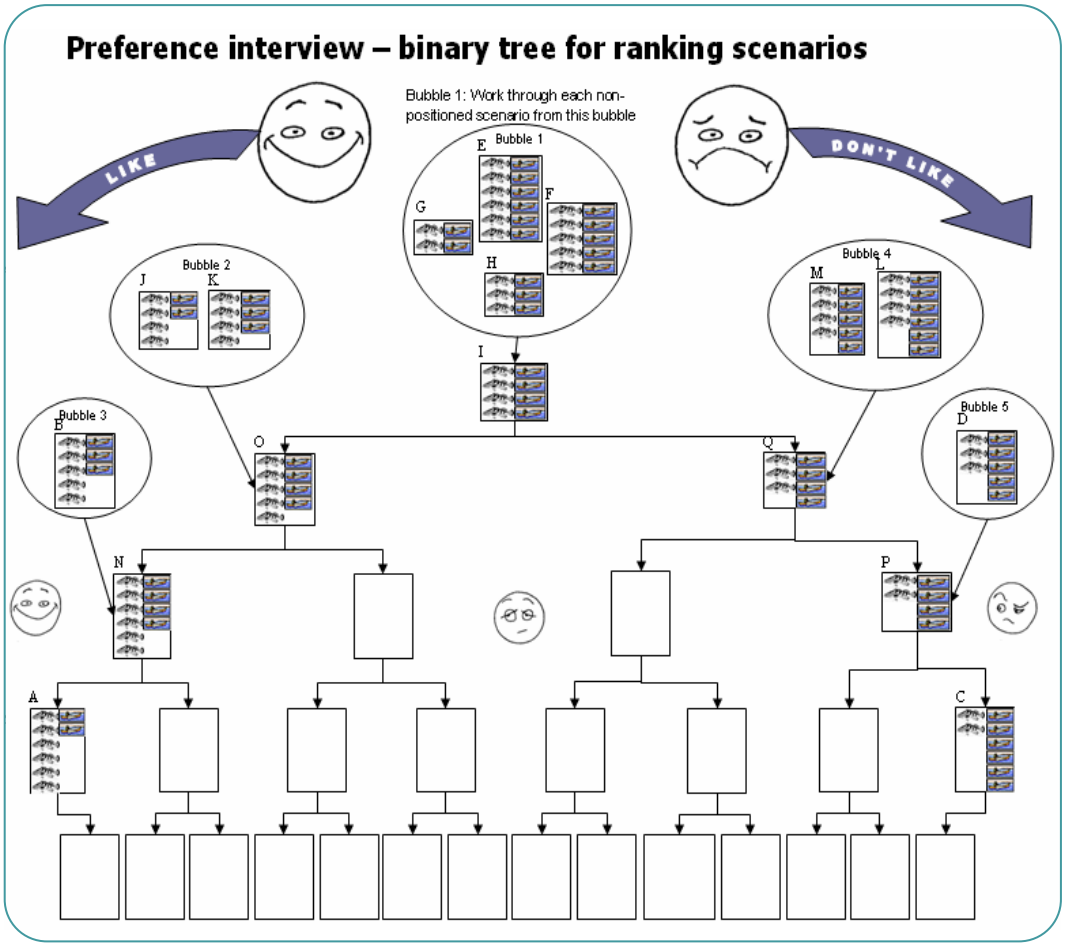


Figure T7: Binary tree to aid ranking of preference scenarios

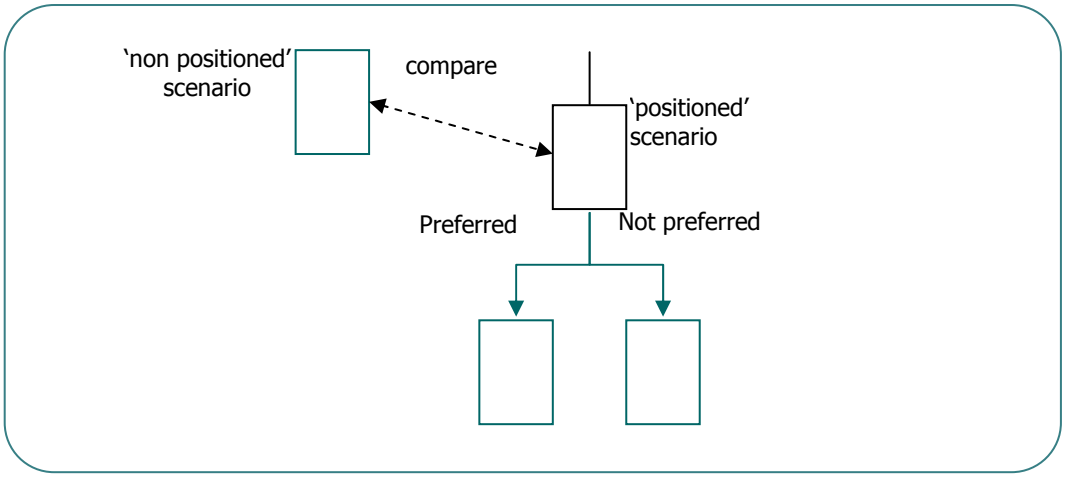


Figure T8: Comparing non-positioned and positioned scenarios using the tree

It is useful to note that some scenarios are dominated by others and comparisons need not be sought from fishers unless to check his/her understanding of what is required. For example, a fisher should clearly prefer any scenario where he catches more fish for the same amount of effort. The ranking can be speeded up by recognising dominance when it occurs.

If a fisher has trouble determining which of two scenarios he prefers, it should be made clear that they will be given the chance later to indicate how much they prefer one over another, or if they like them both equally. Therefore, they need not spend too much time agonising over the order of such scenarios.

When the ranking has been completed (the positions of all scenarios have been recorded on the tree), you should check you have recorded 10 scenarios in the spaces on the tree; 7 are already placed, making a total of 17 scenarios. Not all the spaces on the binary tree will be filled.

The tree can then be 'collapsed'. Imagine all the cards dropping down vertically to lie on the same line. This may need a little practice to do rapidly. Until you get used to it, take your time and make sure your ranking is consistent with the scenarios' positions in the tree. The order of the cards, from left to right, is the preference ranking of the scenarios, from most preferred to least preferred.

Transfer the order of the scenarios to the catch and effort preference scoring sheet (see Interview ProForma) with the most preferred scenario (from the left hand side) as rank 1.

A step-by-step worked example of ranking the scenarios is given below on p109.

Scoring the scenarios

Once all scenarios have been ranked, they can be scored. Before scoring it is worth confirming the rank order. You can lay the scenario cards out in the fisher's preference order and ask him/her to check the order. The fisher should be allowed to change his mind as these are difficult questions that require consideration of many issues.

Scoring between cards allows the fisher to indicate the degree of preference between scenarios. It is quite possible that fishers are indifferent between some scenarios but have a strong preference between others in the ranking sequence.

Ask the fisher to score successive pairs of scenarios against each other on a scale of 0 – 4 to show how strong the preference is for one scenario over the other.

You should explain to the fisher that there is a range of scores that can be given, from 0 (no preference between the two scenarios) to 4 (prefer one scenario much more than the other), with 1, 2 and 3 showing relative strength of preference between the extremes.

Fishers may be unfamiliar with such a scoring method. Some fishers may be happy giving scores of 0 – 4 to indicate their preference, but in order to aid understanding, descriptive terms have also been assigned to each of the 0-4 scores and visual representations provided (see Figure T9). The descriptions are:

0) Do not mind;
1) Prefer it a little;
2) Prefer it;
3) Strongly prefer it;
4) Very strongly prefer it.

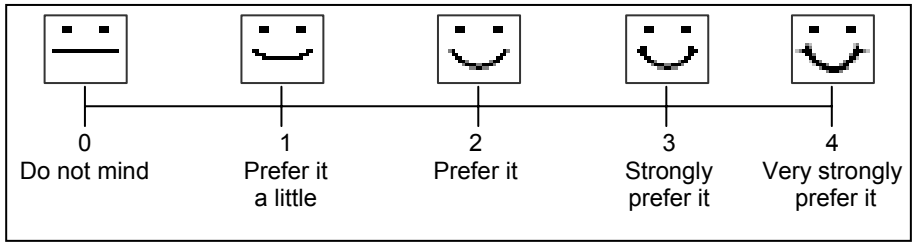


Figure T9: Visual representation for the scoring

For example: Comparing scenarios A & N
Question: *Between these two situations you preferred A to N. If these were real situations would you very strongly prefer A to N, strongly prefer it, prefer it, prefer it a little, or don't mind?*

The score for each scenario is recorded on the catch and effort preference sheet and the question is then repeated for each of the pairs.

Note that the degrees of scale are not important. If fishers have trouble differentiating between all 5 values, reduce it to 4 or less. The aim is to as finely divide the scale as possible.

Worked Example
Preference Interview in Zanzibar

This is a worked example of Parts 1 and 2 of a Preference Interview carried out in the case study in Zanzibar.

Part 1 - Questions

The questions are laid out as on the Interview Proforma provided, with example answers filled in. Explanation of the **purpose** and ideas for **presentation** is given for questions when required.

Background information:

Fisher Name	Sigo Omar	Date	6th June 2004
Fishery	Reef fishery	Interviewer	Juma Dan

Presentation: For reference, record the fisher's name, the date, fishery and interviewer's name, as in the Stock Assessment Interview.

Importance:

Fisher preferences are weighted according to the importance of each fisher. You can choose the variable you want to determine 'importance'. For example, the importance weighting factor could be based on the number of dependents the fisher has, or the fisher's dependency on the fishery as a proportion of his income, or on the fisher's wealth category within the wider community. You can develop your own question for importance (= '15(a)'), or use one of the two suggested below:

Household size: 15(b). Including you, how many people are there in your household?	8	

Purpose: This should indicate all dependants on the fisher. This can be used as a weighting factor for preferences, i.e. how important fishing might be or how many people are supported by the fisher.

Dependence on fishing: 15(c). What proportion of your household income depends on your catch from this fishery?	0.5	Half the family income from fishing, half from agriculture

Purpose: This should indicate the fisher's contribution from this fishery as a proportion of the household income. Income to the household from other people or from other fisheries **must not** be included in this proportion, only in the whole. This can be used as a weighting factor for the preference.

Presentation: It can be beneficial to determine what other sources of income to the household exist through additional conversation.

Discounting:

Discount rate: 16. How much do you earn in 1 month? (= '*x*')	*X* =	*X* + 20% =
Time difference where they cannot decide if they would prefer to receive *x* now, or *x* + 20% later: (Would you prefer to receive *x* now, or *x* + 20% in 1 year? … *Repeat the question, altering the time delay until the respondent has no preference for one or the other)*		Time Units: ☐ Days ☐ Months ☐ Years

Purpose: This question aims to estimate the fisher's discount rate. Discounting is a simple way to adjust future values to represent more realistic estimates of true values. The discount rate indicates the rate at which the future is devalued (i.e. the value of receiving something now compared to receiving it after a period of time). Nobody realistically takes account in their day to day living of what will happen in thousands of years, and few of us take much account of what will happen beyond the next twenty years.

Presentation: Estimate roughly what the respondent would earn in one month, use this as the 'now' value ('x'), and add 20% for the 'future' value ('x+20%'). Aim to find the time difference where the respondent is indifferent between the two scenarios (i.e. between receiving a certain amount now, or more in the future).

A way of posing the question would be 'what would you prefer, $100 now or $120 in a year's time?' If the interviewee chooses $120 in a year's time, the question should be asked again, with a longer time delay, e.g. $100 now or $120 in two years' time? Alternatively, if they choose the $100 now, the time delay should be decreased: $100 now or $120 in 6 months' time?

This should continue until the point is reached where the fisher is fairly indifferent to the two values. If the interviewee cannot choose between two options, use the midpoint (average) as the best estimate of the time delay. Record the time delay and values of payoff now and the payoff after the time delay. The 'Discount Rate Calculations' worksheet in the Excel Template provided with the software calculates the discount rate using this information.

An example of presenting this as a **Savings Scheme** is given in the box below, which may be useful if the fishers have experience of savings schemes and the future payoffs expected.

Alternatively, you can use the bank interest rate as an indicator of discount, but this may be quite different from the true discount rate. It is better to obtain the discount rate from the fishers themselves, using this question, rather than using the bank interest rate.

Case Study: Using a Savings Scheme to determine Discount Rate

This case study example from Zanzibar shows how the discount rate questions were presented to fishers, using a savings scheme with which they were familiar.

"There are two identical savings schemes which you are invited to join. In both you save the same amount each month and the payout is 50,000 Shillings each month to one of the members. Payouts to members follow a sequence: from the first to last, then back to the first again. Each has the same number of members and the same rotation time between payouts. In the first scheme, you get paid immediately. In the second scheme, you are 24th in line and so must wait 2 years for your payment, but the local hotel has added a bonus to support it, so the payout will be more - 60,000 Shillings. Which scheme would you prefer?"

The indifference point can be found most rapidly through halving or doubling a time bracket (see example table below). The 'bracket' is the pair of time values within which the indifference point must lie. If the interviewee rejects scheme 2 (preferring scheme 1 i.e. the payout 'now'), then the bracket is 0 and 24 months. There must be a time delay between 0 and 24 months where the fisher would not be able to choose between the 50,000 Shillings now, or 60,000 later.

If the fisher prefers scheme 2, double the time delay until the interviewee prefers the first scheme. Now the bracket (e.g. 24 – 48 months) encloses the indifference point. Halve the difference and check which scheme the fisher would prefer again (24 – 36 months). Repeat this process until the interviewee finds it too difficult to choose or the bracket is very small. If the interviewee cannot choose between two options, use the midpoint (average) as the best estimate of the time delay.

For example, the following table shows a series of preference selections for different time delays (i.e. place in line for payout) of the Opato savings scheme.

Time delay	Interviewee's Answer	New Bracket		
		Low	High	
24 months	Prefer 1st scheme ('now')	0	24	→ Prefer 1st scheme, so we decrease the time delay
12	Prefer 1st scheme ('now')	0	12	
6	Prefer 1st scheme ('now')	0	6	
3	Prefer 2nd scheme ('later')	3	6	→ Prefer 2nd scheme, so we increase the time delay
4	Prefer 2nd scheme ('later')	4	6	
5	Cannot decide	4	5	→ Cannot decide between them, so time delay taken as mid-point

Time delay = 4.5 months

Part 2 – Scenario Cards

A worked example of ranking and scoring the scenario cards is provided. The example is based on a real interview undertaken in Zanzibar for a coral reef handline fishery. You should work through this example to practice undertaking this part of the Preference Interview.

Ranking the scenario cards

The scenario cards are used to represent catch and effort per unit time (e.g. per month) for a variety of potential fishery scenarios. Scenario I represents the fisher's current catch and effort and serves as the start point for comparisons in the binary tree. The first step is to deduce the fisher's normal catch and effort. This has already been determined in the Stock Assessment Interview (Q3 & Q5).

For example a fisher may catch 17 fish/day, and spend 20 days per month fishing (Q4). Therefore normal catch is 17 x 20 = 340 fish/month.

In this instance card I (4 fish images and 4 effort images) represents 340 fish, and 20 days effort;
So one fish image represents a catch of: 340/4 = 85 fish;
and one boat image represents an effort of: 20/4 = 5 days.

The catch and effort for every scenario can be calculated to represent the comparisons to the fisher during the interview. Refer to the binary tree in Figure T7 to help with ranking the scenarios. A larger version is provided with the Interview Proforma.

The example below uses the number of fish and the number of days fishing per month, though in some instances more explanation may be required.

Start: Bubble 1 - Scenario E

Compare: Scenario E with Scenario I
Q) What would you prefer: 510 (85x6) fish for 30 days' fishing in a lunar month (scenario E) OR stay with the existing 340 fish from 20 days' fishing (scenario I)?
A) Preference: I over E
Explanation: The fisher prefers Scenario I which represents his current effort, otherwise he would have to fish more often, or there are some constraints that exist which prevent him from doing so. Scenario E was rejected so it goes to the right and is compared with the next scenario on the tree.

Compare: Scenarios E and Q
Q) What would you prefer: 510 fish in 30 days (E) OR 255 (85x3) fish in 20 days (Q)?
A) Preference: Q over E
Explanation: The fisher is unwilling to fish everyday even though the catch rate (CPUE) is higher. He may have other responsibilities, or not be able physically to fish everyday, for example. Scenario E was rejected again so it goes to the right and is compared with the next scenario, P.

Compare: Scenarios E and P
Q) What would you prefer: 510 fish in 30 days (E) OR 170 (85x2) fish in 20 days (P)?
A) Preference for P over E;
Explanation: Even though the CPUE is even lower in scenario P, the fisher would still be willing to accept this rather than spend all of his available time fishing. He values the time he needs for other work/activities. Scenario E was rejected again, so it goes to the right and is compared with the next scenario, C.

Compare: Scenarios E and C
Q) What would you prefer: 510 fish in 30 days (E) OR 170 fish in 30 days (C)?
A) Preference: E over C;
Explanation: C represents the worst case scenario offered by the questionnaire, and represents a much smaller catch than scenario E for the same amount of effort. In fact, there is no need to undertake this comparison but you can verify the answer with the fisher. Scenario E is preferred, so it goes to the left. As there is an empty box, scenario E is placed there. Write 'E' in the empty box.

Now repeat the exercise with Scenario F (from Bubble 1)

Compare: Scenario F with Scenario I
Q) What would you prefer: 425 (85x5) fish for 25 days (5x5) effort in a lunar month (F) OR 340 fish for 20 days effort (I)?
A) Preference: F over I
Explanation: The fisher was willing to work that much harder for the extra catch, although in reality he found that weather constraints prevented him from doing so. He preferred scenario F, so it goes to the left and is compared with the next scenario on the tree, scenario O.

Compare: Scenarios F and O
Q) What would you prefer: 425 fish (85x5) for 25 days fishing (F) OR 425 fish for 20 (5x4) days fishing (O)?
A) Preference: O over F
Explanation: Even though the fisher would have caught more fish overall in the lunar month in scenario F, the catch rate in scenario O is higher. Therefore the fisher would prefer higher catch rates and lower effort in this comparison. F was rejected so it goes to the right where there is an empty box. Write 'F' in the box.

Continue the exercise with Scenario H (from Bubble 1)

Compare: Scenarios H and I
Q) What would you prefer: 255 (85x3) fish in 15 (5x3) days (H) or 340 fish in 20 days (I)?
A) Preference: I over H
Explanation: The fisher was not willing to accept a lower total catch with a proportional reduction in effort. This is due to the need to maintain income at its current level and the fisher is not willing to decrease this. Scenario H was rejected so it goes to the right and is compared with scenario Q.

Compare: Scenarios H and Q
A) Preference: H over Q
Explanation: H can be automatically placed in the tree ahead of Q as the catch rate is higher, it represents the same catch for less effort. Scenario H was preferred so it goes to the left. There is an empty space so Scenario H is placed there. Write 'H' in the box.

Continue with Scenario G (from Bubble 1)

Compare: Scenarios G and I
Q) What would you prefer: 170 fish in 10 days (G), or 340 fish in 20 days (I)?
A) Preference: I over G
Explanation: The fisher is unwilling to accept a 50% decrease in total catch even if the effort was halved and the catch rate remained the same. Scenario G was rejected so it goes to the right.

Compare: Scenarios G and Q
Q) What would you prefer: 170 fish for 10 days fishing (G), or255 fish in 20 days (Q)?
A) Preference: Q over G
Explanation: Even though the overall catch rate is lower in scenario Q, the fisher would prefer to catch more fish and accept a lower catch rate suggesting that a decrease in catch may have a negative impact on his current situation. Scenario G was rejected so it goes to the right.

Compare: Scenarios G and P
Q) What would you prefer: 170 fish 10 days (G), OR 170 fish in 20 days (P)?
A) Preference: G over P.
Explanation: In scenario P the fisher would have to work twice as hard for the same catch (a 50% reduction in catch rate). G is preferred so it goes to the left and is placed on the tree. Write 'G' in the box.

Now consider the scenarios to the left of the current scenario I: Bubble 2 – Scenario J

Compare: Scenarios J and O
Q) What would you prefer: 340 fish for 10 days fishing (J), or 425 fish for 20 days fishing (O)?
A) Preference: O over J
Explanation: The fisher would be continue to fish with the same effort as he does now and have a higher total catch, even though the catch rate in scenario J is much greater. The fisher does not need the additional time away from fishing to fulfil other needs. J is rejected so it goes to the right and is compared with the next scenario on the tree, F (previously placed).

Compare: Scenarios J and F
Q) What would you prefer: 340 fish for 10 days fishing (J), or 425 fish for 25 days fishing (F)?
A) Preference: F over J
Explanation: The fisher would exert more effort (F) to increase his total catch even though the catch rate is lower. However, he is unable to do this in practice as weather constraints typically reduce the total time he can fish for. J is rejected so it goes to the left and is placed on the tree.

Now consider Scenario K (Bubble 2)

Compare: Scenarios K and O
Q) What would you prefer: 340 fish for 15 days fishing (K), or 425 fish for 20 days fishing (O)?
A) Preference: O over K
Explanation: The fisher would maintain his existing effort and gain a higher total catch at the end of each lunar month. K is rejected so it goes to the right and is compared with the next scenario, F.

Compare: Scenarios K and F
Q) What would you prefer: 340 fish for 15 days fishing (K), or 425 fish for 25 days fishing (F)?
A) Preference: F over K
Explanation: The fisher would be willing to work harder for more catch, even though the catch rate in scenario K would be considerably higher, but the total catch is lower. K is rejected so it goes to the right and is compared with the next scenario, J.

Compare: Scenarios K and J
These scenarios can be ordered without asking the question as the same catch is obtained for less effort in scenario J. K is worse so it goes to the right of J. However, there are some situations in which the fishers would prefer the same catch with more effort (K over J), because otherwise they would get bored if they couldn't go out fishing, so it is worth checking with the fisher.

Now consider Bubble 3 – Scenario B:

Compare: Scenarios B and N
Q) What would you prefer: 510 fish for 20 days fishing OR 425 fish for 15 days fishing?
A) Preference: N over B
Explanation: The fisher would maintain his current effort for a higher catch. The extra time made available in scenario B is not as important as the total catch and thus the income generated.
B is rejected so it goes to the right and is placed on the tree.

Now continue the comparisons by moving to the right of scenario I
Consider Bubble 4 – Scenario L

Compare: Scenarios L and Q
Q) What would you prefer: 340 fish for 30 days fishing (L), OR 255 fish for 20 days fishing (Q)?
A) Preference: Q over L
Explanation: The fisher would not be willing to work continuously for a slightly higher catch but lower catch rate. L is rejected so it goes to the right.

Compare: Scenarios L and P
Q) What would you prefer: 340 fish for 30 days fishing (L) OR 170 fish for 20 days fishing (P)?
A) Preference: P over L
Explanation: Although the catch rate is higher in scenario L, the fisher is still unwilling to fish everyday. L rejected again so it goes to the right.

Compare: Scenario L with Scenarios C and E
Comparisons could be undertaken using the format described for most comparisons. However, L can also be automatically placed in the tree as L always represents a better scenario to C, and a worse scenario than E. This is due to differences in catch rate as the effort remains the same. L can be placed between C and E.

Continue with Scenario M (Bubble 4)

Compare: Scenarios M and Q
Q) What would you prefer: 340 fish for 25 days fishing (M), or 255 fish for 20 days fishing (Q)?
A) Preference: M over Q
Explanation: The fisher would be willing to work a few more days to ensure that his catch remained at its current level. M is preferred so it goes to the left.

Compare: Scenarios M and H
Q) What would you prefer: 340 fish for 25 days fishing (M), or 255 fish for 15 days fishing (H)?
A) Preference: M over H
Explanation: Although the catch rate is lower, the fisher would be willing to fish more days to maintain his current catch. M is preferred so it goes to the left and is put in the space.

Now finish with Bubble 5 - Scenario D

Compare: Scenarios D and P
Q) What would you prefer: 255 fish for 25 days fishing (D), or 170 fish for 20 days fishing (P)?
A) Preference: D over P
Explanation: Neither of the scenarios were appealing to the fisher, but having to choose the fisher would take the higher catch even if it meant more time fishing. D is preferred so it goes to the left.

Compare: Scenarios D and G
Q What would you prefer: 255 fish for 25 days fishing (D), or 170 fish for 10 days fishing (G)?
A) Preference: D over G
Explanation: Neither scenario appealed, though the fisher would try for the higher total catch even if it meant exerting considerably more effort. D is preferred so it goes to the space on the left.

Summary rank order

The rank order for these scenarios is therefore: A, N, B, O, F, J, K, I, M, H, Q, D, G, P, E, L and C.

Tool 18

Fishing Experiments

What is it?

Fishing experiments are a rapid way of obtaining information on the fishery stock that you are assessing and provide data for the stock assessment. Local fishers undertake fishing within a defined area for an established period of time. Catch and effort data are recorded as well as visual census data if possible.

Why use it?

Fishing experiments are a rapid way of gaining useful information on a stock when data such as catch and effort time series are limited or absent, as in the majority of small scale fisheries. Also, by involving fishers in the experiment and purposefully depleting a small area, the process demonstrates that fishers can directly affect the status of their target stocks and reaffirms the importance of developing a management process.

How to do it

Example data forms are provided in the Toolkit. Undertaking fishing experiments is best achieved through a planned approach involving the following steps:

1. Assess the suitability of the fishery;
2. Encourage the participation of fishers;
3. Design the experiment;
4. Map and demarcate the experiment area;
5. Prepare data collection forms;
6. Conduct the experiment and record the data.

1. Assess the suitability of the fishery

In the initial stages of ParFish (Stages 1 and 2), issues surrounding the suitability of the fishery for carrying out experimental fishing are considered. This tool is most effective when the targeted fish population is partly isolated and therefore fish migration into or out of the experiment area is limited during the period of the experiment (about 8 – 10 days). Patch reefs provide an example of such an area and are useful for conducting experiments.

However, it is also possible to use the method where immigration is suspected (e.g. on continuous fringing reefs). Good experimental design can minimise such effects, such as by maximising the fishing effort applied and keeping the experiment period short to help reduce the inaccuracies. It may also be possible to use models which can take some account of fixed immigration or emigration rates. The method is usually not suitable for highly migratory species, such as many pelagic fish.

If the answers to the questions below are '**yes**', then the approach can be introduced to the fishers and planning for the experimental phase of the fishing experiment can begin.

1. Is the stock of the proposed experiment area relatively isolated?
   e.g. coral reef area (especially patch and platform reefs);
2. Is there potential for stock recovery after the experiment?
   e.g. stock replenishment through immigration of fish to the depleted area.
3. Is the site lightly exploited or unexploited?
4. Is the site traditionally associated only with the fishers involved in the assessment and experimental fishing?

2. Encourage the participation of fishers

The idea of conducting a fishing experiment should be introduced to the fishers. If the fishery is well known and thought to be suitable for a fishing experiment, then the concept of conducting a fishing experiment can be introduced early on in the ParFish process during the initial meetings suggested in Stage 2.

Otherwise, a separate meeting dealing specifically with the fishing experiment can be arranged with the fishers. Such a meeting should involve key informants (e.g. experienced fishers) and as many other fishers as possible to introduce the idea and seek support for the activity. Fishers should be informed of:

- What the approach involves;
- Why it should be undertaken; and
- What they stand to gain from participating.

What does the experiment involve?

For participating fishers, the experiment involves them fishing in a designated area for a period of several consecutive days (e.g. 8 – 10 days). The fishing area may be further than they would usually go to fish, and they may find that their catches decrease towards the end of the experiment (it may be worth considering compensating them for this, such as by contributing to their fuel or time expenses and foregone catches – see ***Incentives*** below). They will need to land their catch at an agreed place, and it will be weighed each day. They will be able to keep or sell their entire catch afterwards.

Why should it be undertaken?

Fishing experiments provide important information for the stock assessment, improving its reliability and accuracy. They relate fishing activity to the stock size and exploitation rate. An explanation of the kinds of information that can be obtained should be outlined to fishers, as well as the kind of questions that can be answered and how this is important in understanding and managing the fishery.

Data required:

- Catch: How much (e.g. baskets, kgs etc);
- Effort data.

Other data that can also be collected:

- Catch composition: target species;
- Length-frequency data.

These can be used for multispecies assessments or length-frequency analysis (e.g. using LFDA software).

These data are used by the software to calculate:

- Catch rates;
- Species' catchability.

What will fishers gain from participating?

Fishers will gain a better knowledge of how much fishing is sustainable for their stock, and this will inform whether fishing should be controlled and at what level. The process should also encourage fishers to ask questions about their own fishery and to use the experiment as a valuable tool for providing answers. It may be possible to incorporate the collection of additional data into the experiment to answer some of the fishers' questions.

If fishers have widely divergent views on certain issues which have to be answered to sustainably manage the resource (you may be able to identify this if you have already carried out the Stock Assessment Interviews, and answers of different fishers are very different), this should be brought up in meetings. The experiment can be a form of arbitration over such disagreement: "instead of arguing let's find out by conducting some simple experiments". It is this idea of empirically-based management that is a central concept in ParFish.

Incentives

Ideally, fishers will want to participate in the experiment because it seeks to provide information which will benefit their knowledge and help improve management of their fishery. However, because the experiment requires the fishers to fish in a specific location which may be further than they would usually go to fish and they may find that their catches decrease towards the end of the experiment, in practice it may be necessary to provide an incentive to ensure the participation of sufficient fishers throughout the period of the experiment so that a successful depletion is achieved and the data is informative for the stock assessment. It should be emphasised that the fishers will be able to keep all catches once they have been weighed and recorded.

If financial compensation is to be paid to participants in the experiment, it should be kept to a minimum (a guideline might be the income that they would typically generate from a days' fishing); the prime incentive for their participation should be the knowledge about their resource they hope to obtain. It may also be the case that financial compensation is required for the first experiment but that fishers may value the assessment to undertake the experiments without compensation in the future.

Since the object of the experiment is to force a depletion, fishers' catch rates should fall considerably during the experimental period. As such they will be returning with smaller catches by the end of the experiment and will be less satisfied. This provides a clear demonstration of what may happen to the entire fishery if it is overfished and can be used to demonstrate that the fishers **can** have an impact on their target species.

3. Design the experiment

Once agreement on carrying out an experiment has been reached then the site for the experiment can be identified and how and when it will be conducted can be decided. Initial meetings and the information gathered in Stages 1 and 2 of ParFish will provide relevant information for the experiment.

Seasonality and weather

Discuss weather conditions and seasonal factors to determine when will be most appropriate to conduct the experiment and when most fishers will be able to participate. Conducting experiments during times when fishers do not usually fish, such as windy seasons or those of heavy rain, may reduce the fishers' effectiveness to deplete the area (e.g. during rough sea periods bite sensitivity and hook position are affected and may reduce catch rates) and should be avoided. In Zanzibar, the timing of the fishing experiments was constrained to a time of the year of rough seas that was

not ideal for fishing. As a result, catches were not as high as they would have been in a better fishing season.

Site selection

To identify an area suitable for conducting an experiment the subject can be raised during the initial experiment meeting. However, it may be preferable to discuss the matter with key informants before addressing a larger audience. These informants may be experienced fishermen who know the fishing grounds well. Once some consensus has been reached amongst a small but influential sector of the fishers then the potential area for the experiment can be introduced more widely to the other fishers in a meeting and the informants can help guide further discussion. Initial surveys of the site can then be conducted.

Ideally the site will not have been previously exploited. In practice, sites which are only lightly exploited can be used. For sites which are already heavily fished it will be difficult and/or undesirable to further deplete the population. It is important that the site chosen is not traditionally associated with the grounds of fishers other than the ones involved in the assessment and selected for the experimental fishing.

Site selection considerations:

- Not heavily fished;
- Accessible;
- Representative of fishing grounds;
- Small enough to show a depletion during the experiment.

When considering the size of the area to be depleted it is important to take into account the number of fishers available to participate, consider the overall size of the fishery (depleting the experiment area must not be detrimental to the overall fishery or ecosystem), and remember that smaller areas are more likely to be successfully depleted, and in relatively short spaces of time. There is no standard rule for determining the size utilised but remember that the size chosen must be considered in relation to the size of the total fishing area (e.g. in a small lake fishery an area of 300 x 200m may encompass an unacceptably large proportion of the fishery, whilst a similar sized area in an extensive reef fishery would be readily justifiable). Large areas should be avoided as it will be difficult to successfully deplete them, and if they are depleted, the fishery as a whole could be damaged. 'Large' and 'small' will be relative to the particular fishery involved. You need to observe a depletion in the stock during the experiment. If you do not achieve this, the area may be too large, or you may require more fishers (greater effort).

How many fishers?

The number of fishers participating will depend on the number of fishers within the fishery, the kind of fishery or gear (e.g. less efficient gears will require more effort than more efficient gears), how many are willing to participate, the size of the experiment area and the budget for financial compensation if required.

In large fisheries it may be necessary to use a lottery system for fisher inclusion such as drawing names from a hat or sampling from a list of names willing to participate, whilst in small fisheries all fishers may be included. In Zanzibar it was found that other fishers became interested in what was going on and joined during the course of the experiment, wanting to be involved as well.

A collective meeting of all the fishers interested in participating in the experiment should be undertaken and names recorded.

Considerations for the number of fishers:

- The size of the experiment area;
- Number of fishers in the fishery;
- Gear type and number of different gear types;
- How many are willing to participate;
- Budget available to compensate fishers.

For a reef area of 300 x 200m or similar then in the order of 20 fishers would be likely to achieve a sufficient depletion by the end of the experiment.

How long should the experiment last?

Typically a period of 8-10 days should be enough as long as the effort is sufficient, that is, enough fishers are involved. The catches and catch rates should be monitored during the experiment to give an indication of how the area is being affected (see example data collection sheets). If signs of decreasing catch rates are only apparent towards the end of the experiment period then additional days of fishing should be considered in order to show a clear reduction in CPUE during the experiment. An example of a successful depletion experiment conducted on offshore patch reefs at Dimbani, Zanzibar, is shown in Figure T10. CPUE declines from 10 kg per boat day on the first day, to 4 kg per boat day on day 8.

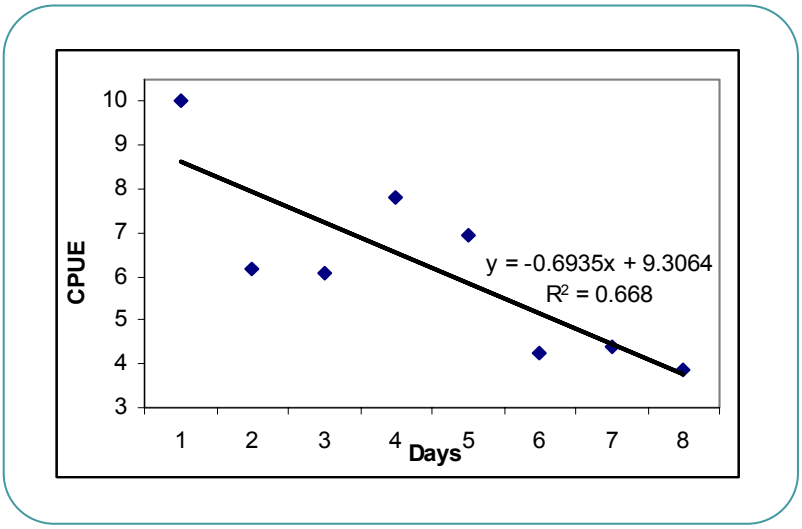


Figure T10: Catch per unit effort (CPUE) over the course of the fishing experiment at Dimbani, Zanzibar

Staffing requirements

The number of ParFish staff will depend on the number of fishers and therefore the amount of catches landed and number of fishers to supervise. Typically one member should accompany the fishers to the fishing ground to ensure that the fishers are fishing within the limits of the experiment area. Then one or more teams of two or three people should be at the landing site to measure and weigh catches and record data.

Staff should be trained prior to the experiment through recording data for normal landings. They should become competent in species identification and in rapidly measuring fish. This will reduce problems and speed things up on the first day of the experiment, which is usually the most difficult.

The catches will probably be the largest and everybody will be learning their tasks. You should prepare the fishers for this and ask for their patience.

Survey Index

An index of stock size in the experiment area on each day of the fishing experiment provides extra information on the stock and can improve the certainty of the fishing experiment data. An index could be a visual census of the fish population (e.g. diving transects within the fishing area) using trained observers, carried out on each day of the experiment. Refer to the references provided in ***Additional sources of information*** at the end of this tool for guidance on carrying out underwater visual censuses. Any method can be used as long as it can be assumed that the counts are proportion to the size of the fishable stock.

Monitoring recovery rates

If fishers are willing to not fish in the experiment area for a period after the experiment is finished, and if resources allow, the recovery rate of the stock can be monitored through visual diving surveys of the fish population. This will provide information on the recovery rate (r), and on the unexploited state of the stock (Binf), two of the parameters of the model for the stock assessment.

After recovery, a repeat fishing experiment can be carried out, to provide another estimate of stock size and compare the results to the first experiment.

Will it harm the ecology?

The experiment should cause no overall harm to the fishery or its ecology and may actually reduce overall fishing mortality temporarily, albeit only by a small amount. You should not be using any gear which causes habitat damage. While it is true the local fish population will be depleted, this would probably be drawing fishing effort from elsewhere in the fishery. The result should be no overall increase in fishing mortality, just targeting fishing to a smaller area (similar to no take zones which may just divert fishing effort away from an area). The total catch during the period from the fishery is actually likely to be below that where the fishers are given freedom to fish where they like, indicating an overall decrease in fishing mortality. Since only a small area is depleted relative to the overall size of the fishery, the area will recover most likely through immigration of fish to the experiment area.

4. Map and demarcate the experiment area

The experiment area should be visited, marked with buoys and mapped before the experiment gets underway, to define the area for the fishers to use. The markers should be checked during the experiment and replaced if necessary. You should use biodegradable materials if possible, particularly for the rope, and generally minimise your impact on the habitat.

One or more fishers familiar with the site should be included in the fieldwork plan to aid in reaching the site and for answering questions about the site which might arise once in the field. It may also be appropriate to hire a local fishing craft to conduct the site visit.

Initial data that should be collected for mapping the area are:

- Coordinates of experiment site(s) [Important];
- Coordinates of the experiment area boundaries for mapping and area estimates [Important];
- Coordinates for marker buoy placements [Optional];
- Spot dives/snorkels/manta tows to verify habitat and depth [Optional].

5. Prepare data collection forms

Prepare data collection forms for recording the data from the experiment. This may involve giving log books to the fishers to record their effort data, if possible. Alternatively, this will have to be deduced at the landing site. You will need catch forms to record the weight of catches, and length-weight and species identification data for each fish landed if you are collecting multispecies data. Some example data forms are provided with the Toolkit.

Fishers' Log Book data:

- Date;
- Captains name;
- Time out, time in;
- Time start fishing, time stop fishing;
- Number of fishers on the boat;
- Number and type of gear set or hauled (e.g. lines, traps, nets).

Catch data:

- Date;
- Total weight of catch (kg);
- Species name and length of individual fish (if you are recording multi-species and length-weight data).

6. Conduct the experiment and record the data

The fishers should be informed of when the experiment is due to start and asked to gather together on the first day for a final briefing.

At the briefing the fishers should be informed of what is needed over the coming days. They should be asked to conduct fishing for a similar number of hours as they would normally, and must fish only within the experiment area boundaries. A reminder should also be given that all catches must be returned to the weighing station(s) to be measured. Subsequently, you can provide each fisher with a pre-prepared log book and encourage them to record their own catch and effort data. Alternatively, this will have to be deduced at the landing site.

On each day of the experiment the fishing activity should be monitored at the fishing experiment area, to ensure fishers are fishing in the correct location, catch and effort data recorded and any payments due to the fishers should be made. Records of payments should be kept alongside the list of fishers participating. You will need weighing scales and data sheets to record the catches of each fisher.

If you have decided to collect length-weight and species data, the species name, length and weight should be recorded for each fish landed. Although not supported in the current version of ParFish, this can be used in other stock assessment software such as LFDA. Preparation with good weighing scales, fish measuring boards and well trained staff (in species identification), in order to record species name, length and weight will help things run smoothly. You may also need a method for dealing with species which cannot be identified in the field (e.g. a digital camera and sample identification tags).

7. Data treatment

Calculating total catch and effort for each day

You need a value for the total weight of the catch on each day of the fishing experiment, and the total effort expended in order to catch it. For each day, sum the weights of the catches from all fishers to calculate the total catch. Sum the total effort for each day as well. Depending on your unit of effort (e.g. boat day) this may require simply summing the number of fishers fishing in the experiment area on each day.

Raising the experimental area to the total fishing area

It is necessary to raise the catch and effort data from the experiment area to the total fishing area to obtain correct estimates for the relevant parameters. The simplest way to do this, which is recommended as an initial technique, is simply to raise the total catch in proportion to the ratio of experiment area to total area. So if the experimental area is 5% of the total fishing area, the experiment catches would be raised by a factor of 20 (multiplied by 20) to provide an indication of total catches in the whole fishing area. Hence the experiment becomes a simple of model of what we would have expected to happen had the fishing effort been raised to this level across the whole fishery.

Survey Index data

Survey Index data should be translated into an index (units are unimportant) that represents relative abundance or population size for each day in the experiment area.

Entering the data into the Excel template

The data will need to be summarised to enter it into MS Excel in the ParFish Template provided with the ParFish Software, or to input it directly into the Software (see ParFish Software Manual). The data needed are, for each day:

- Total catch for the whole fishing area (i.e. experiment catches raised by an area factor – see above);
- Experiment effort for each gear;
- Experiment catches for each gear;
- Survey index if available.

Additional sources of information

English, S., Wilkinson, C. & Baker, V. (1997). Survey Manual for Tropical Marine Resources, 2nd Edition. Australian Institute of Marine Science, Townsville, 390pp.

Jennings, S., Kaiser, M.J. & Reynolds, J.D. (2001). Marine Fisheries Ecology. Blackwell Science Ltd, London.

Labrosse, P., Kulbicki, M. & Ferraris, J. (2002). Underwater Visual Fish Census Surveys. Proper use and implementation. Secretariat of the Pacific Community, Noumea, New Caledonia. (Available at http://www.spc.org.nc /coastfish/Sections/reef/react/index.htm).

Samoilys, M.A. (ed.) (1997). Manual for Assessing Fish Stocks on Pacific Coral Reefs. Queensland Department of Primary Industries, Brisbane.

Samoilys, M.A. & Carlos, G. (2000). Determining methods of underwater visual census for estimating the abundance of coral reef fishes. *Environmental Biology of Fishes* **57:** 289-304.

Tool 19

Using existing Catch and Effort Data

What is it?

This tool gives guidance on using existing catch and effort data in a ParFish assessment.

Why use it?

If data on the fishery you are interested in already exists, particularly catch and effort data, then it is useful to include it in the stock assessment to inform the analysis. However, the quality of existing data should be assessed and verified before incorporating it in the assessment.

How to do it

Follow the steps below:

1. Find existing catch and effort data;
2. Compile the data;
3. Check the quality;
4. Standardise the units;
5. Enter the data.

1. Find existing catch and effort data

Assess whether catch and effort data exists for the fishery you are dealing with. Possible locations for datasets include the Department or Ministry responsible for fisheries, fisheries research institutes, co-management organisations and projects, researchers or NGOs working in the relevant villages.

2. Compile the data

Compile the existing catch and effort dataset for the fishery you are interested in. You need data on effort in the fishery (e.g. number of boat-days per year) for a number of years, and the catch that relates directly to that effort. If the catch and effort data are comprehensive for the whole fishery, this is all the data you need. If the catch and effort data relate to only a proportion of the total effort in the fishery, you also need an estimate of the total catches from the fishery for each of the years so that the catch and effort data can be scaled up to the whole fishery.

3. Check the quality

Check the quality and relevance of the raw data using the following points as a guide:

- ☐ Are the data from the fishery and area that you are interested in for ParFish? Can the data for the relevant areas / fisheries / communities be extracted?
- ☐ Have the data been consistently recorded; is the gear size (effort unit) the same over time; is the catch unit consistent over time (if not, you may be able to convert to standard units – see below)?
- ☐ Was the data sampling regime sufficient? Have the data been scaled up for non-sampled fishing units and days?

4. Standardise the units

If the units are different from those you are using for the assessment, convert the catch and effort data into the same units as you are using. For example, if the catch and effort data are recorded in tonnes, and you are using kilograms for the assessment, multiply by 1000.

5. Enter the data

Enter the data in a spreadsheet, or use the Excel template provided with the ParFish Software, using the following column headings in this order: Year; Total catch (for all gears); effort for 'gear 0' (the first gear you are assessing); catch for 'gear 0' (the catch that relates to that gear only). If you are considering more than one gear, complete further columns as necessary for the effort and catch for each gear. For each year, the 'Catch' column(s) should be less than the 'Total Catch' column, or will be equal to it where it is a single gear fishery and all catches are recorded. An example using the Excel ParFish Template is shown in Figure T11 [and described in Step 2 of the Software Manual].

	All Gears	Gear 0	Gear 0	Gear 1	Ge
Year	**Total Catch**	**Effort**	**Catch**	**Effort**	**Ca**
1977	2,518,885	4388	2,262,383		
1978	2,074,712	5157	1,950,395		
1979	2,088,519	6939	2,072,405		
1980	2,555,970	7456	2,555,550		
1981	1,462,015	3814	1,461,952		

Figure T11: Example of catch and effort data in the Excel template

Tool 20

Guidance for Monitoring

What is it?

This tool helps you identify what types of monitoring you may need to undertake to collect further information to feed into a ParFish assessment.

Why use it?

There will always be uncertainty within assessments especially in early assessments which are likely to be based on limited information. It is therefore recommended that further data are collected which can be incorporated in the assessment, using the software, to update it. The information will be most informative if a change in control is made e.g. decreasing effort, quotas or introducing a closed area. In addition you should collect data in the future to assess impacts of any management action taken.

How to do it

Options for collecting monitoring data are given below. The option you choose will depend on the resources available and the interest and commitment from stakeholders.

Options for monitoring include:

1. **Collecting regular catch & effort data from a proportion of fishers.**

   This would provide further information on the catchability parameter (q), and current biomass (Bnow).

2. **Undertaking or repeating a fishing experiment in a different area or season, or within a closed area after a few years of closure.**

   This would provide further information on the catchability parameter (q), current biomass (Bnow) and unexploited biomass (Binf).

3. **Undertake further interviews (or repeat interviews) to ascertain their opinions on the state of the stock.**

   This provides information on all parameters and undertaking further interviews will increase the data points and thereby make the assessment more representative of fisher knowledge.

   Interviews could be repeated with fishers to assess any changes in the fishery when re-doing an assessment.

4. **Repeat Preference Interviews with fishers (or undertake more interviews with different fishers) to determine any changes in their preferences.**

   Undertaking further Preference Interviews will increase the representation of fisher preferences. Repeating Preference Interviews after a lapse in time will determine any changes in fisher preferences over time.

5. **Monitoring a closed area: see Tool 21: Monitoring the Recovery of a Closed Area**

   This would provide further information on the growth rate parameter (r) and the unexploited biomass parameter (Binf). Modelling these data will not be simple; you may require extra support for the design of the experiment and analysis of these data.

Tool 21

Monitoring the Recovery of a Closed Area

What is it?

This tool explains how to monitor the recovery of a closed area where fishers agree not to fish for a set period of time. This would be subsequent to the ParFish assessment, and implemented as a management action agreed on by the fishers and other stakeholders.

Why use it?

Closing an area to fishing and monitoring the recovery of the area provides important information on recovery rates of the fishery stock. This information can be subsequently incorporated into the ParFish Software to improve and update the assessment, although you made need to get technical help to do this.

How to do it

Follow the steps below:

1. Identify the area to be closed to fishing;
2. Demarcate the area to be closed;
3. Carry out regular surveys of the fish population;
4. Incorporate the results into the ParFish assessment.

1. Identify the area to be closed to fishing

The area to be closed to fishing should be decided in collaboration with the fishers. There are a number of issues involved in selecting closed areas, for reference see Garaway & Esteban (2003). However, specific considerations for collecting data for ParFish are that the area should have similar characteristics to the rest of the fishing area, and should not be an area that the fishers are happy not to fish in because it is a very poor area for fishing. If the area is already over-fished this will give a better indication of recovery rates than if the area already has a fish population near carrying capacity. The area should be somewhere that the fishers can regularly check to see that no-one is fishing there, including outsiders or visiting fishers.

This tool can be particularly useful in combination with fishing experiments – a fishing experiment serves to deplete the area, the area is then closed to fishing and allowed to recover, and the recovery is monitored. A second fishing experiment could be conducted in the area at a later stage to provide information on catch rates of a (relatively) unexploited stock.

Refer to **Tool 18: Fishing Experiments** for more information on involving fishers in the process.

2. Demarcate the area to be closed

The area to be closed to fishing should be demarcated with buoys so that the boundaries are clear. The coordinates of the area should be recorded (see **Tool 15: Mapping and Calculating the Fishing Area**).

3. Carry out regular surveys of the fish population

Surveys of the fish population (see 'Survey Index' in **Tool 18: Fishing Experiment**) should be carried out at regular intervals (e.g. weekly for the first month, then monthly after that) and should be continued at least until the index appears to have stopped increasing.

4. Incorporate the results into the ParFish assessment

You will need to develop a model to interpret these data outside ParFish, in MS Excel for example, and generate parameter estimates there (see Gaudian et al. (1995) for an example model). Support for this type of model may be provided in future ParFish versions.

Additional sources of information

Gaudian G., Medley, P.A.H. & Ormond, R.F.G. 1995. Estimation of the size of a coral reef fish stock. *Marine Ecology Progress Series 122: 107-113.*

Tool 22

Guidance Notes for interpreting the ParFish Analysis

What is it?

This tool explains how to interpret the results of the ParFish analysis and the outputs of the software, and the issues to cover to present the findings in a logical way. Examples from assessments of mixed species handline fisheries in Kizimkazi, Zanzibar, and from a single-species conch fishing in the Turks and Caicos Islands (TCI) are given throughout this tool.

Why use it?

The outputs from the ParFish Software need to be interpreted into useful information on the state of the stock, level of fishing effort and recommended management controls.

How to do it

This tool refers to the outputs of the analysis using the ParFish Software. The graphs illustrated are taken from the ParFish Software, and show estimates of the probability distributions similar to those you may encounter when you use the software. Refer to the Software Manual for guidance on how to plot and interpret the graphs. This tool explains how to interpret the following:

Current situation:

1. State of the stock;
2. Level of fishing effort and fishing mortality;
3. Maximum Sustainable Yield and Catch Rates;
4. Recovery time.

Management recommendations:

5. Baseline scenarios;
6. Closed area scenarios;
7. Comparative scenarios;
8. Impacts of different scenarios on CPUE;
9. Management advice.

Current situation

Instructions

- Carry out a baseline scenario that different scenarios can be compared to, by using all the information sources available in the models with an Effort or Quota control (depending on the fishery);
- Carry out other scenarios using different data inputs (e.g. just fisher interview data, or default preferences, or a closed area control – see **Step 6: Analysis** in the **Software Manual** for more details) to compare to the baseline scenario.
- Investigate the following 4 points concerning the current situation, based on the baseline scenario, and compare with alternative scenarios where appropriate.

1. State of the stock

What is the current level of exploitation of the stock? Is it overfished?

Instructions

- Plot the 'current state' graph.
    - Look at the current stock biomass and give the median value for the most likely state of the stock biomass as a proportion of the unexploited biomass, with confidence limits. The biomass units will be the same as those you use for the catch.
    - Look at the probability that the stock is over-exploited. The proportion of the graph that falls between 0 and 0.5 (illustrating less than 50% of the unexploited biomass currently remaining) illustrates the probability that the resource is overfished.
    - Look at the shape of the curve – is there a high likelihood the stock biomass is at a certain proportion of the unexploited biomass (i.e. is the probability curve very peaked) or is it the probability curve very flat in which case the state of the stock will be uncertain over the values where the curve is flat.

50% of Binf is taken as the limit for the stock being overfished, based on the logistic biomass growth model. If you wish to be precautionary in management, this limit is acceptable, unless you have evidence that a lower percentage of unexploited biomass is appropriate.

If there has been no long term monitoring, it is likely that the software will illustrate what you probably suspect, that the state of the stock is unknown. A faster way to improve this information is to close an area to fishing and eventually record what the resource looks like when it is unexploited. A comparison between an unexploited and exploited area will provide your best guess as to the state of the stock.

Example:

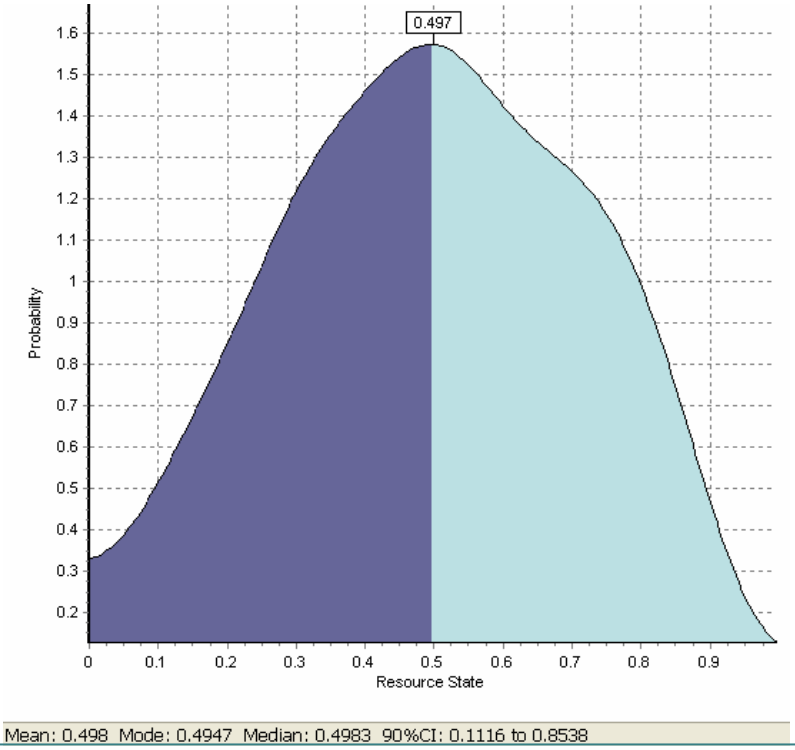


Figure T12: Current state graph for patch reefs, Kizimkazi - Dimbani 1

Figure T12 indicates there is a 50% chance that the stock is over-fished, i.e. that the current resource biomass is less than half of the unexploited biomass. The wide spread of the curve illustrates that there is a high level of uncertainty (the resource state could be between 0.11 and 0.85 of Binf (90%CI)). This is likely to be the case in an initial assessment where there is limited information, and illustrates the need to collect further data on the fishery using the resources available.

2. Level of fishing effort and fishing mortality

What is the current level of fishing effort and fishing mortality and is it sustainable?

Fishing mortality is proportional to fishing effort when using the logistic biomass growth model.

Instructions

- Plot the 'Effort at MSY' graph as described in the Software Manual (this is essentially the same graph as 'F at MSY' and effort may be easier to relate to than fishing mortality) (Example 1).
    - Look at the graph and give the median value with confidence intervals for the effort level that would be required for MSY.
    - Compare this value to the current effort in the fishery. If the current effort is higher than the effort at MSY, then over-fishing is occurring and catches could be increased if effort were lower.

Example 1

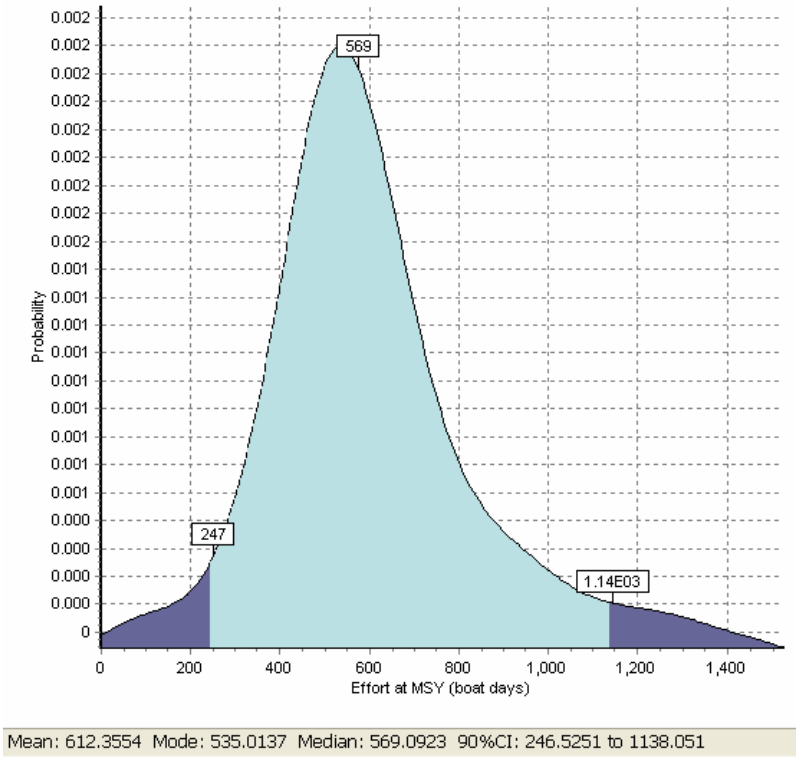


Figure T13: Effort at MSY graph for patch reefs, Kizimkazi - Dimbani

The graph in Figure T13 indicates that the effort required for MSY would be 569 boat days. Although the median value is greater than the current effort (550 boat days), the actual value may lie outside this range (90% CI: 344 boat days to 1184 boat days), and you should consider the graphs of F at MSY and Relative F at Optimum. The value of F at MSY will depend on the fishery, although 0.6 would acceptable for shrimp, or less for longer lived species. If F at MSY is greater than 1, you should check your models as this would be an unrealistically optimistic result. The Relative F at Optimum will indicate if effort should be increased or decreased as an initial step, based on what would be most preferable to the fishers. See the Software Manual for more explanation about both these graphs.

- Plot the 'Relative F at MSY', 'F at Optimum' and 'Relative F at Optimum' graphs (Example 2).
    - Look at the current F as a proportion of the F at MSY (Relative F at MSY graph). This illustrates the likelihood that effort is more or less than that required for the maximum sustainable yield. The proportion of the graph below 1 illustrates the likelihood that the current effort is below the MSY.

Example 2

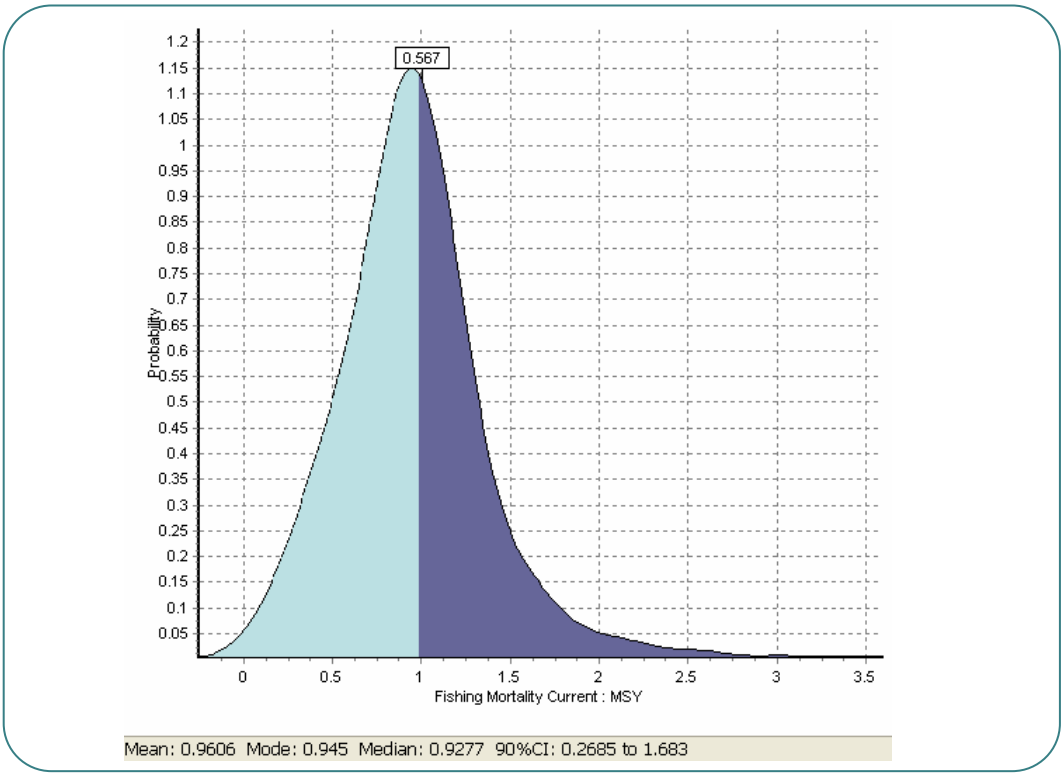


Figure T14: Relative F at MSY graph for patch reefs: Kizimkazi - Dimbani

The graph suggests that there is a 56.7% chance the current fishing mortality (and therefore effort) is below that required for MSY. Therefore, there is also a 43.3% chance that it is above MSY. The area of the graph to the left of 1 (F<1) indicates the probability that current F is less than F at MSY (shaded green). The area under the right hand side of the graph (F>1) shows the probability that the current F is greater than F at MSY (shaded purple). This can be checked with the Relative F at Optimum graph, which shows the probability that F is less than or more than the F that would be most preferred by fishers. This graph indicates that overfishing may be occurring, but the results are inconclusive. To be confident in this answer you need a good estimate of

catchability (q) (which can be obtained through fishing experiments) and of current effort (given through the fisher interviews and background information). This information may need to be improved on by collecting more data such as catch and effort data or undertaking another fishing experiment.

3. Maximum Sustainable Yield and Catch rates

What is the MSY for the stock, and what would be the expected catch rate for an unexploited stock?

Instructions

- Plot the 'MSY' graph as in the Software Manual.
    - Compare the MSY to the catches that fishers currently obtain, either from interviews or from other data. If catches are lower than MSY, they could be increased. See 'Level of fishing effort' above to determine if fishing effort should be increased or decreased to improve catches.
- Plot the 'Unexploited CPUE' graph as described in the Software Manual.
    - The graph indicates how much higher fishers believe that catch rates would be on an unexploited stock compared to current catch rates.

Example

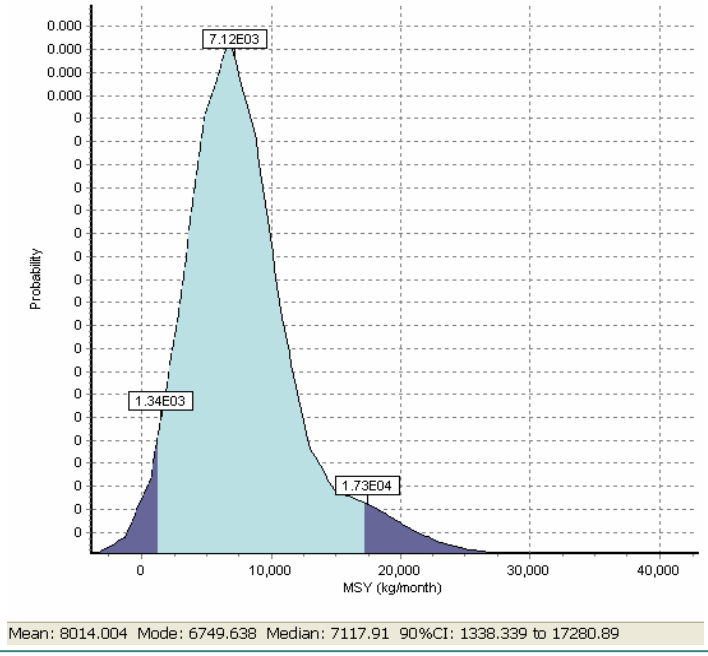


Figure T15: MSY graph for the fringing reef at Kizimkazi - Mtende

The median MSY in Figure T15 is 7118 kg per month.

4. Recovery time

How long would the stock take to recover to unexploited levels if fishing were to stop?

This indicates how long a closed area would need to be closed for, for the fish population in the area to recover.

Instructions

- Plot the 'Recovery Time' graph as described in the Software Manual.
    - Look at the median value for the time to unexploited and confidence intervals. This indicates how long the stock would take to recover to unexploited biomass if fishing were to stop. Unless you have monitored the recover of a closed area (see **Tool 21: Monitoring the Recovery of a Closed Area**), the recovery time is a variable obtained from the fisher interviews.

Example

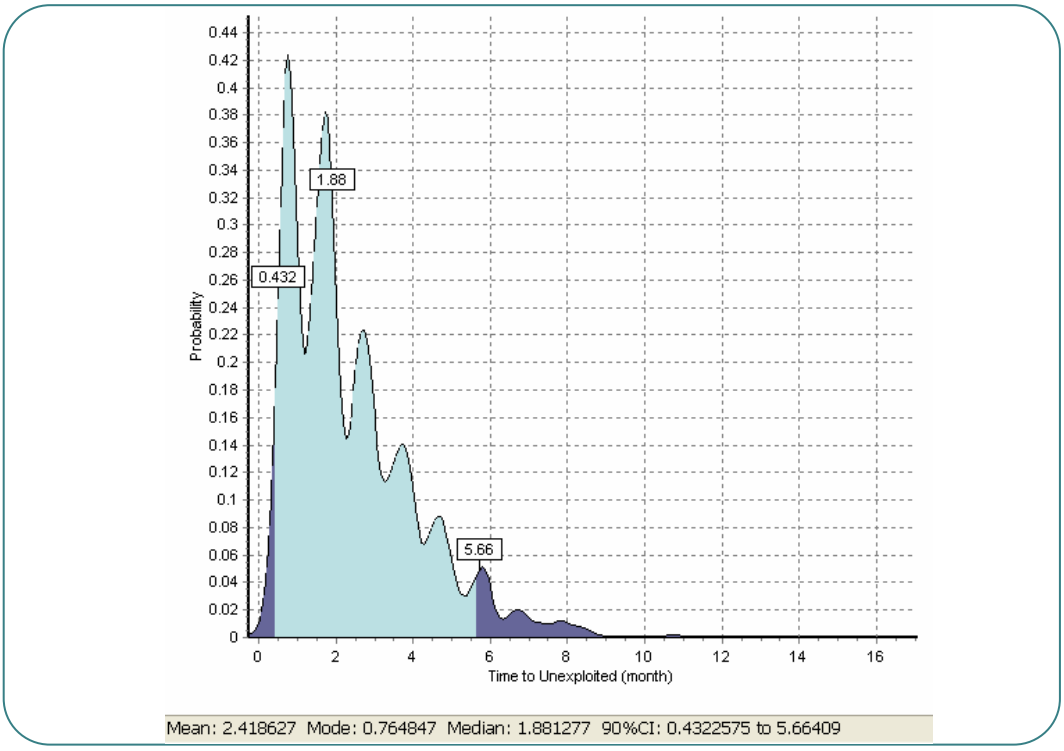


Figure T16: Recovery Time graph for the patch reefs at Kizimkazi - Dimbani

The graph in Figure T16 indicates that the stock would be expected to recover to unexploited levels within 0.4 – 5.7 time units (months), with a median value of 1.9 months. If these estimates depend upon only upon interviews, they indicate the time fishers might be willing to leave an area to recover before fishing it again. The short time periods involved here suggest that fishers would expect the areas to be repopulated with fish through immigration rather than through growth and reproduction of resident individuals.

Management recommendations

5. Baseline scenarios

What are the target and limit control levels under the baseline scenario?

Instructions

- Look at the 'Resource States' graph (see Figure T17).
  - Describe the limit control level (the required control to reduce the probability of the stock being overfished to a user-defined level, or 50% as default) and the target control level (the control level that would result in the catch and effort levels most preferable to fishers) for this fishery. Both of these are labelled on the 'Resource States' graph, and indicated within the Current Scenario results box at the bottom of the Analysis screen of the software. The limit control level is also illustrated by the 'Reference Point Probability' Graph.
  - Look at the 'Resource States' graph and consider the shapes of the curves and how these change with higher or lower control levels. The curves are flatter at higher effort or quota levels, illustrating the greater uncertainty (see Figure T17).
  - Compare the limit and target control levels against the current level and indicate the % reduction or increase in effort or quotas suggested by each.
- Look at the 'Preference' graph (see Figure T18).
  - Look at the range of preferences held by fishers. The preferences of individual fishers are shown by red lines and the overall preference by a black line.
- Plot the 'Demographic' illustration (see Figure T19).
  - Look at the proportion of fishers that would be happier or indifferent to the target control over the current control level.

Example

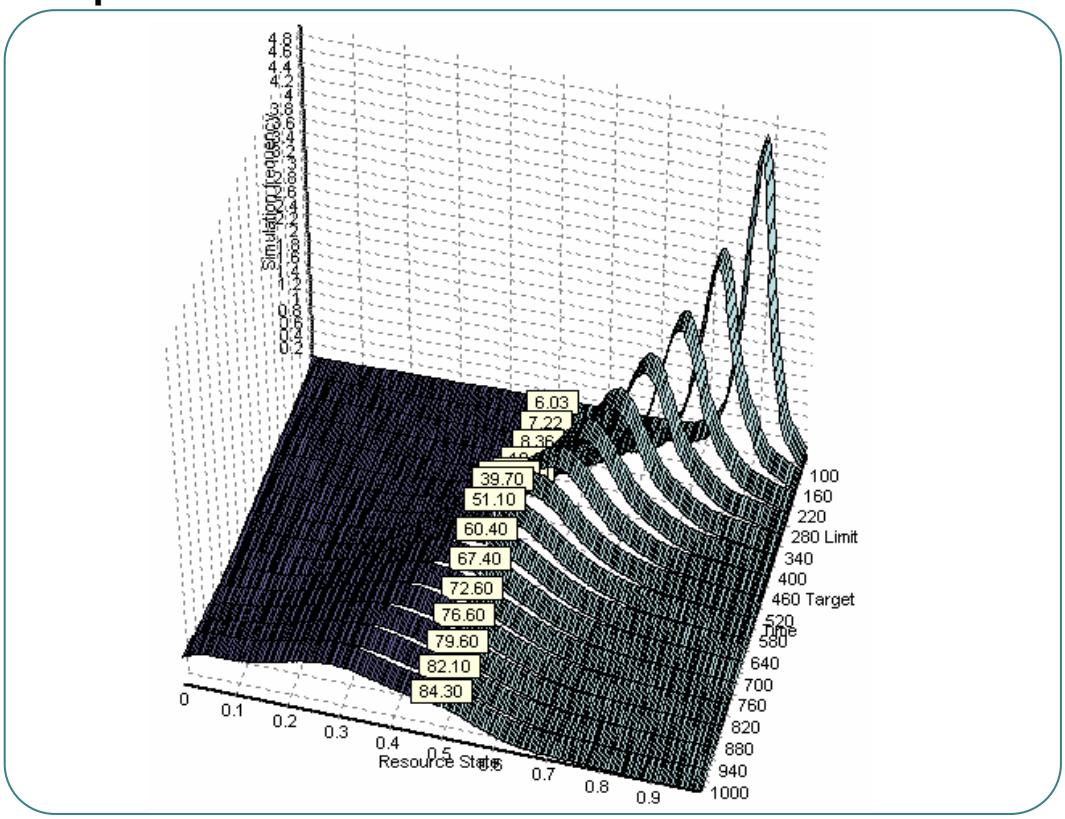


Figure T17: Resource States graph for outer patch reefs, Kizimkazi - Dimbani

Resource States

The graph in Figure T17 shows probability distributions for the resource state at each level of control. The control being applied here is effort in boat days (axis on the right side of the graph). The resource state (on the bottom axis) is the current biomass measured as a proportion of the unexploited biomass. It varies from 0 (extinct) to 1.0 (unexploited) with MSY at 0.5. The probability density (on the vertical axis) indicates the chance that stock is in a particular state during the simulation. The cumulative probability (as %), shown as labels, shows the probability of the stock being below the limit resource state for each control level, in this case the MSY reference point (0.5).

The curves become flatter and peak further to the left at higher effort levels (towards the front of the figure), illustrating the higher level of uncertainty of the outcomes and the higher chance of overfishing at higher effort levels.

This graph illustrates that if the **limit control** level were implemented the resulting resource state is best represented by the curve showing an effort of 280 boat days per month, corresponding to a 10.2% likelihood of the stock being overfished. The exact values for the limit control level can be seen in the Scenario Results box of the Analysis screen in the software, and the chance of overfishing in this example would be 10%, for 276 boat days. The **target control** is 434 boat days which relates to a 28% likelihood of the stock being overfished. To determine how many boats should be fishing in the fishery, you can divide the number of recommended boat days by the average number of days fishing of each boat per month.

The target control level may be greater than the limit control level initially, due to uncertainty in the data rather than due to overexploitation. Therefore, the limit should be seen not as a limit that must not be exceeded, but rather as a guide to how much data you have. You should gather more data until the limit is greater than the target.

Preferences

Individual fisher preferences are illustrated as the red lines and the overall (average) preference as the black line in Figure T18. The top of each curve indicates the effort control level with the highest preference score from the Preference Interview (i.e. for catch and effort outcomes under each control level). The average (black) line peaks at around 440 boat days which is less than the current effort on the Dimbani offshore reefs of 550 boat days. Therefore, the results suggest that if effort is reduced by 20%, this would result in catch rates that the average fisher would prefer compared to the current catch rates.

The results indicate the expected preference and are not a prediction. The decision is in fact a gamble. Based on the probability generated by the interviews and assessment methods, the computer can estimate the chance of the different outcomes in response to changes in the management control. The costs or benefits as relative preferences for each outcome can be obtained from the preference information. The graph indicates the average preference summed over all possible outcomes for that action. This is a rational response to uncertainty but cannot guarantee a good outcome. Identifying the true best action can only be determined through more and better data collection and stock assessment.

Demographic

Figure T19 shows that, out of 100 fishers, 84 would prefer the target level of effort to the current level and 16 would not prefer the new control level to the current one (best represented by the demographic for 460 boat days). This gives an indication of how widely acceptable the proposed control level might be amongst the fishers. One way of considering uncertainty is as disagreement between people. Do not expect everyone to be happy even with the best alternative. The demographic illustrates putting management controls to a vote of people representing the internal

state of the computer model. That is, if the data and model are accurate, the 'vote' represents what the community would vote in theory if they had the same information, including the relevant scientific knowledge. The comparison is between the current control and the new proposed control being put to the vote. The demographic is an exploratory graphical output to demonstrate the meaning of probability and preference. Note that the votes are qualitative. There is no assessment how much worse or better each person thinks the control is. The target management control does take this into account.

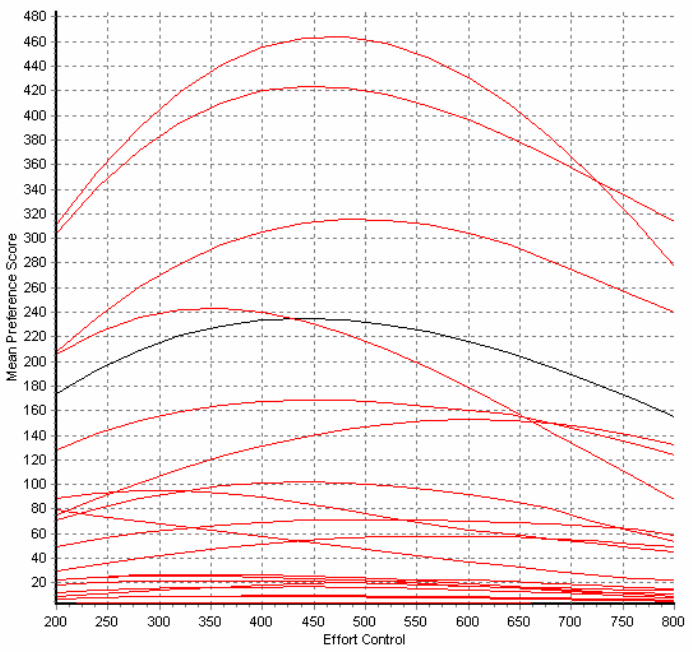


Figure T18: Preference graph for outer patch reefs, Kizimkazi - Dimbani

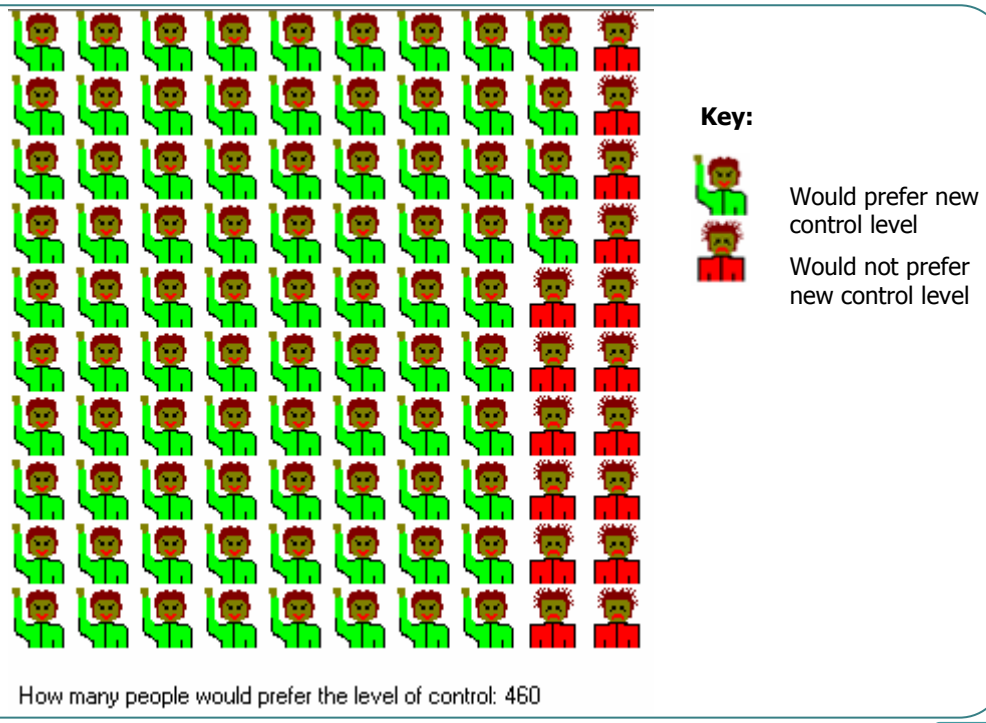


Figure T19: Demographic for recommended control level, Kizimkazi - Dimbani

6. Closed area scenarios

What are the target and limit control levels under closed area scenarios?

Instructions

- In addition to the effort and or quota controls, run the analysis using a closed area as the control. One interesting element to running this scenario is that it will indicate how acceptable a closed area might be to fishers. This can again be run using all the information available or only with the fisher interview data.
- If a closed area would be acceptable to fishers it is also instructive to consider how long the recovery time of an area would be. This can be determined from the 'Recovery Time' graph (see Figure T16). Looking at the recovery time using only information from fisher interviews will illustrate the time-span fishers may accept for a closed area.

7. Comparative scenarios

What are the target and limit control levels under different scenarios using different data sources and controls (alternative scenarios)?

Instructions

- After describing the baseline scenario, illustrate results from other scenarios. For example run scenarios where only the interview data are used, or where only the fishing experiment and catch and effort data are used. You will then be able to compare the results of using information from different sources and illustrate the contribution that fishers' knowledge has made to the results of the assessment.
- Run a scenario that uses the default preference and default discount rate rather than fisher preferences and fisher discount rates to explore the difference this makes to the suggested levels of controls.
- Record these scenarios in a comparative table (see example below) detailing:
    - the name of the scenario;
    - the type of control used;
    - the current control;
    - current state probability;
    - target control and limit control.

Example

Results from different scenarios for the Dimbani assessment

Scenario	Control Type	Current Control	Current State Probability	Target Control	Limit Control (boat days)
Baseline	Effort	550 boat days	0.50	434 boat days	276 boat days
Interview only	Effort	550 boat days	0.50	429 boat days	146 boat days
Baseline without fisher preferences	Effort	550 boat days	0.50	308 boat days	254 boat days
Baseline	Closed area	0 % of fishing area	0.50	0 % of fishing area	5 % of fishing area
Interview only	Closed area	0 % of fishing area	0.50	3 % of fishing area	29% of fishing area

The baseline suggests that the preferred CPUE of fishers can be achieved though a decrease in effort from 550 boat days per month to 434 boat days per month – a reduction of 20%. However it also illustrates that a reduction of much more than this to 276 boat days would be needed to reduce chance of the stock being overfished to below 10%. However, this is due to the high uncertainty in the data. If the interview data are used alone, the limit control is reduced further to 146 boat days a month, illustrating the uncertainty in the estimates of the parameters.

The scenarios that use closed areas as a control illustrate that there is no preference from fishers to have a closed area; using the baseline the target closed area is 0%, while the limit reference is a closed area of 5%. In this case, it may be difficult to convince fishers that implementing a closed area would be an option, but discussion could be initiated on rotating closed areas so that further data can be collected on the fishery reducing uncertainty in future assessments (see notes on monitoring options in **Stage 3** and **Tool 20**). Note that closed areas may be most useful as a device to collect information on stock productivity and the unexploited state, which the fishers should be interested in identifying.

8. The impacts of different scenarios on catch per unit effort (CPUE)

How will the recommended controls influence catch rates?

Instructions

- Plot the 'CPUE Projection' graph. It indicates the probability that the target control will result in an increase or decrease in average CPUE after 1, 2, 3, 4 and 5 time units.
    - The proportion of the graph above 1 indicates the probability that the control will result in increased CPUE.
    - Look at the shapes of the curves for the different times. It is likely that the curves will become flatter over time as the outcome becomes more uncertain.

Example

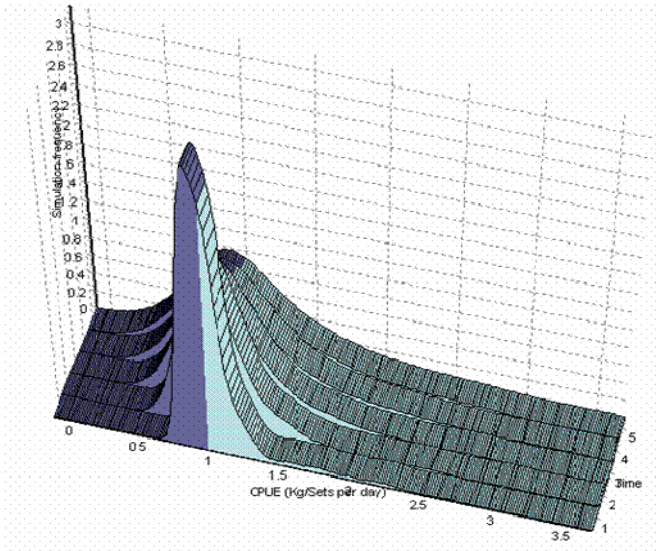


Figure T20: CPUE Projection graph for outer patch reefs, Kizimkazi - Dimbani

The darker colour is the probability that catch rates will decrease. If this darker area is increasing over time, the target policy is risky. If the management intend to be risk averse (e.g. apply the precautionary approach), the target would appear to be inconsistent with a low risk management strategy. This would indicate a potential problem.

9. Management advice

What management controls are advised?

Instructions

Based on the results of the scenarios and levels of uncertainty consider what control levels can be advised. This is only to give guidance to managers and the next step will be to build consensus with the relevant stakeholders on what management action should be taken based on the results. Where the assessment is uncertain, stakeholders will have considerable leeway in developing and applying controls. As the assessment becomes more certain, the aim is to get managers and fishers to understand the scientific evidence, which should lead them to adopting the assessment advice.

The results of the first assessment are likely to include a certain level of uncertainty and so the first recommendation may be to agree with stakeholders to take an initial step (however small) and monitor the results so that the assessment can be updated and uncertainty reduced. This initial step does not need to be what is best for the resource but what is best for all stakeholders concerned depending on their objectives. Where there are conflicting objectives among stakeholder groups, negotiation of the issues will be needed through workshop facilitation. You should also consider the costs and potential benefits of possible actions. For example, if implementing a small reduction in effort will result in high enforcement costs that do not outweigh the benefits it may be preferable to maintain the *status quo*.

- Consider what controls could be put in place considering the possibilities for adopting the controls suggested by the analysis, given what is known about the fishery.
- Consider what is known about the fishery as well as what is not known and therefore how much confidence can be placed in the results of the assessment. If this is low suggest a precautionary approach where a small change is trialled and monitored, or an adaptive approach where a larger change is implemented, designed to bring about monitorable changes in the fishery (see Garaway & Arthur 2004 for guidance on what to consider in determining the change that might be required).
- Consider what information could be collected to reduce uncertainty in the assessment (some ideas for monitoring and further data collection are described in **Tool 20**. See also Garaway & Arthur 2004 for further guidance on selecting options for data collection)
- Consider other issues for management that will impact on the implementation of management recommendations e.g. illegal fishing, socio-economic concerns etc. For example, controls recommended need to be cost-effective and enforceable.
- Consider the level of agreement or disagreement amongst fishers on the resource state, recovery time, etc. This can be done by:
    - Going to the Probability Models step of the Software and plotting the probability for the Interview Model, plot the probability curves for each parameter and assess the uncertainty or level of disagreement amongst the fishers; or
    - Looking back over the raw interview data to see the spread of answers in the recovery rate, unexploited CPUE or current state.

This may be important to point out as it firstly shows the level of uncertainty surrounding the stock and may lead you to recommend that more data is collected; secondly, it indicates how fishers may react to suggested management actions such as the length of time a closed area should be set aside for. For example, if fishers believe the recovery time is six months, then closing an area for two years or more may meet with resistance from fishers. This is also useful information to communicate back to fishers as it can illustrate the need to collect further data.

- Refer to **Stage 5** in the Toolkit which refers you to useful material for management planning.

Tool 23

Outline for a Summary of the ParFish Analysis for Government Fisheries Officials

What is it?

This tool provides a suggested outline for writing a summary of the ParFish analysis to present to government fisheries officials. For guidance on how to develop the content from the analysis, see **Tool 22: Guidance Notes for interpreting the ParFish Analysis.**

Why use it?

The results of the analysis need to be presented to various stakeholder groups. Government fisheries officials are one of the most important, as they are involved in determining management measures.

How to do it

Write a summary, based on the results obtained from the software and outlined in **Tool 22**, under the following headings:

1. State of the stock;
2. Level of fishing effort;
3. Levels of control;
4. Scientific background;
5. Management advice.

Refer to the **Software Manual** for guidance on carrying out the analysis and interpreting the outputs.

1. State of the stock

What is the current level of exploitation of the stock?

- Outline whether the analysis suggests the stock is over- or under-exploited, and the uncertainty surrounding the estimate.

2. Level of fishing effort

What is the current level of fishing effort and is it sustainable?

- Describe whether the current level of effort is sustainable for the resource, or if it is too great for the resource to be sustainable, and the uncertainty surrounding the estimate.

What are the standard stock assessment outputs?

- Describe the standard stock assessment outputs in terms of MSY, F at MSY and F at Optimal (Fopt, the fishing mortality which maximises the expected preference score).

3. Levels of Control

What are the target and limit controls under different scenarios?

- Describe the results for target and limit controls under different scenarios. Present the different scenarios that were carried out, e.g. using all available information, using just

fisher interviews or just scientific information, and the controls on which they are based (e.g. effort, quota or closed area). Outline the recommended control levels (both limit and target) from each scenario and relate them to a percentage change from current levels e.g. 10% reduction in effort, 10% increase in quota, closure of 5% of the fishing area.

4. Scientific background

What is the scientific basis of the assessment?

- Explain the model on which the assessment is based (in this case, a logistic population model using the four parameters: Current biomass (Bnow); Unexploited biomass (Binf); Growth rate (r); and Catchability (q).
- Explain what information has been used in the assessment e.g. fisher interviews, fishing experiment, and/or catch and effort data.
- Evaluate whether the assessment results make sense. If there are problems, indicate how they need to be solved.

What are the sources and levels of uncertainty within the assessment?

- Summarise the levels of uncertainty and give a view of how this uncertainty could be decreased in future assessments:

  The parameter estimates –
  - Assess the uncertainty of each parameter. Explain what information has been used for each parameter and describe the level of uncertainty, for example if the growth rate parameter has been estimated only from the fisher interviews, there may be high uncertainty in the estimate.
  - Look at the level of agreement between the fishers for each of the parameters. There may be high agreement on some parameters such as the resource state, whereas others such as the recovery rate may be very uncertain.

  The 'state of the stock' probability –
  - Look at the shape of the probability curve and the 90% confidence limits for the current state graph to assess the level of uncertainty.

  The resource state probabilities –
  - Look at the shape of the curves and comment on where (i.e. at what levels of control) these curves are broad or peaked.

- Comment on where there is the highest uncertainty and what information could be collected to reduce this uncertainty (see **Tool 20: Guidance for Monitoring**).
- List any other issues with the assessment here, such as whether the fishery is sufficiently defined, or any concerns that not all the information has been collected or is accurate etc.

5. Management advice

What control levels are advisable?

It should be emphasised that the advice given is for guidance only and any management actions should be agreed by all the relevant stakeholders, most importantly the fishers.

- Based on the results of the scenarios and levels of uncertainty present the possible management options. The next step will be to build consensus with the relevant stakeholders on what management action should be taken based on the results.
- Cover any **issues for management** such as issues relating to the enforcement of any future management actions, illegal fishing or socio-economic issues related to the fishery. These issues may have arisen during meetings with the fishers, and observations of the fishery. Not all such issues can be addressed by the assessment and therefore some adjustment may be required on the assessment advice.

Tool 24

Communicating the Results of the ParFish Analysis to Fishers

What is it?

This tool gives ideas of what concepts and outputs from the ParFish assessment should be communicated to the fishers, and suggests ways to do this.

Why use it?

It is important that the results of the assessment are returned to the fishers, in a way they can understand, so that they are empowered by and involved in the process, and may decide to take action to manage their fisheries.

How to do it

Results are best communicated to the fishers through meetings or workshops, possibly involving other stakeholders as well where appropriate. Here we outline the following concepts to be communicated, and ways of representing these to fishers:

1. The ParFish assessment;
2. State of the stock;
3. Level of fishing effort;
4. Possible controls and their effects;
5. Monitoring.

The exact information presented and the numbers involved will depend on the results from your assessment and may be different from the values given here.

1. The ParFish assessment

Remind the fishers what information went into the assessment and what kind of results it gives. This can be done using a visual diagram showing the different components such as in Figure C9 in **Concept 5: How ParFish works**.

2. State of the stock

Review concepts

Review the concepts involved in fisheries stock assessment and management. For example, stock size is referred to as a percentage or proportion of the unexploited stock size. Remind the fishers why stock assessments are useful and concepts such as the stock size is finite and fishing removes a portion of the unexploited biomass; the stock is over-exploited if there is less than half the unexploited biomass remaining; over-fishing leads to an overexploited stock and results in decreased catches.

Refer to **Concept 2: Fish Stock Dynamics** for ways of presenting this, such as the 'bau' game, the water jug example and the scenario cards; and refer to **Concept 3: Fisheries Monitoring and Assessment** for ways of explaining why we need a stock assessment.

Feedback Results: Is the resource over-fished?

After reviewing these concepts you can give feedback on what the assessment told us about the state of the stock.

Show the fishers the state of the stock graph. As this is a complex graph, break the explanation into 1) describing the probability and 2) the uncertainty of the stock being over-exploited.

Probability

Describe the probability of the resource being over-exploited as a percentage, and equivalent to the number of people agreeing or disagreeing that the stock is over fished. Compare the results of the assessment using information from different sources i.e. including or excluding fisher interviews and either use the demographic or describe the number of people out of 10 or out of 100 that would agree or disagree.

For example, the patch reef assessment in Kizimkazi showed there was a 49.7% chance that the stock was overexploited (less than half of the unexploited biomass remaining). In Figure T21 below this is illustrated by half of 100 people agreeing that the stock is over fished. Using information only from the fisher interview 7/10 fishers (70% probability or 70 people out of 100) would think the stock was over fished. It is not possible to carry out the assessment using just the fishing experiment data as it does not provide information on all the model parameters.

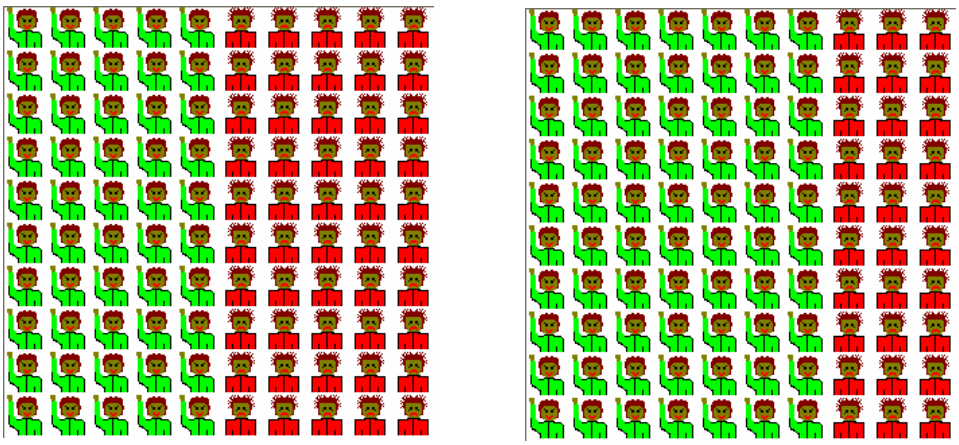


Figure T21: Using the demographic to describe the probability that the resource is over-exploited

Uncertainty

The shape of the 'state of the stock' curve illustrates the level of uncertainty. You can explain what the shape of the curve means by liking it to the exercise of estimating the number of oranges in the container (See **Concept 4: Uncertainty and Adaptive Approaches**).

When there is a high level of uncertainty in the assessment results because we do not have sufficient information, it is like having the paper covering the bowl of oranges. We would need to collect further information to improve our estimate.

Figure T22 illustrates the estimates for the number of oranges in the container and in this example just under half of a room full of people believing that there are less than 15 oranges in the jar. In this example a piece of paper is covering the jar, and the curve is relatively flat showing a high level of uncertainty.

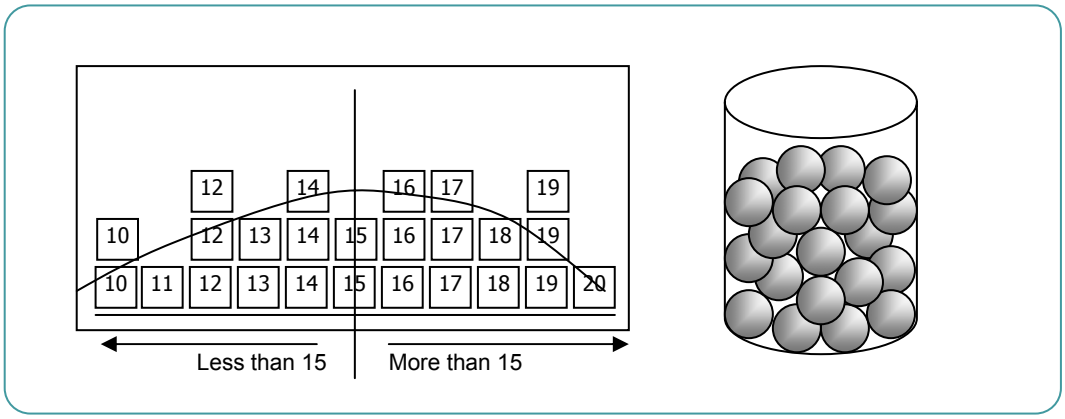


Figure T22: Using the orange jar concept to describe the uncertainty surrounding the state of the stock

3. Possible control measures

Describe here the different options for controls based on the outputs of the assessment. Illustrate the options for effort, quotas closed area and combination controls.

It is best to feed back changes in effort in relation to the effort measurement you have been using (e.g. boat days per year) rather than as a percentage. When describing the recommended controls for closed are convert a % area into an area measurement that will be understood by fishers e.g. time required to travel across in a boat or area that would house x number of traps. Also make sure you state how long an area should be closed for and refer back to the recovery rates for this information.

Remind the fishers that the assessment calculates what the recommend level of control is in order to reduce the chance of the stock being over-fished, and give catch rates (the amount of fish caught in a fixed time period or effort level) preferred by fishers.

You should explain that the results of the assessment are dependent on what information is included within the assessment. By illustrating the differences you can show how the fishers' knowledge and preference is taken into account and alters the assessment results.

4. Monitoring

It will be important to point out that there is uncertainty in the analysis and so it will be necessary to take initial action and monitor the impacts so that we can learn more about the stock and gain more certain results in the future. This might be monitoring catches and effort over a period of time, closing an area to fishing and monitoring its recovery, or repeating fishing experiments (see **Tool 20: Guidance for Monitoring**).

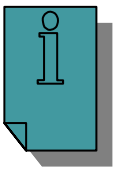
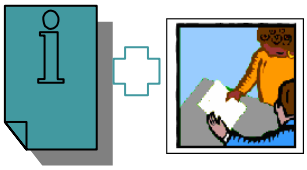
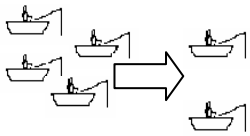
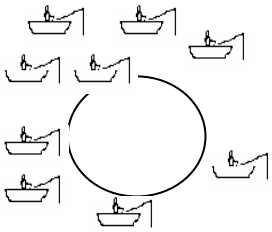
	Information sources		
	Scientific information 	Fisher knowledge and preferences 	Combined information 
EFFORT CONTROL 			
CLOSED AREAS 			
COMBINED CONTROLS Effort Controls  Closed area			

Figure T23: An example matrix that can be used to illustrate the different options and recommended controls to fishers

Tool 25

Prioritising Issues and Developing an Action Plan with Stakeholders

What is it?

This tool outlines a process through which the fishers and other stakeholders identify and prioritise the issues and problems they face relating to the fishery, identify options for addressing those issues and develop an action plan for implementation. Some of this has already been initiated through **Tool 13: Agreeing Objectives with Stakeholders**.

Why use it?

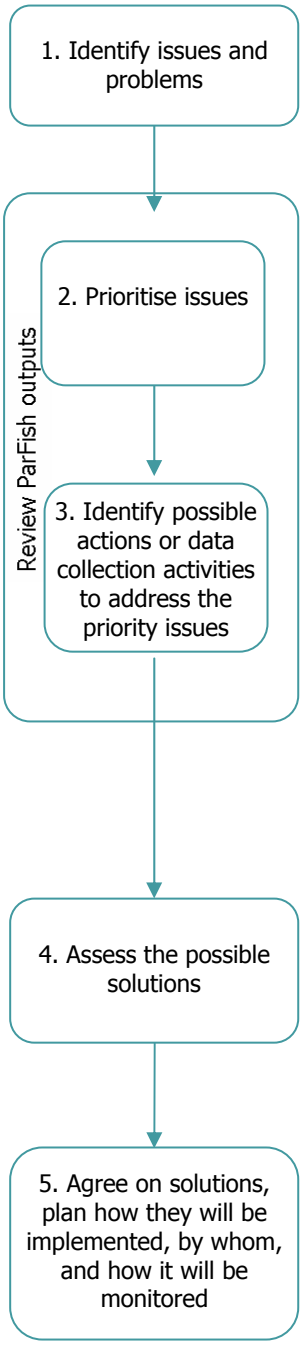
It is important that stakeholders consider practical ways in which the management of the fishery can be improved. After going through the ParFish stock assessment, learning more about the resources, and reviewing the assessment recommendations, ideas for improving the situation need to be turned into actions.

How to do it

The views of all the primary stakeholders should be represented in this process. You may need to involve control and enforcement authorities, local government, fisheries extension workers, fisheries department and research institutes. The steps to follow are:

1. Identify fisheries issues and problems;
2. Prioritise the issues;
3. Identify possible solutions;
4. Assess possible solutions;
5. Plan implementation of identified solutions.

Figure T24 below illustrates recommended steps for prioritising issues and developing a management action plan.



1. Identify issues and problems

Review fisheries issues and problems. This should have already been done in Stage 2 and **Tool 13: Agreeing Objectives with Stakeholders**, in which case review the objectives and check to see if there are any others to add. If not, this can be done through group discussions, break-out groups or idea cards (see Stage 2).

2. Prioritise the issues

Prioritise the issues within the fishery taking into consideration the outputs from ParFish analysis. Identify issues that can be addressed, for example those where the power and influence to do something about them exists. The stakeholders could either rank the issues according to their importance, or give an importance score to each issue (e.g. low, medium, high), or vote for the most important issues.

3. Identify possible solutions

Identify possible actions or solutions to address the priority issues, again referring to the recommendations from the ParFish assessment. The participants should think of ways they might address the priority issues. This could include involving other stakeholders, finding out more about their resource, reducing fishing effort to avoid overfishing, collecting information about illegal activities etc. It is important that the participants and resource users consider concrete actions that can be implemented by a combination of the represented stakeholders. They will also need to consider enforcement issues.

4. Assess possible solutions

The possible impacts (positive and negative) that these solutions should be considered. This may include social, environmental and political impacts and should include a review of the impacts on all stakeholders. This can be done in groups, with each group assessing one or two solutions.

5. Plan implementation of the solutions

In plenary, share the outputs of the assessments of the possible solutions, and debate and agree the most viable solutions to be implemented. Plan how those actions will be implemented and by whom. The participants should identify how each action will be implemented and who will be responsible (see the **Case Study** in Stage 5).

Figure T24: Steps to developing a management action plan

Tool 26

Example of an Outline Management Plan

What is it?

This tool provides an outline of a Management Plan for a fishery, detailing the various sections and information that could be included. It is based on existing management plans for other fisheries.

Why use it?

Once priority issues and solutions have been identified (see **Tool 25: Prioritising Issues and Developing an Action Plan with Stakeholders**), it may be useful to document these and record them as a Management Plan to present to the relevant authorities for approval and implementation.

How to do it

The outline Management Plan below gives examples of the following:

1. Stakeholder participation;
2. Description of the fishery;
3. Stakeholder objectives;
4. State of the Fishery;
5. Management system;
6. Management actions;
7. Enforcement issues;
8. Other important issues;
9. Monitoring and research requirements.

Outline Management Plan

1. Stakeholder Participation

See Stage 2: Engage stakeholders

Describe which stakeholders were involved in the preparation of the plan, and how. Specific points you might consider are:

Points	Examples
• Stakeholders involved in producing the management plan	Stakeholders involved e.g. fishers, fisheries division, government fisheries officials, researchers etc
• Process through which stakeholders participated and were represented	Through workshops, meetings, individual consultations Fisher representatives elected by fishers
• Communication channels with stakeholders	Through extension workers, availability of documents, radio

2. Description of the Fishery

See **Tool 2: Background Information to Compile**

Provide background information on the fishery, which might include some of the following points:

Points	Examples
• Fisheries resources	Species, distribution, abundance
• Fishing methods and gears and their numbers	Nets, handlines, vessels and motorisation, and their numbers
• Fish catch	Annual catch by species
• Boundaries of the fishing area	The area of the fishery
• Origin of fishers	Local or visiting fishers
• Fishing seasons	Low/High seasons, closed seasons
• Socio-economic information	Numbers of fishers, ages, household incomes and dependency on fishing

3. Stakeholder objectives

See **Tool 13: Agreeing Objectives with Stakeholders**

Identify what the objectives for the fishery are. Specific points you might consider are:

Points	Examples
• Stakeholder issues/problems in the fishery	Overfishing, enforcement, information, habitat degradation, conflicts
• Stakeholder objectives/priorities	Achieve sustainable use of the fishery, optimise fishing capacity, maintain production, minimise waste, discards or post-harvest losses, maintain food supply, increase incomes of fishers

4. State of the Fishery

See **Tool 22: Guidance Notes for interpreting the ParFish Analysis**

Describe the state of the fishery, based on the ParFish assessment and any other available information. It is recommended you cover the following points:

Points	Examples
• State of the stock	Is the resource overfished?
• Level of fishing effort	Is overfishing occurring?
• Catch rates, Maximum sustainable yield, Fishing mortality, recovery time	Standard stock assessment measures
• Recommended management controls	Outputs from the ParFish Software

5. Management system (rules, regulations, decision-making structures)

See **Tool 2: Background Information to Compile**

Briefly describe the structures and processes for decision-making in the fishery. You might cover some of the following points:

Points	Examples
• Government and other agencies and bodies involved in the fishery and their roles	Fisheries Department or Ministry, enforcement authorities, research institutes, community or fishers' organisations, protected areas' management
• Co-management approach	e.g. fishers' organisations, co-management fora, and the governance systems established for management
• Relevant laws for implementation of management measures	Fisheries laws and regulations

6. Management Actions

See **Tool 25: Prioritising Issues and Developing an Action Plan with Stakeholders**

Describe what management actions were identified as priorities by the stakeholders, for example:

Points	Examples
• Management actions agreed	Effort and quota controls, closed areas or seasons, gears permitted, gear sizes permitted, size limits, access issues (e.g. licensing, cost of access etc)

7. Enforcement issues

See **Tool 25: Prioritising Issues and Developing an Action Plan with Stakeholders**

Outline what the roles and responsibilities are for enforcing the agreed actions. This might include some of the following points:

Points	Examples
• Description of existing capacity	Patrol boats, surveillance equipment, enforcement officers
• Involvement of fishers in enforcement	Fishers report illegal fishing, fishers can arrest illegal fishers
• Role of agencies in enforcement	Agencies arrest, fine or charge offenders, respond to reports of illegal fishing from fishers
• Punishment for infractions	Fines, confiscation of gear

8. Monitoring and research requirements

See **Tool 20: Guidance for Monitoring**

Outline what monitoring and on-going data collection is planned, for example:

Points	Examples
• Current research and stock assessment	Biological, ecological and socio-economic
• Further monitoring required	Catch and effort data, length-frequency data

9. Review of plan

Outline the following points:

Points	Examples
• How and when will the plan be reviewed?	Annually, Biannually; by Committee or individuals
• How will further assessments feed into the management plan?	Annually, Every 2 years
• Who is responsible for the plan and its review?	Fishers Association, Fisheries Department

Tool 27

Evaluation Framework

What is it?

This tool provides a framework for evaluating the ParFish process and outcomes.

Why use it?

Evaluation provides a change to step back from implementing ParFish and ask questions about the assessment, management actions and improvements in the fishery. This enables the success of the process to be assessed, and for the team to learn from the experience and make adjustments for future activities.

How to do it

Follow these steps:

1. Gather a group together for the evaluation;
2. Explore issues surrounding the process and the outcomes.

1. Gather a group together for the evaluation

You could carry out the evaluation with different groups, for example:

- A group of fishers an resource users;
- A group from the facilitating institution;
- A group from the facilitating institution and other involved institutions.

2. Explore issues surrounding the process and outcomes

Ask questions about the process and the outcomes it has had on the fishery and its management. A framework with questions you might explore is provided in Figure T25.

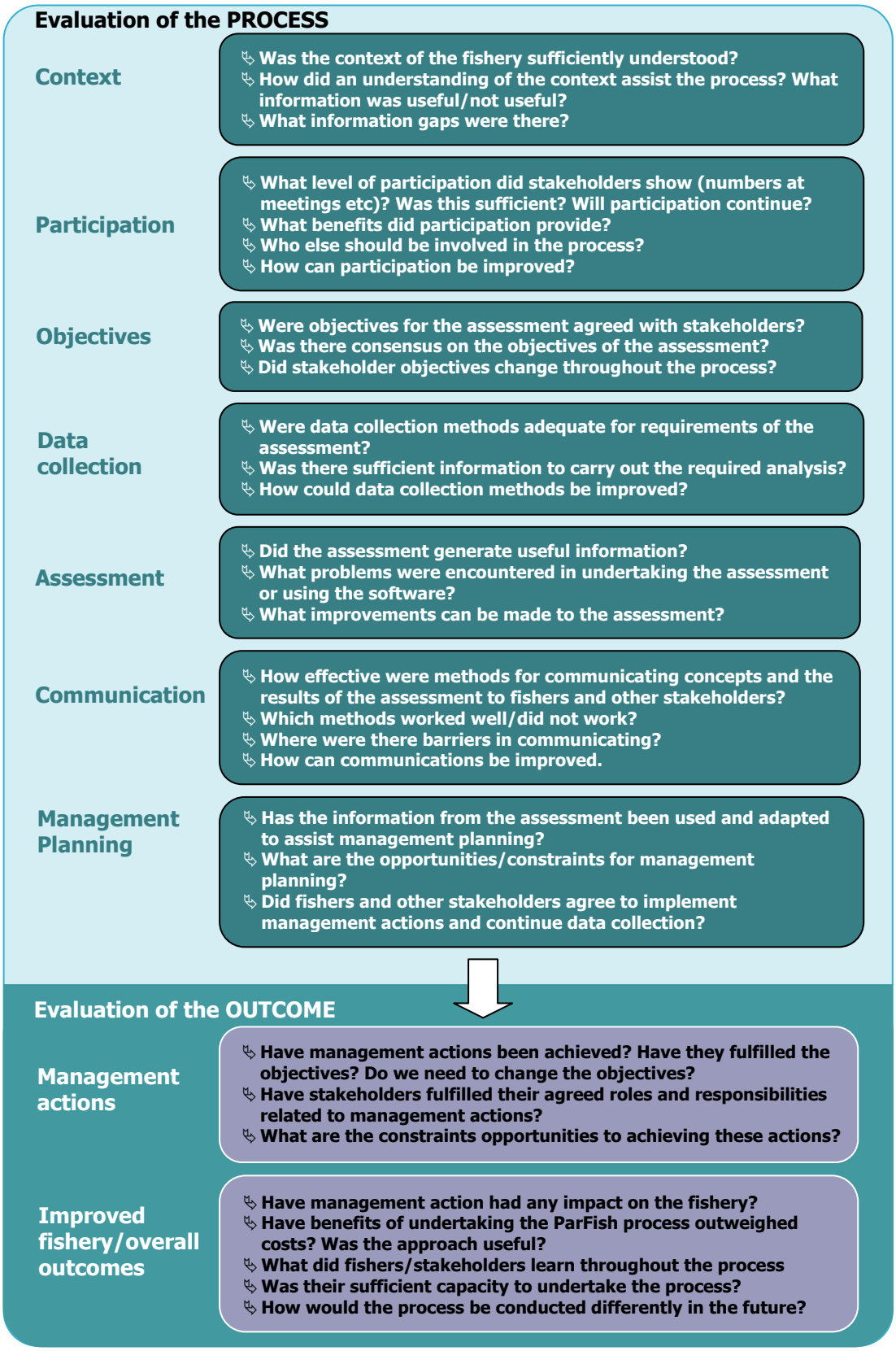


Figure T25: An evaluation framework