Application and Promotion of FMSP Participatory Fisheries Stock Assessment (ParFish)

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1 Executive Summary

1. **Executive Summary**:

The project tested, revised and widely promoted a methodology for participatory fisheries stock assessment (ParFish), developed under R7947 and R8397, through field testing, a training workshop and communication and promotion activities to increase capacity in its implementation, increase its dissemination and uptake to improve sustainable utilisation of artisanal fisheries resources in developing countries to contribute to the livelihoods of the poor.

Field testing of the methodology was undertaking with collaborating institutions in India, Gabon and Kenya and a training workshop was carried out in India. The case studies allowed testing of different approaches to data collection and provided lessons learned for promotional materials. The training workshop increased capacity of those involved and resulted in its uptake and application by participants' institutions, as well as providing new training materials which were included in the Toolkit. The Software was modified to make transition between different assessment models easier and to enable incorporation of other models such as age-based models at a later date. Communications and promotion activities resulted in interest in the methodology from the European Union and the Fisheries Department of the UN Food and Agriculture Organisation, which will be explored for further development and promotion of the approach.

Development and promotion of the methodology has achieved increased access of poor people, principally fishers and their dependents, to improved fisheries knowledge generated through the application of ParFish. ParFish enables stock assessments to be carried out rapidly in fisheries for which no prior data exist, and facilitate the implementation of management measures to improve sustainability of fisheries exploitation, thus supporting fisheries catches and fishers' livelihoods in the medium to long term. The participatory nature of the process gives fishers a voice in management of their resources and empowers them within a comanagement framework. The project has increased the capacity of fisheries management, research and implementing agencies' staff, particularly in the East Africa and Asia regions, to implement ParFish and involve fishers in fisheries assessment and management planning.

2 Background

Information should include a description of the importance of the goal or researchable constraint(s) that the project sought to address and a summary of any significant research previously carried out. Also, some reference to how the demand for the project was identified.

2.1 Developmental Need

Across the developing world coral-reef fishery resources are of central importance in the suite of livelihood strategies employed by tens of thousands of fisher communities. Small-scale fisheries provide important contributions to the livelihoods of poor people in developing countries through income, food security and protein and micro-nutrient availability. However, the coping and adaptive strategies of the majority of communities appear largely unable to stem falling catches or the destruction of reef habitat.

There are a number of reasons for the dilemmas faced by stakeholders in coral reef fisheries management. At one level, the potential for success of those (often external) voices calling for restraint in the level of fishing is constrained by the significant poverty imperative faced by most dependent stakeholders in these fisheries. Human population growth implies that limited resources are being targeted by ever increasing numbers of fishers. This creates a negative feedback cycle of increasing poverty and increasing fishing pressure that further reduces natural productivity of coral reefs. At another level, despite the importance of such fisheries to the wider economic and nutritional health of coastal communities, investment in management by the State is usually minimal. A lack of resources to collect and analyse data on the fishery results in a lack of information on which to base management decisions, which may jeopardise the sustainability of the fishery and put many people's livelihoods at risk. This situation is exacerbated by the fact that the poverty faced by fisher communities perpetuates their social and political exclusion such that they are often without effective means to participate in or influence what limited management decision-making may currently be underway. Finally, the technical assessment of such complex eco-systems is challenging and costly, requiring a considerable amount of data and resources to collect these data.

Management research agencies (e.g. Universities; development agencies; FAO & UNDP), state management authorities and NGOs are constantly seeking approaches to address these resource, governance and technical constraints. Issues of resource limits are being addressed through the promotion of alternative livelihoods or the enhancement of resource productivity (or access to new resources) through FADs, artificial reefs, mariculture, improved post-harvest technology and increased resource value through market development etc. ParFish focuses on addressing governance and technical issues through the provision of improved information for use by dependent stakeholders.

2.2 Researchable constraints

Stock assessments are an important component for managing fisheries, and provide advice on recommended exploitation rates in order to maintain sustainability of the resources, but there is a lack of stock assessment methodologies which support data-poor small-scale fisheries. Existing assessment methods often demand detailed time-series of catch and effort data, data beyond the scope of the majority of State (NGO) agencies in developing countries operating under severe financial constraints. The result

is that there is often no information available on which to base management decisions, which can result in the unsustainable exploitation of stocks, leading to associated social and economic problems.

Experience has shown that participation of resource users is important for sustainable management of resources, but participation is not integral to the methodology of conventional stock assessments. Neither have participatory methods (e.g. those developed for rapid rural appraisal) addressed adequately quantitative assessment or dealt with uncertainty. Participation of resource users in the stock assessment facilitates their uptake and acceptance of the results, making them more likely to take ownership of the results and recommendations, and take an active role in management decisions or the implementation of actions based on them.

ParFish addresses these constraints by providing:

• A resource-efficient stock assessment technique that does not require long-term time series data, can be applied with limited resources to provide a starting point for management decisions and involves the resource users in setting management objectives, data collection and management planning;
• Access to clear, reliable and cost-effective resource assessments. While data should be used where they are available, their absence should not prevent stock assessments and management advice;
• Decision-making protocols that rigorously capture stakeholder knowledge, objectives and utility that have previously been generally unavailable in fisheries;
• An approach which encourages the involvement of resource users, explicitly incorporates their knowledge in the assessment and includes ways of communicating the results of the assessment to them so that they can assimilate and use the information to develop participatory management plans.

Case studies have important uses in developing and promoting new scientific methods. Primarily they are used to indicate when and how the method activities contribute to the FMSP goal. We used this strategy to develop the practical application of ParFish. A set of case studies in different areas that vary in their fisheries, environments and cultural contexts help provide evidence supporting the practical value of the approach, as well as allowing development and adaptation of the method to suit different types of fisheries.

2.3 Scientific Background

This project built on previous work undertaken by project R7947, which developed the stock assessment and data collection techniques (see Medley, 2003), and by project R8397, which developed the Toolkit for implementing ParFish. No further scientific research has been undertaken in R8464.

There are a number of stock assessment methodologies currently available, but none that are able to cope with data-poor artisanal fisheries and integrate a truly participatory approach.   ParFish provides this type of methodology using a decision analysis technique and Bayesian statistics.

This technique is used to build a target reference point and estimates limit reference points based upon estimated probability distributions for the state of the fishery in response to different fishing controls. The advantage of using a probabilistic approach is that uncertainty is explicit and even very uncertain information might be used which otherwise would have to be dismissed. This enables a stock assessment to build up information from various sources more easily. ParFish applies a particular, but 'standard' decision analysis approach (e.g. Lindgren 1976).

ParFish is innovative in two ways in respect of its use of the logistic model for stock assessment:

- Firstly, it builds individual probabilities using non-parametric kernel smoothing functions (Silverman 1986). This is more flexible and faster than using parametric approaches, at the cost of lower accuracy where parametric distributions can be identified or are known. The method is able to use information as long as it can be represented as parameter frequencies. These frequencies are treated as though they have been drawn from some underlying probability distribution, which encapsulates the uncertainty in the stock assessment.
- Secondly, it uses interviews with resource users to model subjective probabilities for initial parameters and to model the 'utility', that is a measure of preference among different outcomes for the fishery. The method for obtaining subjective probabilities is based on one described by Press (1986). Again, the method builds a probability from individual fishers' best estimates of the current state and productivity of the stock using kernel smoothers to bridge differences in opinion. The 'utility' measure is based on fishers ranking different outcomes in the fishery and providing a relative score on how good or bad these outcomes are. This is a new method, but related to various approaches used to model utility (see Keeney and Raiffa 1993). In particular, it contrasts catch and effort under different scenarios using pairwise comparisons. It could be further developed into a multi-attribute hierarchal utility model, but field work has shown that simpler and faster methods perform better than complex ones, even though the latter may be more theoretically rigorous.

ParFish could also provide multi-species stock assessments in the future although this goes beyond the method promoted in this project and would require further testing given the large number of parameters involved. A multispecies model does exist in the software (developed under R7947) but has been hidden for this release. A simpler model was chosen for this initial version of ParFish to assist with its uptake by a wide range of organisations. Multispecies analysis and assessments are planned to be investigated further at a later date.

Project R8397 developed the ParFish methodology into a Toolkit, which was required for effective promotion of ParFish and use by fisheries management or stock assessment institutes. It includes:

- Guidelines on implementation of ParFish, a framework for implementing the approach and the necessary tools such as participatory approaches, interview sheets, examples of how information and concepts can be presented to fishers, experimental schedules, and methods of communicating the results back to fishers (Walmsley *et al.* 2005a).
- User-friendly software package;
- Software user manual (Walmsley *et al.* 2005b).

The Toolkit was developed based on case studies carried out on a single-species fishery in the Turks and Caicos Islands and on a mixed reef fish fishery in Zanzibar, Tanzania. It proved successful in testing in these areas, but required testing in other situations to provide evidence for its applicability in other fisheries and cultural contexts. The appropriateness of the underlying model, as well as the participatory techniques recommended for implementation of the approach needed verification.

2.4 Demand for the Project

Co-management is being widely promoted as an approach to the management of fisheries, and ParFish complements this by providing a framework within which information can be collected, and management recommendations can be made and

discussed with the fishers and other stakeholders involved in the process.

A wide variety of stakeholders expressed an interest in the ParFish approach through the communications component of project R8397. Interest stems from ParFish being a new and rapid approach to stock assessment that supports co-management, is participatory and is particularly applicable in small-scale fisheries. Institutions that have expressed an interest include: the World Bank through the Marine and Coastal Environment Management Project in Tanzania; FAO Regional Office for Asia and the Pacific; WorldFish Center, Bay of Bengal Programme, CORDIO (Coral Reef Degradation in the Indian Ocean) in collaboration with fishers at Diani, Kenya, the Sustainable Fisheries Livelihoods Program in West Africa, Government Fisheries Departments in India, the Western Pacific Fishery Management Council, the Lake Victoria Fisheries Organisation, WWF-Kenya, WWF-Brazil (Amazon) and researchers, consultants and other projects from Canada, Gabon, the Philippines, Sri Lanka, Tanzania, Australia and UK.

The principles underlying ParFish support international fisheries policy and direction. The United Nations Program of Action on Sustainable Development concluded that it was necessary:

'To strengthen national capacities, particularly in scientific education and training, to enable Governments, employers and workers to meet their environmental and development objectives and to facilitate the transfer and assimilation of new environmentally sound, socially acceptable and appropriate technology and know-how.'
AGENDA 21, Rio de Janeiro, 1992

ParFish supports this by providing an appropriate methodology for promoting environmentally sound, socially acceptable and appropriate resource management plans, and training will build national capacity to enable governments to implement this through their fisheries management and research institutions.

The Code of Conduct for Responsible Fisheries (CCRF), contains several articles which ParFish supports:

Article 6.3 States should prevent over fishing and excess fishing capacity.
ParFish allows an assessment of the state of the stock and appropriate management actions for small scale fisheries which otherwise cannot be assessed through a lack of resources and information.

Article 6.4 Conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account local knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors.
ParFish allows many sources of information to be combined in the assessment, including 'standard' data such as catch and effort time series as well as fisher knowledge recorded through interviews. Fisher interviews also take account of economic and social factors.

Article 6.5 States and sub regional and regional fisheries management organisations should apply a precautionary approach. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment.
ParFish focuses on identifying the best management action under uncertainty. This means that a recommendation can always be made. At the same time, ParFish identifies the main sources of uncertainty and can be used as the basis for recommending future data collection and research.

Article 6.18 Recognising the important contributions of artisanal and small-scale

fisheries to employment, income and food security, States should appropriately protect the rights of fishers and fish workers.

The participatory framework allows wider management issues important to fishers to be taken into account, as well as exploitation issues addressed by the stock assessment.

The FAO Strategy for Improving Information on the Status and Trends of Capture Fisheries recognises the importance of small-scale and multispecies fisheries, particularly in developing countries, and highlights the need for improving data and information for this sector. The use of rapid appraisal methodologies and participatory processes are specifically identified.

The FMSP East Africa Strategy paper (DFID, 2002), reports a high demand for baseline information and improved data collection systems which involve communities. ParFish addresses these areas by providing baseline information (stock assessment), and also a method for data collection with community involvement that can be applied elsewhere in the region with the support of IMS. There is a new World Bank funded project, 'Marine and Coastal Environmental Management Project' (MACEMP), which is starting implementation in late 2005, has stated stock assessments and participatory planning as part of the objectives (World Bank, 2003) and has shown interest in the ParFish methodology. ParFish can inform the World Bank project, and IMS will be able to provide support through their capacity and experience of ParFish. A proposal for supporting coastal livelihood development in Tanzania which incorporates ParFish, has already been approved for funding by the Japanese Social Development Fund.

Tanzania's Poverty Reduction Strategy recognises the environment as an important source of subsistence and income for many of the rural poor, and progress reports confirm that the government will 'initiate a process with a view to reviewing existing laws and regulations governing the utilisation and management of open-access resources (coastal fisheries and forestry) and initiate the implementation of community-based management of these resources' (United Republic of Tanzania, 2000). In Zanzibar, the Poverty Reduction Plan identifies 'rural small farmers and fishermen' as primary target groups for poverty reduction and the main strategic interventions to address the problem will be the assessment of fisheries potential in offshore and inshore grounds (Revolutionary Government of Zanzibar, 2002). ParFish addresses these issues by providing a methodology for stock assessment that can support initiation of management plans with community participation. Kenya's Economic Recovery Strategy for Wealth and Employment Creation also recognises the important contribution of fisheries to local incomes, subsistence and nutrition, particularly in the Nyanza and Coast provinces that have the highest incidence of poverty (Government of the Republic of Kenya, 2004).

India's rural development policy is shifting towards the emphasis of the participation of people through Panchayati Raj Institutions (PRIs), and promoting decentralisation to ensure this (Ministry of Rural Development, 2003). Andhra Pradesh is one of the largest and poorest states in India, with a population of almost 80 million, and one-third of the population living in poverty. DFID's Country Assistance Plan for India 2004 – 2008 (DFID, 2004) identifies Andhra Pradesh, Orissa, Madhya Pradesh and West Bengal as focus states for development assistance.

Gabon has a relatively high per capita Gross National Income (GNI) of US$ 3,060, but social indicators are barely higher than averages for sub-saharan Africa. Poverty alleviation, improved social outcomes, and better governance are becoming increasingly important policy goals for the Government and multilateral donors working in the country (World Bank, 2004). Fisheries in Gabon are worth US$ 55 million annually, with the majority of this coming from the artisanal sector (FAO, 2003).

Whilst considerable interest had been expressed in ParFish, to facilitate wider uptake of the approach, further examples of its use, and evidence of its application in a variety of situations were necessary in order to convince potential users of its applicability.

3 Project Purpose

The purpose of the project and how it addressed the identified development opportunity or identified constraint to development – what changes did the project aim to achieve

The purpose of the project was to promote the ParFish methodology and approach for fisheries stock assessment and management in developing countries, This is expected to contribute to poverty reduction through the improved and sustainable management of small scale fisheries on which the poor are dependent and through the subsequent benefits expected for associated fishery dependent livelihoods.

The ParFish software and methodology provide a stock assessment technique that can be used to provide management advice for fisheries that have no or little existing data. It involves the resource users in setting management objectives, data collection and management planning, supporting co-management and enabling them to have a voice in the management of their fishery. The previous ParFish project R8397 developed a Toolkit which comprises:

- **ParFish Guidelines**, which provide:
    - A framework for the implementation of ParFish;
    - Guidance on carrying out each stage of implementation, from identifying the fishery and understanding the context, involving stakeholders and carrying out the stock assessment to interpreting and feeding back the results, developing management action plans and evaluation;
    - A selection of Tools for implementing the approach;
    - Concepts involved and ways of communicating them to stakeholders;
- **ParFish Software**, which includes:
    - Easy to use interface;
    - Step-wise approach to guide the user through entering data, setting up models, etc.;
    - A wizard for setting up the most common models encountered;
    - New control panel on the analysis page to allow settings for the analysis to be adjusted directly from the analysis page;
    - New graphical outputs;
- **ParFish Software Manual**, which provides step-by-step guidance on using the Software.

The complete Toolkit provides the guidance necessary for adapting ParFish to a local situation and implementing it, including analysing the data and interpreting the results. The increased uptake and application of ParFish through this project contributes to resolving the problems faced by many small-scale fisheries due to a lack of resources for data collection and management. This is achieved through the provision of a methodology for stock assessment in fisheries that have little or no existing data on which to base decisions for resource management, therefore providing a starting point for adaptive and participatory management involving the resource users. This in turn helps promote good governance of fisheries, and empowerment of the resource users who become more involved in decisions which affect their livelihoods, have their voices heard, and build links with the institutions responsible for supporting resource management. The outcome of implementing the ParFish approach is expected to be a greater chance of sustainable resource use and management, which will support the continued contribution of fisheries resources to the livelihoods of the rural poor, thus contributing to sustainable livelihood strategies towards reducing poverty.

Some potential users had expressed a need to see practical evidence that the method

works in a range of situations. Therefore to facilitate successful promotion of the approach, a set of case studies in different areas that vary in their fisheries, environments and cultural contexts were necessary to provide evidence supporting the practical value of the approach. This project sought to test the approach in different fisheries in order to provide this evidence to support its uptake more widely, in addition to building practical experience across a number of institutions in implementing the approach. A further constraint to development is the lack of experience of potential users in applying the approach, which may limit their confidence to test the methodology in their fisheries. This project sought to overcome this constraint by providing a training course to those institutions that would be carrying out case studies, and to other institutions in the Bay of Bengal area, to increase the capacity of potential users. The training materials developed for the workshop can also be used by other institutions in the future that are interested in applying the approach. Increasing awareness of potential users was achieved by widely promoting the approach through implementing the communications plan including producing a synthesis document to contribute to FMSP project R8470.

This project follows on from FMSP projects R7947 and R8397, which developed the approach and the Toolkit to support its implementation. Further information on the method and models used, including comparisons between the ParFish approach and other 'conventional' stock assessment methodologies, can be found in the FTRs to these projects.

4 Outputs

The research results and findings achieved by the project against each output. Were all the anticipated outputs achieved and if not, what were the reasons?

Research results should be presented as tables, graphs or sketches rather than lengthy writing, and provided in as quantitative a form as far is as possible.

Summarise the research products / communications media produced. Report how and with whom these were promoted (quantify where possible). Describe the identified promotion pathways to target institutions and beneficiaries. The project communications matrix should be inserted, and reported against.

4.1 Output 1: Revised ParFish Toolkit produced based on additional field testing of ParFish outside the original case study location.

4.1.1 Revised Toolkit

The ParFish Toolkit was revised by adding training materials, promotional material including information on case studies, and a revised version of the ParFish Software. It was decided not to modify the content of the Guidelines and Software Manual as it was felt they address the current need for support for practical implementation of ParFish. Lessons learned and results from the case studies were reported on and disseminated through the communications materials, and are also available together with the Toolkit from the FMSP website. More copies of the Toolkit have been printed and distributed, and copies are held in reserve ready for distribution after the end of this project, as demand arises.

Changes have been made to the internals of the ParFish Software to allow easy transition between assessment models, although the basic interface remains the same. Additional changes have been initiated for a future version of the software to be developed based on a life history model, something that has been requested by potential users including FAO. In the Andhra Pradesh case study, new interview questions were tested to see if it would be possible to obtain the priors for such a model from fisher interviews, which were successful (see Section 6.1.1). In addition, the ParFish statistical approach has been used in a different project promoting assessment and management planning techniques for enhancement fisheries software, EnhanceFish.

Training materials that were developed for the Mangalore Training workshop (see Section 5.2.2) were added to the Toolkit and are available for download from the FMSP website. In particular, an animated version (in Powerpoint) of how to carry out the Preference Interview, demonstrating how to use the binomial tree for ranking scenarios, is expected to be particularly useful for people wishing to learn how to implement ParFish. See training workshop report in Annex 2.1 and download of training materials from FMSP website.

Other communications materials about ParFish have also been made available as part of the Toolkit download, such as the Synthesis Document aimed at policy makers, fisheries managers and scientists. Information on various ParFish case studies is available through the Synthesis Document.

4.1.2 Andhra Pradesh Case Study

The Case Study was successfully completed in Andhra Pradesh and served to demonstrate that the principles on which ParFish is based are adaptable to a biologically different fishery, on a different continent and with a different socio-cultural context.

Four key people received training in ParFish, from Andhra Pradesh Fisheries Department, the State Institute for Fishing Technology and the United Fishermen's Association. In addition, Mr Varma, a Fisheries Officer based in the villages where the case study took place, was also key in helping obtain background information and carrying out key informant interviews. The people trained through the Case Study have the capacity to implement ParFish independently in the future, although some support with data analysis may facilitate the process. Mr Ram Mohan Rao, Assistant Director, SIFT, who was involved in the Case Study, will be using some aspects of ParFish as part of his research for his PhD.

110 stock assessment interviews and 37 preference interviews were successfully completed with fishers about the mud crab (*Scylla serrata*) fishery in the Coringa mangroves, East Godavari District, Andhra Pradesh. Initial meetings were held with the fishers to introduce them to the ParFish process and seek their collaboration. During the interview data collection, different approaches to carrying out the interviews were tested, such as carrying out the Stock Assessment and Preference interviews together; carrying out the Stock Assessment separately from the Preference Interview; carrying out individual interviews and carrying out group interviews. See the report on the case study in Annex 1.2 and methodology / research activities in section 7 for more details.

Analysis of the ParFish interview data indicated that the fishers believe that the current stock biomass is roughly 55% (mode) of the unexploited biomass (90% confidence interval between 19% and 79%), with a 45% chance of the stock being overfished.
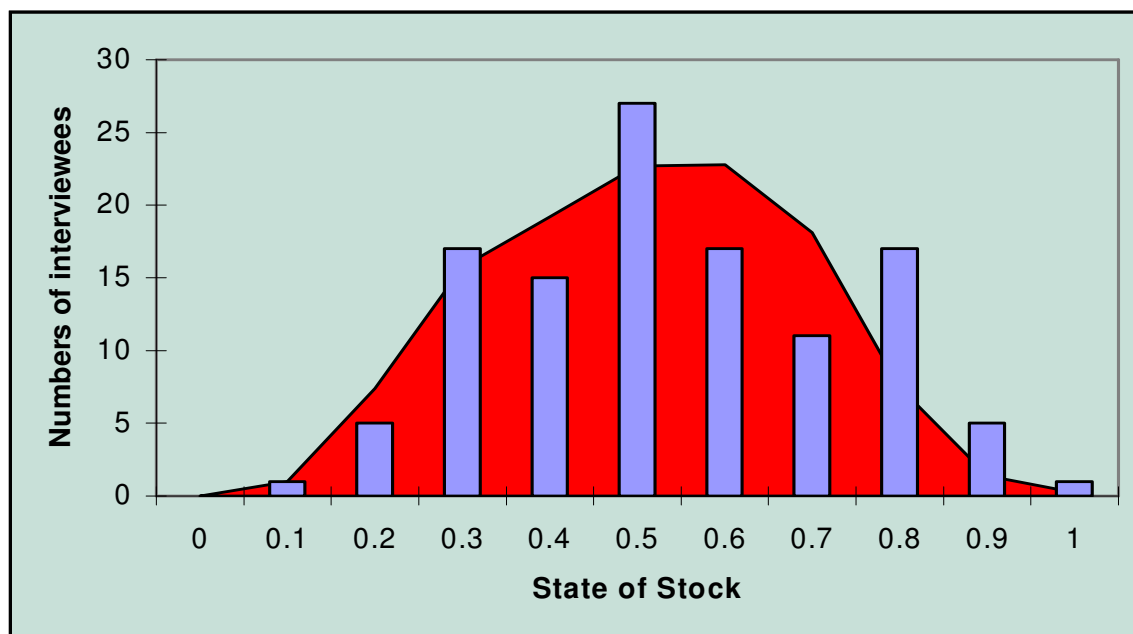
The histogram above shows the distribution of responses from fishermen about the state of the stock. We interpret the state in this figure as the stock is overfished when the values are below 0.5 and 0.5 is fully (sustainably) exploited. The fishers do not all agree, but the values are spread around the fully exploited point. The red area represents the expected response from fishers for the state of the stock as obtained from the analysis. We can see that based on fishers' beliefs, there is a possibility that the stock is overfished (45%), but overfishing is not extreme and no immediate management response is required.

The expected recovery time for the stock, based on the fishers' beliefs, is 2.3 months (median). The fishers expect a very high growth rate, which suggests that they may be accounting for immigration as well as growth rate in their answers. In the histogram below, the blue bars show the fishers' responses, and the red area shows the expected response from the fishers as obtained from the analysis, which corrects for the tendency for fishers to fix their replies at around the six month mark.
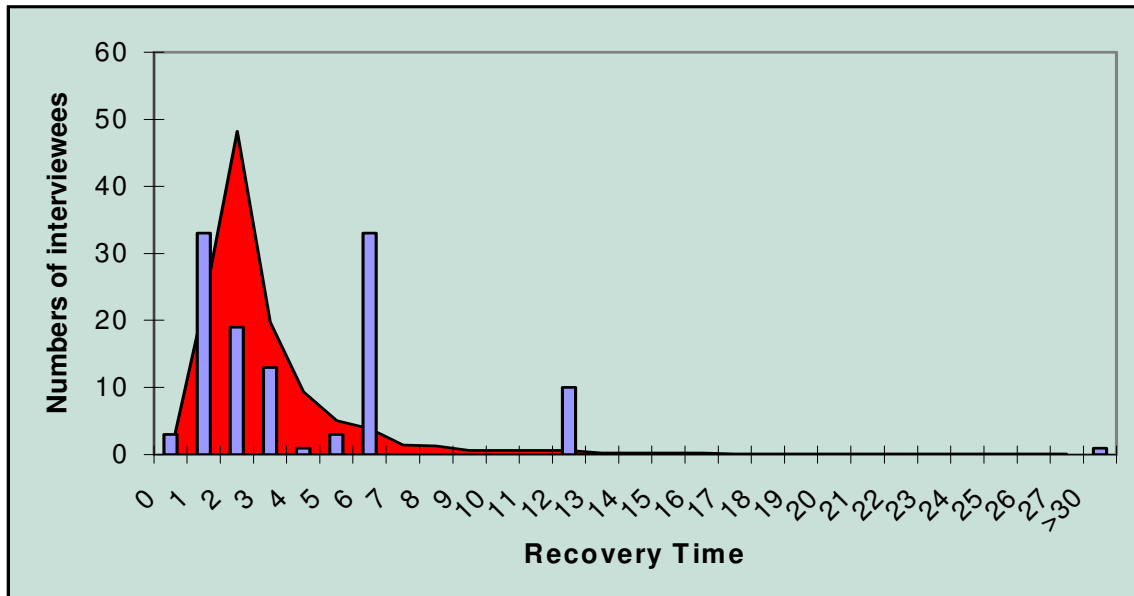
Fishers were enthusiastic about the case study and the new knowledge that was gained about their fishery. Through the workshop held at SIFT, the fishers expressed interest in the possibility of setting up co-management arrangements to manage the fishery and were very pleased at the opportunity to learn more about their fishery and to put their concerns across to the Department of Fisheries, NGOs and scientists working in the area. Some fishery control measures that were put forward to the fishers, SIFT and APDOF were closed seasons, habitat restoration, minimum size controls, returning berried females, effort control and closed areas. A poster was also prepared, aimed at the fishers, to encourage discussion about the state of the crab fishery and possible management measures. The poster (see Annex 1.2, poster is shown in English, but was printed in Telugu, the local language) was presented at the workshop at SIFT and 200 copies were distributed to the villages and other institutions involved in resource management in the area. In addition, the workshop at SIFT was covered by the local television channel (a 5-10 minute piece covering the workshop was shown on the evening news the same day) and newspapers. Several articles about the workshop were published in Telugu newspapers, and one in an English-language newspaper (see Annex 3.4).

This case study represents a completely different type of fishery from previous case studies which had been carried out on coral reef fisheries (single species gastropod and multispecies reef fish assemblage). It represents a single species fishery (*Scylla serrata*) conducted in a mangrove area using multiple gear types.

4.1.3   Gabon Case Study

The Gabon case study was carried out on an inshore net fishery for a variety of species with restricted ranges, and is the main fishery in the area. The Department of Fisheries representative for the region approved the work plan and was keen for the case study to take place. 30 fishers were interviewed for both the stock assessment and preference

interviews.

Overall, ParFish was positively received, and the World Conservation Society in Gabon is planning to expand the experience to cover the local lagoonal oyster fishery for which they are already collecting catch and effort data.

4.1.4 Kenya Case Study

The Kenya case study was able to gather and synthesise background information on the study site in order to plan data collection through the interviews. One staff member from Kenya Fisheries Department attended the training workshop in Mangalore and received training in all the ParFish techniques, and felt that on his return to Kenya he would be able implement the approach. However, this case study was not in a position to proceed to conducting the interviews during the life of the project due to several concomitant external factors at the field sites which impeded smooth implementation according to the current project's timetable, which are detailed below.

- There are a set of new fisheries regulations that are coming into place over the next few months on Beach Management Units (BMUs). These could really be a determining factor on how the fishers take and work with the results (more details in background document in Annex 1.3). The team has to make sure that they take time making fishers aware of these regulations with this implementation.

- The areas where the team is working in have been heavily influenced by research work, and issues have come up recently about allowances, payments etc, we have to start making sure that fishers are motivated for genuine reasons and not just the token received from research. This all came to a head in August/September and the staff and the Fisheries Officer were not very comfortable with starting a new series of work (and the ParFish interviews are more intensive than any they have implemented so far) while their project coordinator was away under these conditions.

- Before the above two issues could be settled the fasting month of Ramadhan began, and fishers prefer not to engage in meetings during this period, and Mr. Ndegwa from the Dept of Fisheries was on leave till after the end of Ramadhan (Mid Nov).

Despite this, interviews will still be carried out at a later date (planned for November / December 2005) and contact will be maintained with our collaborators. The team have begun exploring some dummy data sets with the ParFish Software and are learning its different functionalities. Mr Ndegwa, who attended the Mangalore training workshop, has arranged with the Director of Fisheries to extend the case study to three more sites along the Kenyan coast, and is providing training to staff on the ground so that they can effectively carry out the ParFish case studies.

Overall, the case studies found that the Toolkit was useful to support implementation of ParFish, and that no major modifications were necessary. Some alternative approaches to implementing the interviews (e.g. group vs individual interviews) that were trialled in Andhra Pradesh led to the conclusion that the individual interviews, as indicated in the Toolkit, were most appropriate, because the responses from the group interviews tended to be overly influenced by one or two influential individuals in the group. The individual interviews have the advantage that even though individual fishers may not be correct, their personal views are expressed.

4.2 Output 2: Increased capacity and commitment to use ParFish through wide uptake promotion to fisheries research, management and training institutions

4.2.1 Communications Planning

A stakeholder analysis was carried out and a Communications plan developed in coordination with FMSP projects R8470 and R8462. The Communications plan is reported against in Section 5.4.

4.2.2 Training Workshop

Training materials were developed including interactive and participatory exercises which demonstrated various principles of ParFish. The Toolkit also provided good training materials as it contains guidance on the implementation of each stage of the approach and of the various supporting Tools. The Toolkit was distributed to participants at the workshop as course material. The Workshop was held at St Alyoises College and was organised by the College of Fisheries, Mangalore. 14 participants, from a range of Indian state and national level fisheries management, research and teaching institutions from Andhra Pradesh, Orissa, West Bengal, Karnataka and Kerala, and from Kenya, received training in the six stages of ParFish including data collection and data analysis using the Software. The workshop was run by Dr Paul Medley, Ms Suzannah Walmsley and Dr Narriman Jiddawi (Institute of Marine Sciences, Zanzibar). The workshop received very positive feedback from the participants who all enjoyed it, and expressed that at the end of the workshop, they had a greater understanding of the overall ParFish process, the use of the ParFish software and how and when it can be applied, and how it can support co-management.

As a result of the training received at the workshop, some participants are already attempting to apply it in their own fisheries. West Bengal Fisheries Department are attempting to apply ParFish to the 'Kansabati reservoir' fishery. Orissa Fisheries Department participants have submitted a proposal to apply it in the Chilika Lagoon fishery. Dr Keshavanath, the workshop logistical organiser, is also taking up a ParFish case study on an estuarine fishery as a result of the training received during the Training workshop (see progress report in Annex 1.4).

Other workshop contacts are also in interested in the approach, including J.K.Patterson Edward from the Suganthi Devadson Marine Laboratory concerning the Vellpatti Crab Fishery and its potential certification by Marine Stewardship Council (MSC). Stephen Ndegwa from Kenya's Department of Fisheries will also implement ParFish in the near future in Kenya in collaboration with CORDIO, which was foreseen under this project.

4.2.3 Communication materials

A range of communication materials were produced by the project in accordance with the Communication Plan at the project and case study levels. The Andhra Pradesh case study produced a poster aimed at the fishers, to raise awareness and encourage discussion about the state of the fishery (see case study report in Annex 1.2). Project flyers (see Annex 3.1) updating stakeholders on progress were produced in March and August 2005 and distributed by email to the following numbers of stakeholders:

Policy Influencers	57
National Implementing agencies	7

Regional and International Implementing agencies	18
National Research	5
Regional and International Research	3
Promotion organisations	8
Capacity Building	1
Consultants	2

The flyers were also distributed on OneFish and on the FMSP website, and were distributed to participants in a number of international workshops (e.g. the Guidelines evaluation workshop for R8462 in Dhaka, Bangladesh). Updated information about the project was maintained on the FMSP website (see Annex 3.7). IMS has also been promoting ParFish through regional networks and contacts.

A presentation on ParFish was also given to the European Commission, including people from DG Research, FishCode, DG Development and Europe Aid (ACP country coordinator).

The Synthesis document (see section 5.3, below) was also distributed to the following numbers of stakeholders:

Policy Influencers	74
Regional & International Implementing Agencies	25
National Implementing agencies	18
National Research	7

A poster was prepared (see Annex 3.3), which compiled information about three FMSP projects relating to co-management, and was used to raise awareness at key meetings and conferences. It was displayed at the project R8462's Guidelines evaluation workshop in Dhaka, attended by 14 people from fisheries policy, management and extension institutions and projects; at the XIX Annual Meeting of the Society for Conservation Biology, at the Universidade de Brasília, Brazil, 15-19 July 2005, attended by about 1000 scientists, academics and students; and at the Climate Change and Fisheries workshop at DFID Headquarters, London. It will also be displayed at a workshop run by the Sustainable Fisheries Livelihoods Project in Senegal, 21 – 25 November 2005.

Other opportunities were also taken to promote ParFish, including a meeting of the Marine Stewardship Council in Miami, and a stock assessment conference in Hawaii.

The Toolkit has been sent out in hard copy to 70 people from 52 institutions in 28 countries. So far, 7 are attempting implementation of ParFish independently. A summary and link to the Toolkit has also been included on the Eldis website (see Annex 3.2). ParFish is also included as a chapter in the forthcoming FAO publication 'A Guide to Fisheries Stock Assessment using the FMSP Tools'.

Uptake of the approach, as a result of these promotion activities has been achieved in several cases. A PhD student from the University of Newcastle is using ParFish as part of his research on the use of fishers' knowledge in fisheries management and is carrying out research in collaboration with the Seychelles Fishing Authority (SFA) on the Bêche-de-mer fishery and a trap fishery. SFA are also interested in using ParFish for a study on on the outer island schooner fishery. The Galapagos Marine Reserve is particularly interested to apply ParFish where, after several years of conflicts and collapsing resources, there appears to be a new opportunity to change the system and make it truly participatory. They have recently developed a proposal to try to incorporate the fishers' knowledge and perceptions in future management models, along with the scientific information, and they believe there will be scope to use ParFish in this aspect and expect

to start implementation in January 2006. The Sustainable Fisheries Livelihoods Project (SFLP) in Ivory Coast will test ParFish on the Kossou Lake in order to develop a participatory method for fish stock assessment. This activity has a linkage with one of the major outputs of the SFLP project (a participatory management plan and functional institutions framework in place). ParFish will also be applied in Tanzania through a project funded by the Japanese Social Development Fund.

The ParFish team has also been invited to give talks at future seminars which are the result of current promotion activities and also provide for further future promotion opportunities:
- Reading University – offered an invitation to give talks on participation and the use of statistics in ParFish;
- The Principal Investigator is invited as a key speaker at a workshop on Data Needs for Coral Reef Fisheries, to be held in Oxford, early 2006;
- Newcastle University – Suzannah Walmsley has been invited to give a second talk on ParFish to students of the Masters course on Tropical Coastal Management in early 2006.

A proposal for implementation of ParFish in Tanzania and Zanzibar has been developed in collaboration with IMS and submitted to WWF-East African Marine Ecoregion for funding. Oliver Taylor has also submitted a proposal for using ParFish as the basis of a marine park and fisheries management project which is being initiated with funding from the USA.

4.3 Output 3: Synthesis of key points and lessons learned from ParFish disseminated via FMSP Project 05/09

A Synthesis Document summarising key points and lessons learned from ParFish, especially in relation to co-management, was produced. The document is aimed at fisheries policy makers, managers, scientists and facilitators and provides an accessible summary of the key points of ParFish. It was distributed to 124 policy makers, regional, national and international implementing and research agencies. Following review of the document by a communications advisor, the text was edited to break down long sentences and make it clearer to read, and captions were added to the photos. The document is included in Annex 3.6.

4.4 Communications Matrix

Communication stakeholders	Research Product / message to be communicated	Current knowledge, attitude, practice of stakeholders	Communication objectives: Desired outcome of communication / promotion	Communication channels and media in which research product will be communicated	Approach to monitor and evaluate implementation of communications plan	Results
Fishers within case study countries	Participation in stock assessments (through ParFish) can help fishers to understand their resource and become involved in its management and sustainability	No previous knowledge on ParFish but some understanding of co-management, depending on location	Actively involved in the ParFish case study and engaged to continue with the ParFish approach.	Community–level meetings facilitated by a relevant intermediary (e.g. research institution, fisheries department or project) Communications materials provided in Stage 2 and Stage 4 of the ParFish guidelines: Stage 2 covers tools for communicating and promoting ParFish to fishers Stage 4 covers tools for communicating concepts such as stock assessment issues, uncertainty, recommendations from the assessment. These are all designed to be used within community-level meetings.	Attendance at meetings Recorded issues raised within community-level meetings	Fishers were actively involved in the case studies through village meetings and interviews. In Andhra Pradesh, 130 fishers were interviewed, and 54 fishers, representing all 9 involved villages, attended the workshop for dissemination of the results. A poster was prepared and 200 copies were distributed to the villages involved and institutions working in natural resource management and community development in the region, to raise awareness of the issues surrounding the crab fishery and promote debate on its management. 54 fishers also attended the workshop held at SIFT, where the results of the assessment were communicated to them. Newspaper articles were also published in the local press in the local language, about the workshop. In Gabon, fishers attended the introductory village meeting and 30 fishers were interviewed. Issues raised in the meetings and workshops with fishers were recorded (see report on Andhra Pradesh case study)
Training Institutions within East Africa (e.g. FAST, Tanzania), Asia (e.g. CIRE,	ParFish is a useful method for stock assessment that complements co-management approaches. It also assists in teaching	Some knowledge in some regions e.g. East Africa through project flyers	Institutions consider including ParFish within their training remit	Project Flyers Selected institutions invited to training workshop Follow up emails & telephone calls	Distribution lists of flyers Feed-back monitoring from training workshop Record of email	Flyers were distributed to over 100 people, including 9 research and training institutions in East Africa and Asia. 68 copies of the Toolkit have been distributed. Three research and training institutions were involved in the Mangalore training workshop, from East Africa and India, and

CMFRI, India) **[Capacity Building organisations]**	about Bayesian statistics and decision support tools.			Distribution of the finalised ParFish toolkit on CD Synthesis product on the lessons learned from the ParFish approach FMSP website, links and list servers Newsletter articles	correspondence Distribution lists of ParFish toolkit Questionnaire on predicted use of the approach. Distribution lists of synthesis product.	feedback from the workshop was very positive. Independently, a professor from Rhodes University, South Africa, has confirmed that he will be using ParFish in his teaching materials. Emails and telephone calls were followed up (see email correspondence record in Annex 3.7). Information on the ParFish case study was included on the Andhra Pradesh Department of Fisheries website, including links to the FMSP and MRAG websites. The Synthesis product was distributed to 124 policy makers, and personnel in regional national and international implementing and research agencies. The FMSP website was kept up-to-date with project information, communication materials and downloads. Newspaper articles and television news reports contributed to awareness-raising about ParFish in the Andhra Pradesh region for the case study.
Fisheries management and research institutions in India (Fisheries Departments for Andhra Pradesh, Orissa, West Bengal, Karantaka and Kerala) **[Implementing organisations - National fisheries management)**	ParFish is a useful method for stock assessment that complements co-management approaches	Some knowledge of the software component of the approach through training courses in stock assessment [FMSP project R8360]. Less knowledge on the ParFish approach detailed in the ParFish toolkit.	Institutions consider using ParFish as a tool for stock assessment within a co-management arrangement.	Project Flyers Follow up emails & telephone calls Distribution of the finalised ParFish toolkit as hard copy and CD Synthesis product on the lessons learned from the ParFish approach FMSP website & links Selected institutions involved in testing stock assessment component of	Distribution lists of flyers Record of email correspondence Distribution lists of ParFish toolkit Feed-back monitoring from training workshop Web registrations for Toolkit download Questionnaire on predicted use of the approach.	See reporting above, and, personnel from 10 fisheries management and research agencies from East Africa and Asia were involved in the training workshop. Subsequent to the workshop, four of these institutions (in addition to SIFT, UFA and APDOF who were involved in the Andhra Pradesh case study) have either already started to apply ParFish, or have submitted proposals to their boards for applying ParFish in their fisheries. A questionnaire has also been developed and is being sent out with the Toolkit to solicit feedback on the potential usefulness of the approach and if/how the receiver foresees using it. During implementation of the case studies, face-to-face meetings were also held with

				toolkit. Selected institutions involved in Training workshop Face-to-face meetings Newsletter articles	Distribution lists of synthesis product.	the Commissioner of Fisheries, APDOF, Director of SIFT-Andhra Pradesh, and the Director of the Department of Fisheries, Gabon-Mayumba region.
Regional fisheries management and research institutions in Asia (e.g. Bay of Bengal Programme, WorldFish Center, FAO Regional Office, Fourth Fisheries Project, Asian Fisheries Society) **[Implementing organisations – Regional fisheries management)**	ParFish is a useful method for stock assessment that complements co-management approaches	Some knowledge on the approach through previous communication (e.g. project flyers, telephone conversations and email correspondence)	Institutions consider using and/or promoting ParFish as a tool for stock assessment within a co-management arrangement.	Project Flyers Follow up emails & telephone calls Distribution of the finalised ParFish toolkit as hard copy and CD Synthesis product on the lessons learned from the ParFish approach FMSP website & links Selected institutions involved in testing stock assessment component of toolkit. Selected institutions involved in Training workshop Newsletter articles	Distribution lists of flyers Record of email correspondence Distribution lists of ParFish toolkit Web registrations for Toolkit download Questionnaire on predicted use of the approach. Distribution lists of synthesis product.	See reporting above, and, flyers, Toolkit and Synthesis document were sent out to Bay of Bengal Programme, WorldFish Centre, FAO Regional Office and FAO Head Office, and Fourth Fisheries Project. This has generated considerable interest. FAO Regional Office (Asia & Pacific) are considering possible areas for its application and FAO Head Office are interested in the contribution ParFish could make to their strategy for improving information on the status and trends of capture fisheries, in particular for the small-scale sector (see Annex 3.5). Unfortunately Bay of Bengal Programme were unable to attend the training workshop because of commitments on post-tsunami assessments and planning, but they remain interested in the approach.

Fisheries management and research institutions in East Africa Region (e.g. CORDIO, , WWF, TAFIRI, TCMP, Tanga Coastal Zone Management Project, KMFRI, FIRRI) **[Implementing organisations – Regional fisheries management)**	ParFish is a useful method for stock assessment that complements co-management approaches	Some knowledge of ParFish through flyers, meetings and briefs.	Institutions consider using and/or promoting ParFish as a tool for stock assessment within a co-management arrangement.	Project Flyers Follow up emails & telephone calls Distribution of the finalised ParFish toolkit as hard copy and CD Synthesis product on the lessons learned from the ParFish approach FMSP website, links & list servers Selected institutions involved in testing stock assessment component of toolkit. Selected institutions involved in Training workshop WIOMSA newsletter	Distribution lists of flyers Record of email correspondence Distribution lists of ParFish toolkit Web registrations for Toolkit download Questionnaire on predicted use of the approach. Workshop feed-back forms Distribution lists of synthesis product.	See reporting above, and, Toolkits, flyers and the Synthesis document have been distributed to fisheries management and research agencies in the East Africa region. CORDIO/Department of Fisheries, Kenya, were involved in the training workshop, and IMS also provided training for the workshop. CORDIO and the Department of Fisheries, Kenya, have been involved in preparing for a ParFish case study under this project, and although it has not been possible to collect the interview data so far, training is being carried out on the ground for data collection before the end of 2006, and the planned area for implementation is being expanded to three more sites on approval of the Director of Fisheries. A proposal has been submitted to WWF East African Marine Ecoregion for funding application of ParFish in Tanzania and Zanzibar, and money has already been secured for use of ParFish in a coastal community livelihoods project under Japanese Social Development Fund funding with the World Bank Marine and Coastal Environment Management Project in Tanzania.
Fisheries management, research and training institutions globally i.e. Latin America, West and Southern Africa, Pacific, N. America, UK **[Implementing organisations – Regional/Interna**	ParFish is a useful method for stock assessment that complements co-management approaches	Some knowledge of ParFish through flyers in some areas, no previous knowledge in other areas	Institutions consider using and/or promoting ParFish as a tool for participatory stock assessment.	Project flyers Follow up emails & telephone calls Distribution of finalised ParFish toolkit Synthesis product on the lessons learned from the ParFish approach FMSP website, links & list servers	Distribution lists of flyers Record of email correspondence Distribution lists of ParFish toolkit Web registrations for Toolkit download Questionnaire on predicted use of the approach.	See reporting above, and, flyers, Toolkit and Synthesis document have been distributed to fisheries management, research and training institutions worldwide, including Ireland, Ecuador/Galapagos, Seychelles, Cote d'Ivoire, Mozambique, Cameroon, Brazil, India, Oman, Cambodia, Bangladesh, Gabon, Malaysia, Australia, USA, USA (Hawaii), Canada, Thailand, Philippines, South Africa and Nigeria. ParFish is also included as a chapter in a forthcoming FAO publication 'A Guide to Fisheries Stock Assessment using the FMSP Tools' which presents various different stock assessment techniques.

tional fisheries management)					Distribution lists of synthesis product.	
Policy Makers and Donors (e.g. World Bank, FAO, NOAA) **[Policy Influencers]**	ParFish is a useful method for stock assessment that complements co-management approaches. It is possible to address many of the management constraints to small-scale fisheries through further support.	Some knowledge in ParFish through flyers, briefs and meetings.	Interest in future support to ParFish.	Project Flyers Synthesis product on the lessons learned from the ParFish approach Policy brief/ Proposal FMSP website & links Email and telephone calls Face to face meetings Group meetings Newsletter article Final reports	Distribution lists Email correspondence	The Synthesis document was prepared specifically aimed at policy makers, decision makers, scientists, managers and facilitators, providing a summary of the importance of information-based management for small-scale fisheries, and how ParFish can support this. It was distributed to over 70 policy influencers and over 50 regional, national and international implementing agencies. Meetings, presentations, email correspondence and telephone calls have also been used to follow up on and encourage interest in the approach, including a presentation to the European Commision (including DG Research, DG Development, FishCode and Europe Aid). Proposals have also been developed for implementation of ParFish in Tanzania (WWF) and Oman (USA funding).
Promotion organisations (e.g. Eldis, Stream, WIOMSA)	ParFish is a useful method for stock assessment that complements co-management approaches	Some knowledge in ParFish through flyers, briefs and meetings.	Promote information on ParFish to a wide range of further stakeholders	Website, links and list servers Email and telephone Newsletter articles Project flyers, briefs Final reports and Toolkit	Distribution lists Questionnaire on predicted use of the approach. Email correspondence	The ParFish Toolkit was promoted on internet portals including Eldis (see Annex 3.2) and OneFish. A search on Google for 'participatory fisheries' yields the R8464 page on the FMSP website in 1st place, a search for 'participation + fisheries stock assessment' or 'participation + fish stock assessment' yields the ParFish flyer in 2nd and 3rd place, respectively. A search for 'parfish' yields the ParFish flyer on OneFish in 1st and 2nd place, and the FMSP website in 3rd and 4th place.

5 Research Activities

This section should include descriptions of all the research and communication activities (research studies, surveys, experiments, communications pathways, product testing etc.) conducted to achieve the outputs of the project. Information on any facilities, expertise and special resources used to implement the project should also be included.

Indicate any modification to the proposed research activities, and whether planned inputs were achieved.

5.1 Output 1: Revised ParFish Toolkit produced based on additional field testing of ParFish outside the original case study location.

5.1.1 Andhra Pradesh Case Study

The Andhra Pradesh Case Study on mud crab, *Scylla serrata*, was conducted with the collaboration of the Andhra Pradesh Department of Fisheries (APDOF), the Andhra Pradesh State Institute of Fisheries Technology (SIFT) and the United Fishermen's Association (UFA), a grassroots fishermen's organisation that proved very useful for facilitation. The fishery involves nine villages that border the mangrove area, namely Pedavalasala, Chinna valasala, Gadimoga, Kothuru, Lakshmi pathi puram, PBV Palem, CBV Palem, Ramanna palem and Chollangi peta, and supports about 5000 fishers[1].

The fishery was selected on the basis that it was a sedentary stock within a defined area, and the villages involved in fishing the stock were easily identifiable as those villages situated along the edge of the mangrove area. No fishers from outside the mangrove area fished there for crabs.

Training was carried out with G.Venkata Raju (Assistant Director, APDOF), Ram Mohan Rao (Assistant Director, SIFT), P. Sreeramulu (Fisheries Officer, SIFT) and L. Narasimha Raju (General Secretary, UFA) by Suzannah Walmsley (MRAG) during a three-week visit to Andhra Pradesh. During this time, training was provided on collecting background information for the fishery, conducting a stakeholder analysis and developing a communications plan, and on carrying out the ParFish interviews. Regular trips were made to the villages in order to inform the fishers about ParFish, to familiarise them with the researchers and interviewers, to gather background information and to trial the questionnaires. An estimate of the number of fishers and fishing gears in each village was made through key informant interviews, and was used as the basis for the stratified sampling strategy which covered four different gear types across nine villages.

The training received was practical, hands-on training, and as the exercises were explained, they were put into practice for the mud crab fishery. For example, the stakeholder analysis and communications plan that were prepared are provided in Annex 1.1. The stock assessment and preference interviews were translated into Telugu, the local language, and adapted for the mud crab fishery. They were tested in the field with some fishers and fisheries department field officers (who were also fishers) and subsequently modified. The fishers use between 1 and 3 gears for fishing, and because the interviews were carried out for all of the gears that a fisher used, some interviews took a very long time and were tiring for both interviewer and fisher. As a result, stock

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[1] Studies conducted by Bay of Bengal programme (BOBP) and Central Marine Fisheries Research Institute (CMFRI)

assessment interviews were carried out separately from preference interviews.

Data collection was carried out over a period of 3 weeks by the SIFT, UFA and APDOF staff. 110 stock assessment and 37 preference interviews were carried out, according to the stratified sampling strategy to sample fishers of different main gear types in different villages according to their numbers. The data were analysed during the Mangalore workshop using the ParFish Software.

Age-based questions were developed and tested with the fishers. Three different sizes were used, small, medium and large, and crab shells of crabs of each size were used to assist discussion of the following points:
Mortality: fishers were asked about how many of each size of crab they catch currently, and how many they think they would catch if the stock was unexploited.
Growth: fishers were asked about the maximum size/age to which the crabs could grow, and how long they think it takes for the crabs to grow from small to medium size, and from medium to large size.
Selectivity: fishers were asked to imagine equal numbers of each size crab in an area, and how many of each size they think they would catch in the area if they were to fish there. They could not conceptualise the idea of having equal numbers of each size crab in an area, or accept the notion of experimental fishing in a pond in which equal numbers of each size crab had been put, as they said they would not be able to catch anything in a pond. Instead, fishers were asked what proportion of each size crab they believed were in the natural environment, and what proportion of each size they actually catch when they go fishing. This enables the selectivity for each size category to be calculated.

A follow-up workshop to disseminate the results was held in Kakinada, involving fishers, government fisheries managers, NGOs, politicians and scientists. 54 fishers attended, including representatives from all of the villages involved in the fishery. During the workshop, the fishers were able to hear others talk about the conclusions of their work on the mangroves and the mud crabs, and were able to express their concerns about the current situation. One of the main concerns was that the channels dug in the mangroves in the ambit of the mangrove restoration project of the Swaminathan Foundation had in fact drained and thus destroyed the nursery areas of the mud crabs and was responsible for the decline in catches since 1998. Although this may not be the sole reason for the decline, the Swaminatham Foundation agreed that perhaps some negative impacts may have been felt. As a result the potential process for discussion of the issues was opened up.

5.1.2   Gabon Case Study

The case study was coordinated by Oliver Taylor in coordination with the Wildlife Conservation Society (WCS). A competent local staff member was identified to take on the interviewing role and a member of the Department of Fisheries was also involved in the field work. The interview sheets were translated into French and an initial village meeting was held to meet with the fishers, to explain the objectives of the work and seek their collaboration for the interviews. Interviews were carried out with individual fishers over a period of two weeks.

5.1.3   Kenya Case Study

Contacts were established with the team to be responsible for implementing the Kenya case study in Diani – Kenya. Training was provided for one of the team members, Mr Stephen Ndegwa from the Kenya Department of Fisheries, through the Mangalore workshop in India as described in Section 6.2.2. Background information was collected and compiled, and is presented in Annex 1.3. However, it was not possible to conduct the interviews during the life of the project due to several concomitant external factors at

the field sites which are detailed in Section 5.1.4.

5.2 Output 2: Increased capacity and commitment to use ParFish through wide uptake promotion to fisheries research, management and training institutions

5.2.1 Communication Plan

The communication plan was updated in collaboration with projects R8462 and R8470. This is reported on in Section 5.4.

5.2.2 Training workshop

Training sessions and materials were prepared by Paul Medley, Suzannah Walmsley and Narriman Jiddawi (IMS). The facilities of St Aloiyses College and the College of Fisheries, Mangalore, were used for the training workshop. The IT facilities at the College were very important for providing training in the use of the ParFish Software.

Presentations were developed to cover the six stages of ParFish, as well as extra background information on Bayesian Statistics, for the following sessions:
- Introduction to ParFish
- Previous experiences of ParFish (by IMS and APDOF)
- Introduction to Bayesian Statistics
- Understanding the context and collecting background information
- Data collection techniques
  - Interviews
  - Fishing experiments
- Software
- Feedback and management planning
- Evaluation of the workshop

Practical sessions and group participatory exercises were also developed on the following:
- An imaginary case study that brings out various important lessons learnt in previous testing experiences of ParFish, for the participants to plan what background information to collect and from where, carry out a stakeholder analysis and a communication plan.
- Participants experimented asking the interview questions to each other, as well as trying out the preference interview.
- A 'fishing experiment' using ping pong balls hidden in shredded paper in a large box was used as a practical example of the principles of the fishing depletion experiments and how the data can be used to estimate the initial population size using simple models in Excel. Detailed information on how to conduct the box experiment, and the models on which it is based, are included in the training workshop report.
- Training in the Software was through practical sessions using data sets from previous ParFish case studies.

5.2.3 Communication materials

Communication materials were developed to inform communication stakeholders of developments in the project, activities and case studies (i.e. flyers and email correspondence). A proposal was developed for WWF-EAME and project materials and

information were distributed on various websites (FMSP, Eldis, Onefish, Andhra Pradesh Fisheries Department). The revised Toolkit was distributed to interested people and institutions on request, and to key communication/promotion contacts. Communications were maintained by email and a record of email communications is provided in Annex 3.8.

5.3 Output 3: Synthesis of key points and lessons learned from ParFish disseminated via FMSP Project 05/09

5.3.1 Synthesis product

To produce the Synthesis Product, information was compiled from previous experiences of ParFish implementation. The target group was defined as fisheries managers, policy makers, scientists and facilitators, and a key question was identified that would be of interest to those groups. Then an outline of the product was developed and discussed to determine the sections and content of the document.

6 Contribution of Outputs

6.1 Contribution to FMSP's Purpose and Outputs

6.1.1 Purpose OVIs

> Purpose: Benefits for poor people generated by application of new knowledge to fisheries management systems.
>
> By 2005, evidence of application of FMSP research products to benefit target communities[2] in target countries[2] by achieving:
>
> Capture Fisheries: For at least one EFZ, coastal or inland capture fishery, one or more of the following:
>
> OVI3: Improved access by poor people to fisheries knowledge generated by the Programme

Through the Andhra Pradesh case study, the current project utilised communication techniques developed for ParFish to explain concepts of fisheries stock dynamics, stock assessment and probability, improving access and understanding by poor fishers to the knowledge generated by the ParFish stock assessment. The participatory process used in ParFish also facilitated fishers' involvement and enabled them to have contact with staff of the Department of Fisheries and SIFT.

54 fishers from 9 villages attended the workshop for the dissemination and discussion of the results. The workshop provided a chance for the fishers to voice their concerns about the fishery to politicians, scientists, (government) fisheries managers and non-governmental organisations active in the area. In particular the fishers expressed their opinion that mangrove rehabilitation work carried out by an NGO had destroyed the crab nursery grounds, and had had a negative impact on the stock and its productivity. This point was accepted as a possibility by the relevant organisation, and it is hoped that this will mark the start of a dialogue and process to address the problems and seek solutions. The fishers gave very positive feedback about the workshop and the opportunity to learn more about their fishery and put their points of view across. The overall process is expected to benefit the 9000 fishers involved in the fishery.

The implementation of the Andhra Pradesh case study also built capacity among staff of institutions supplying services to the poor (APDOF, SIFT and UFA) as well as among policy makers (APDOF, SIFT) for the implementation of ParFish, participatory techniques and principles, and co-management. The training workshop in Mangalore broadened this impact to institutions supplying services to the poor and policy makers in the target states of West Bengal and Orissa as well as Kenya and Tanzania in East Africa. In total, 10 people from 9 different institutions in key target countries/areas of the FMSP received capacity building in ParFish. In addition, a further 3 key individuals from institutions supplying services to the poor in non-target areas (Karnataka state, India) received training in ParFish.

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[2] Target communities: At least two of:

- Poor people
- Institutions supplying services to the poor
- Employers of the poor
- Policy makers

2. Target countries: S Asia (Bangladesh & West Bengal) and SE Asia (Cambodia, Laos and Vietnam) for inland fisheries, and East Africa (Kenya and Tanzania), Indian Ocean SIDS and S. Asia (Orissa and Andhra Pradesh) for marine fisheries.

6.1.2   Output OVIs

> Existing FMSP research outputs relating to: the contribution of capture and enhancement fisheries to the livelihoods of the poor; fisheries management tools and strategies that could benefit the poor; and, the means to realise improved management, further developed, disseminated and promoted to relevant stakeholders at all levels.

ParFish provides a fisheries management tool that can benefit the poor through the means to realise improved management with the possibility of conducting stock assessments for small-scale fisheries on which the poor are dependent, and for which otherwise carrying out stock assessments is generally not possible due to the lack of data and of resources to collect the necessary data. Stock assessments are a key part of fisheries management, providing information on which to base management decisions relating to any fishing controls, identification of management actions and opportunities for development. Ensuring sustainability of resources is central to protecting resource users' livelihoods, although issues of access, empowerment, and equality are also important. ParFish provides a tool that enables a stock assessment to be carried out rapidly, even where no previous data exist, and encourages and facilitates the participation of poor fishers in the management process.

During this project, ParFish has been further developed, disseminated and promoted to a wide range of institutions and individuals worldwide. FAO and EU have also shown interest in the approach and further partnerships will be explored with both institutions for future development and promotion of the approach.

6.2   Impact of the project

ParFish Purpose-level OVIs:

- By month 5 ParFish toolkit and approach tested outside original case study locations through further field testing in at least 1 location and testing of stock assessment component with data from at least 2 locations

The ParFish Toolkit and approach was successfully tested outside the original case study locations. Field testing with project support took place in the *Scylla serrata* fishery in Andhra Pradesh, India, and independent testing took place in Gabon and in Kenya, although the Kenya case study is yet to complete the interviews.

- By month 5, increased capacity to apply ParFish in at least 5 institutions in the Africa and Asia regions

Increased capacity to implement ParFish has been achieved through the training workshop and case studies. 15 people from 10 different institutions from the South Asia and East Africa regions received training in ParFish at the workshop, surpassing the OVI of 5 institutions. Participants' feedback from the workshop indicated that they had a greater understanding of the overall ParFish process, the use of the ParFish software, how and when it can be applied, and how it can support co-management.

- At least 1 institution implementing ParFish independently by EOP

As a result of the training workshop and the project's promotional activities, several institutions have taken up ParFish to apply in their fisheries. The College of Fisheries, Mangalore is implementing a case study in a fishery in Karnataka state, India; Orissa Department of Fisheries have submitted a proposal for assessment and management for a fishery in Chilika lagoon using ParFish; West Bengal Department of Fisheries is using ParFish in the Kansabati Reservoir, and SFLP will test ParFish on the Kossou Lake

fisheries. The Seychelles Fisheries Authority, together with a PhD student from Newcastle University are testing ParFish in the bêche-de-mer and trap fisheries, and have plans to use it on the outer island schooner fishery; The Galapagos Marine Reserve will apply ParFish in the fishery there to attempt to change the current management system and make it truly participatory.

- By EOP at least 1 institution interested in further support to the ParFish approach.

FAO FishCode-STF project has expressed interest in the ParFish approach (see Annex 3.5), as the only tool currently available that can support stock assessments in data poor small-scale fisheries, a priority in the Strategy for Improving Information on the Status and Trends of Capture Fisheries, and we will be exploring joint proposals for further testing and development with them.

6.3 Further work

What follow up action/research is necessary to further promote the findings of the work to achieve their developmental benefit? What follow up actions might be considered with respect to identified communication pathways?

The development of other models and of a software version for programmers that can be adapted to include different models will be important next steps in the promotion of ParFish. The current model (logistic biomass) serves as a simple introduction to the approach, principles and techniques that is broadly applicable. However, there is demand for an age-based model to be available. We have already explored the possibility of obtaining the relevant information for an age-based model through interviews, which was successful. Follow-up of the Andhra Pradesh case study would include a fishing experiment to gather more information on the stock behaviour, and to develop a co-management system for management of the system, for which there is substantial interest from the fishers. This fishery provides an opportunity to put such a system in place to ensure sustainable management at a time when the stock is not yet over-exploited, which avoids the initiation of a management system having to reduce fishing effort. Application and testing in fisheries with good background data to test and compare the outputs with other stock assessment methods will also be an important step in obtaining support for the approach, so that we have evidence that, where good data exist, ParFish gives comparative results to conventional stock assessment methods. Whilst some communications materials have been developed that are aimed at the target beneficiaries, it is recognised that this is an area that could also be further developed in the future.

Publications and other communications materials

> List the publications and other reports, communications materials and other outputs, according to the following categorization:
>
> (a)   Peer-reviewed publications (published);
> (b)   Peer-reviewed publications (in press or submitted);
> (c)   Non peer-reviewed publications and reports and communications materials;
> (d)   Verbal presentations & project dissemination and other workshops;
> (e)   Other types of project output (eg literature reviews, databases, software etc).

(a)   Peer-reviewed publications (published);

(b)   Peer-reviewed publications (in press or submitted);

(c)   Non peer-reviewed publications and reports and communications materials;

Synthesis Paper: Fisheries management decisions with limited resources and data
Flyers
Application and promotion of FMSP Participatory Fisheries Stock Assessment (ParFish)
     Training Workshop Report
Training materials
ParFish Toolkit (revised, with Training materials)
Report on case study Andhra Pradesh, India
FMSP webpage
Information on Andhra Pradesh Fisheries Department's webpage
Newpaper articles in India
Television news reports on the Kakinada workshop, India
Poster displayed at Climate Change workshop in DFID, at Final Workshop for Guidelines for Designing data collection and sharing systems for co-managed fisheries in Dhaka, Bangladesh
Poster for local distribution in Andhra Pradesh/Kakinada and villages re. the state of the crab fishery
Email correspondence

(d)   Verbal presentations & project dissemination and other workshops;

Training workshop
Presentation to Commissioner for Fisheries, Dept of Fisheries Andhra Pradesh
Presentations at workshop in Kakinada to fishers, politicians and scientists
Presentation to European Commission
Contacts
Conversations with FAO (Gertjan de Graaf) and EU about future testing, promotion and uptake of ParFish
Promoted at FAO FishCode workshop

(e)   Other types of project output (eg literature reviews, databases, software etc).

Revised version of ParFish Software

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8 Project Logframe

Hierarchy of Objectives	Objectively verifiable indicators	Means of Verification	Important Assumptions
Goal			
Existing FMSP research outputs relating to: the contribution of <u>capture</u> and <u>enhancement</u> fisheries to the livelihoods of the poor; fisheries management tools and strategies that could benefit the poor; and, the means to realise improved management, further developed, disseminated and promoted to relevant stakeholders at all levels	1. Information systems to support the co-management of fisheries important to the poor field tested with target groups and institutions in at least three locations in two countries, adapted, and widely promoted (in target countries, international knowledge systems and DFID) by 31 March 2006. 2. Fisheries assessment methods to inform sustainable management for improved livelihood benefits further developed with target institutions in at least two countries, widely promoted (nationally and internationally), by 31 March 2006.	• Programme Management review • Project FTRs • Programme highlights • Publications and other communications materials • Teaching materials • Fisheries management tools • Quarterly and annual reports • FMSP project database • FMSP Website • Correspondence • Requests for manuals and guidelines received • Uptake of research products by target institutions monitored and reported in Annual Report • National statistics and publications • International networks, databases and publications	Policy makers remain receptive to information on fisheries management Government policies continue to support co-management Government policies continue to support pro-poor approaches Target beneficiaries remain receptive to management approaches proposed. Stock enhancement process cost effective and socially appropriate. Target beneficiaries adopt and use strategies
Purpose			
ParFish methodology and approach further field tested, revised and promoted to improve management of small scale fisheries and associated fishery dependent livelihoods.	By month 5 ParFish toolkit and approach tested outside original case study locations through further field testing in at least 1 location and testing of stock assessment component with data from at least 2 locations By month 5, increased capacity to apply ParFish in at least 5 institutions in the Africa and Asia regions At least 1 institution implementing ParFish independently by EOP By EOP at least 1 institution interested in further support to the ParFish approach.	Peer reviewed final report Toolkit Correspondence from target institutions	Capacity to use the methodology exists Continued institutional commitment to participatory management Communities willing to participate in resource management

Outputs	Objectively verifiable indicators	Means of verification	Important assumptions
1: Revised ParFish toolkit produced based on additional field testing of ParFish outside the original case study location.	By month 5 additional case study of ParFish approach (Steps 1-4) complete By month 5, stock assessment component tested with data from field testing in 2 other areas By month 7 results and lessons from case studies and training course (see Output 2) integrated into the ParFish Toolkit	Project reports Revised toolkit Case study report	Collaborating institutions' field testing provides adequate information to revise toolkit Institutions are willing to provide data for testing and to undertake interviews Sufficient capacity exists in collaborating institutions
2: Increased capacity and commitment to use ParFish through wide uptake promotion to fisheries research, management and training institutions	By month 3, at least 10 people trained in ParFish and able to implement the approach By month 7 promotional materials disseminated to at least 15 institutions By EOP ParFish toolkit distributed to at least 30 institutions globally	Participants' feedback forms from training initiatives Participant competency tests Workshop report Communications materials Download registration forms Communications plan updates/ Quarterly and final reports Communication monitoring forms	Targeted institutions willing to take part in training initiatives. Targeted institutions are able to secure sufficient funding to use ParFish approach. The ParFish approach fits with current donor priorities
3: Synthesis of key points and lessons learned from ParFish disseminated via FMSP Project 05/09	By EOP output on the key lessons learned developed and disseminated via FMSP project 05/09	Synthesis product from project 05/09	Appropriate target stakeholders for dissemination are identified

Activities	Milestones*	Assumptions
Output 1: Revised ParFish toolkit produced based on additional field testing ParFish approach outside the original case study location Budget: £29,492.00		
1.1 Confirm case study location through communications with collaborators	Case study location confirmed by month 1	A collaborator confirms support and supplies location for case study
1.2 Conduct additional case study focusing on determining management recommendations through field testing of ParFish	**Case study complete by month 5 involving community-level meetings**	Resource users interested in participating in field testing
1.3 Confirm institutions that will field test stock assessment component	Institutions confirmed by month 1	Institutions willing to allow their data to be

	used

1.4 Institutions conduct interviews with fishers	Interviews completed by month 4	Institutions have capacity to conduct interviews independently
1.5 Test stock assessment software using data from 1.3 and 1.4	Stock assessments carried out by month 5	Data can be obtained from partner institutions
1.6 ParFish toolkit revised based on the lessons learned from additional field testing and training course (see output 2)	**Revised ParFish toolkit developed by month 7**	ParFish case studies and training generate relevant lessons for updating toolkit.

Output 2: Increased capacity and commitment to use ParFish through wide uptake promotion to fisheries research, management and training institutions

Budget: £35,085.00

2.1 Carry out stakeholder analysis and develop and update communication plan in coordination with other FMSP projects	**Communications plan finalised in collaboration with other FMSP projects by month 2**	
2.2 Training materials developed and incorporated within the ParFish toolkit	Participants identified by month 1 including fisheries research, management and training institutions. Training materials finalised by month 2	Interest in ParFish approach continues
2.3 Training in ParFish undertaken with target institutions	**Training workshop held by month 3**	Participants available to attend workshop
2.4 Integrate lessons from further field testing and training course into communication and promotion materials	Revised communication and promotion materials completed by month 6 (e.g. flyers, email correspondence, policy brief, proposal, WIOMSA newsletter)	ParFish case studies and training generate relevant lessons for updating communication materials
2.5. Communication and promotional materials disseminated	**Project flyers and policy briefs distributed to communication targets by month 7** **Communication materials and ParFish toolkit available on FMSP web-site and relevant links to other web-sites created by month 7** By EOP at least 1 proposal submitted to potential funder for further ParFish development.	Demand for proposals exists
2.6 Distribute guidelines, software and synthesis product to interested parties	**Revised toolkit and software disseminated to institutions by EOP**	Continued interest in ParFish toolkit

Output 3: Synthesis of key points and lessons learned from ParFish disseminated via FMSP Project 05.09

Budget: £ 5,377.00

3.1 Draw out lessons learned in coordination with project 05/09		
3.2 Provide synthesis piece to project 05/09	**Synthesis piece distributed to project 05/09 by month 7.**	Format for synthesis product provided by project 05/09

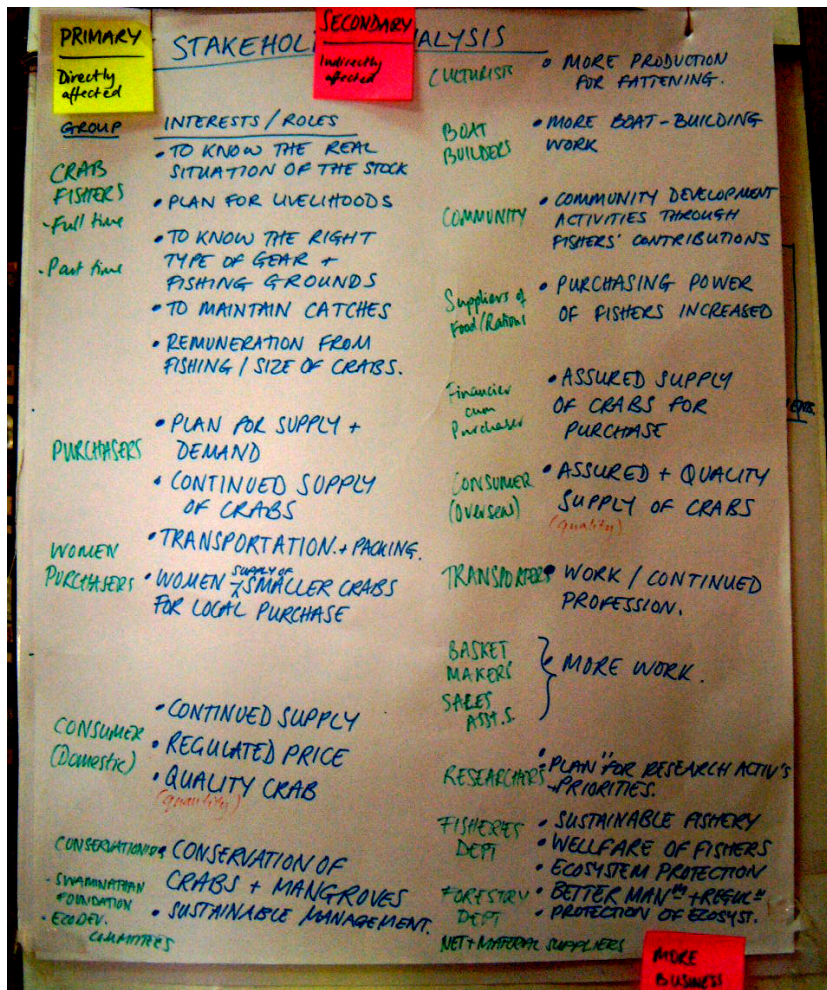* Milestones in **bold type** are key milestones

9 Keywords

Fisheries management, stock assessment, Bayesian, participatory, promotion, uptake, communications, East Africa, West Africa, Bay of Bengal.

Annexes

Annex 1.1: Kakinada Mud Crab Fishery Background Information
STAKEHOLDER ANALYSIS –

Priority and Influence Matrix

LOCAL COMMUNICATION PLAN – KAKINADA MUD CRAB FISHERY

Stakeholder group	Communication message	Communication materials / means
Crab fishers	- objectives of ParFish - results of assessment - management options	- meetings - posters - video films/TV (through training institute) - radio
Managers (Fisheries Development Officers) Fisheries Dept	- how to implement ParFish and benefits of ParFish - how to prepare management advice, plans and regulations - results and recommendations	- Training / workshops - Extension materials (printed leaflets) - software - video films
Policy makers (Hyderabad)	- Strategy support - Successful stories of fisheries management - benefits of management planning	- exposure visits - workshops (July) - reports - newsletters (but discontinued)

Plans:

Prepare poster for fishers (local language)

Fisheries Dept – website   – link to ParFish website
                                     – article re. Andhra Pradesh experience

Produce a 'special publication' for:
- Fisheries officers
- Forestry Dept
- Researchers
- Exporters

PARTICIPATORY MAPS OF FISHING GROUNDS

CHOLLANGIPETA
MUD CRAB FISHING AREAS

KAKINADA

KAKINADA CANAL

HOPE ISLAND

KAKINADA BAY

CHOLLANGI TEMPLE

CHOLLANGIPETA
(KORHAPU CHETTI PETA)

KOTHAPU

RAMANNA PALEM

CORINGA

PEDDA PEDDI VENKATAYYA PALEM

PETA CHINA VENKAYYA PALEM

CHINAVALASALA

LAKSHMIPATHI PURAM

PEDAVALASALA

GADIMOGA

BHAIRAVA PALEM

OLD LIGHT HOUSE

BAY OF BANGAL

YANAM

GODAVARI RIVER MOUTH
(NEELAREVU)

GOUTHAMI RIVER

N

E

MATLANTIPPA

KALUSUTIPPA

MOLLETIVOM

KOTTAPALEM

Kakinada
Chollangipeta

42

KAKINADA

HOPE ISLAND

KAKINADA CANAL

KAKINADA BAY

4

CHOLLANGI TEMPLE

CHOLLANGI PETA
(KORRAPETTI PETA)

5

LOTHERU

RAMANNA PALEM

3

2

CORINGA

PEDDA VENKAYALAM PALEM

BODDU CHINA VENKAYAPU PALEM

CHINA VALASALA

LAKSHMIPATHIPURAM

PEDAVALASALA

GADI MOGA

BHAIRAVA PALEM

YANAM

GODAVARI RIVER MOUTH
(NEELARAVA)

GOLTHAMI RIVER

BAY OF BENGAL

OLD LIGHT HOUSE

RALUTIPPA

MASANITIPPA

MOLLETIMOGA

KOTTAPALEM

N
E

44

KAKINADA

KAKINADA CANAL

HOPE ISLAND

KAKINADA BAY

CHOLLANGI TEMPLE

CHOLLANGI PETA
(K ORIVARI CHETTI PETA)

KOTHU GU

RAMANNA PALEM

10

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6 CORINGA

BODDU PEDA VENKATAYA PALEM

BODDU CHINA VENKATAYA PALEM

OLD LIGHT HOUSE

1

3

CHINAVALASALA

LAKSHMI PATHI PURAM

PEDAVALASALA

BAY OF BANGAL

GADIMOGA

CHIRIVA SALEM

YANAM

GODAVARI RIVER MOUTH
(NEELA RAVA)

GOUTHAMI RIVER

5

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RALVSUTIPPA

MAHASANTIPPA

MOLLETIMOGA

KOTTAPALEM

PBV Zubin
2.6.2015

KAKINADA

HOPE ISLAND

KAKINADA CANAL

KAKINADA BAY

CHOLLANGI TEMPLE

CHOLLANGI PETA
(KORRA CHETTU PETA)

6

LAKSHMI

5

RAMANNA PALEM

4

OLD LIGHT HOUSE

4

CORINGA

BAY OF BANGAL

PEDDA VENKATAYA PALEM

8

CHINA VENKATAYA PALEM

BETA

CHINA VALASALA

2

LAKSHMIPATHIPURAM

PEDDALASALA

GADIMOGA

BHAIRAVA PALEM

YANAM

GODAVARI RIVER MOUTH
(NEELA REVU)

3

GOUTHAMI RIVER

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RALUVU TIPPA

NAMASANI TIPPA

MOLLETIMOGA

K ETTAPALEM

CHINAV ALASALA
MUD CRAB FISHING AREAS

KAKINADA

HOPE ISLAND

KAKINADA CANAL

KAKINADA BAY

CHOLLANGI TEMPLES

CHOLLANGI PETA
(KORRAVANISHETTIPETA)

KOTHURU

RAMANNA PALEM

CORINGA

PEDDAVEDA VENKAYA PALEM

BODDU CHINAVENKAYA PALEM

CHINA VALASALA

LAKSHMIPATHIPURAM

PEDAVALASA

GADIMOGA

PATHRAVA PALEM

OLD LIGHT HOUSE

RAY CC BANGLE

YANAM

GODAVARI RIVER MOUTH
(NEELARAVA)

GOWTHAMI RIVER

BALUNTIPPA

MATLANTIPPA

MOLLESOOM
KOTTAPALEM

China valasala

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LAXMIPATHIPURAM
MUD CRAB FISHING AREAS

KAKINADA

KAKINADA CANAL

HOPE ISLAND

KAKINADA BAY

CHOLLANGI TEMPLES

CHOLLANGIPETA
(K ERRAJ-SHETTI-PETA)

KORTHRU

RAMANNA PALEM

OLD LIGHT HOUSE

BAY OF BANGL

CORINGA
REDDI PEDA VENKATAYA PALEM
REDDI CHINA VENKATAYA PALEM

CHINAVALASALA
LAKSHMIPATHIPURAM
PEDAVALASALA

GADIMOGA
DAIRAVAPALEM

YANAM

GODAVARI RIVER MOUTH
(NEELARAVA)

GOUTHAMI RIVER

BALUSUTIPPA

MATLAGANI TIPPA

MOLLET MOGA
KOTTAPALEM

N
E

PEDAVALASALA
MOD CRAB FISHING AREAS

KAKINADA

HOPE ISLAND

17B

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KAKINADA CANAL

KAKINADA BAY

17A

15

17C

CHOLLANGI TEMPLES

CHOLLANGI PETA
(KODIARI CHUTRUISRAM)

14

12

22

KOTHURU

RAMANNA PALEM

13

OLD LIGHT HOUSE

COLLNOR
REDDIPEDA VENKATAYA PALEM

20

BODDU CHINA VENKATAYA PALEM

18

21

11

CHINA VALASALA

LAKSHMINATHA PURAM

PEDAVALASALA

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BAY OF BENGAL

GADIMOGA

BHAIRAVA PALEM

8

YANAM

GOPALA RIVER MOUTH
NEELAKAVU

GOUTHAMI RIVER

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RAVUSUTIPPA

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MOLLA TEMPLE

PUTTA PALEM

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Annex 1.2: Report on Kakinada Case Study

**REPORT ON THE PARFISH CASE STUDY PROJECT UNDERTAKEN
FOR THE STOCK ASSESSEMNT OF MUD CRAB FISHERY OF CORINGA
MANGROVES IN ANDHRA PRADESH, INDIA.**

By

G. Venkata Raju[1], P.Medley[2], S.Walmsley[3]

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--- D R A F T ---

1 Department of Fisheries, Andhra Pradesh, India

2 Independent Consultant / Marine Resources Assessment Group Ltd?

3 Marine Resources Assessment Group Ltd

INTRODUCTION

With the backdrop of the present system of fishery management prevailing in India in general and in the east coast state of Andhra Pradesh in particular, the importance of effective mechanisms to assess the stocks and derive management programmes to ensure sustainable use of natural resources has gained momentum in the last few years. Existing data collection systems using old and unwieldy practices no longer serve their purposes of informing or convincing at the levels of either policy makers or resource users.

Participatory Fisheries Stock Assessment (ParFish) is a new approach to stock assessment that can be undertaken with the involvement of fishers and managers and in situations where there are limited data available. It uses Bayesian statistics and Decision Theory and does not require long time series of data, but instead uses fishers' knowledge to provide a starting point for the stock assessment. As a result, an initial assessment can be carried out quickly through the use of rapid data collection techniques. Additionally, the approach brings together fishers, managers and other

stakeholders helping them enter a cycle of learning, management planning and implementation, that can support co-management

The proposal for undertaking a case study on stock assessment in Andhra Pradesh, India, was contemplated in the Fisheries Management Science Programme (FMSP) Mangalore workshop on stock assessment tools in September 2004, which introduced the ParFish methodology. It was thought that ParFish would be more relevant than conventional stock assessment techniques to support the preparation of local plans where community based fisheries management and co-management is likely to be the reality. As governments move away from centralised systems for defining fishery regulations, and towards co-management arrangements where resource users and government share responsibility and/or authority to manage, the role of fishermen and other stakeholders in the management of fishery resources will be critical. Tools that support local managers to take decisions on resource management will play a pivotal role in supporting the development and successful implementation of co-management arrangements.

Considering the request of the Department of Fisheries (DOF), Andhra Pradesh, the Marine Resources Assessment Group (MRAG), as part of a project funded by the UK Department for International Development (DFID) under its FMSP, took up a ParFish case study to carry out a ParFish stock assessment of the mud crab (Scylla serrata) fishery in the Coringa mangroves near Kakinada, East Godavari District, Andhra Pradesh, India. The mud crab fishery was chosen as a case study site for ParFish because it is a localised fishery, focused on a small geographical area and was easily accessible to carry out research in the short time period available. Scylla serrata, the edible mud crab is available all along the estuarine regions of maritime states of India. It has good demand in the domestic and export market as its availability in live condition fetches a good price, compared to other species of edible crabs.

Involved in the study were the Department of Fisheries in Andhra Pradesh, the State Institute of Fisheries Technology (SIFT), the United Fishermen's Association (UFA), MRAG and the fishermen themselves.

ABOUT THE CRAB FISHERY

The mud crab (*Scylla serrata)* fishery in the Coringa mangroves near Kakinada, East Godavari District, Andhra Pradesh state, forms an important contribution to people's livelihoods in the area. The crabs are found along the creeks and in burrows in the mangrove areas, and are caught using a variety of gears: hook, baited line, baited ring

Baited line fishing

and stakenets. The crabs are sold both in the domestic market and larger individuals are exported to Malaysia, Singapore and other countries. Few data are available concerning the fishery, but previous studies and information from fishers suggest that the peak season for the fishery is from September to January, and the lean season from February to August. Fishers each use one or more gears to catch the crabs, fish about 20 days each month and catch on average 5kg per day. Information from the fishers suggests that there has been a reduction in catch per unit effort in the last 7 or 8 years, attributed by many fishers to the canals that have been dug in the mangroves aimed at mangrove rehabilitation, which they say have destroyed the crabs' nursery areas. Overall, there seems to have been a change in the size composition of their catches, now catching more smaller and fewer larger crabs. The fishery involves nine villages that border the mangrove area, namely

Crab rings

Pedavalasala, Chinna valasala, Gadimoga, Kothuru, Lakshmi pathi puram, PBV Palem, CBV Palem, Ramanna palem and Chollangi peta, and supports about 5000 fishers.

METHODOLOGY

ParFish is a methodology developed to carry out stock assessments for fisheries where traditional data for stock assessments are lacking. Details of the methodology can be found in the ParFish Toolkit, available from MRAG. Training in ParFish data collection techniques was carried out by Suzannah Walmsley of MRAG in June 2005 with personnel from the Department of Fisheries - Andhra Pradesh, SIFT - - Kakinada, and UFA. The Department of Fisheries, SIFT and UFA held meetings with the fishermen and undertook interviews to obtain information about the number of days they fish and their catch rates.

Initial scoping studies of the fishery were carried out and background information about the fishery was collated from a variety of sources, including scientific papers, workshop proceedings, key informant interviews and stakeholder analysis. Meetings were held with the fishers to introduce them to the research team and the objectives of the study. The ParFish Stock Assessment and Preference Interviews were adapted for the local situation, translated into the local language, Telugu, and tested with a few fishers, after which further modifications were made. A sampling strategy was developed, with stratified sampling across gear type and village, so that the data collected were representative of the range and combinations of gears found in all nine villages in Table 1.

Table 1: number of boats, fishers and gears in each village involved in the crab fishery

Name of Village	Boats	Crab Fishers	Lines	Rods	Stake Nets	Rings
Pedavalasala	350	1200	200	1200	10	1
Chinna valasala	50	250	4	250	10	---
Gadimoga	15	100	1	100	10	6
Kothuru	13	40	10	1	5	3
Lakshmi pathi puram	20	60	4	9	5	1
PBV Palem	20	80	1	35	5	8
CBV Palem	15	65	2	27	2	2
Ramanna palem	20	80	-	20	30	31
Chollangi peta	20	40	-	6	-	30

Total	523	1915	222	1648	77	82

Data collection was then carried out during the period of 27th June – 21st July 2005. 110 stock assessment interviews and 35 preference interviews were carried out. Since the data requirements for the Parfish approach are new and are to be obtained from the fishermen's point of view, the concepts and theories behind the software were provided through a weeklong training to the project team by Ms. Suzannah Walmsley, MRAG consultant. Initially, the team encountered some difficulties in explaining the interview questions to the fishermen for them to understand and be able to answer. However, as the team became more familiar with the questions and the difficulties the fishermen had to understand the questions, the interview process became smoother, easier and

Training to project team

quicker. Through modification and simplification of the questionnaire and by using local examples the team found that many fishermen could reply without any problem.

The main difficulty encountered was that conducting the stock assessment and preference interviews together took a long time (up to two hours, depending on the fisherman and the interviewer),

which was tiring for the fishermen and took up a lot of their time. To combat this, the interview session was divided into two parts, and the stock assessment and preference interviews were conducted separately. After completing one interview, if the fisher being interviewed was happy to continue, the second interview was also carried out.

Though it was felt initially by those conducting the interviews, that the choices of the preference cards by the fishermen were random, and were concerned that the fishers did not understand the implications, it was observed that the

Interviews with fishers

preferences from fisherman to fisherman and from village to village varied and when their reasons for choosing one card over another were explored, the reasons stated by them were very interesting and indicated that they had understood what the cards represented and the implications it would have for their fishing activities.

RESULTS

In the training which was conducted at Mangalore in July 2005 on the use of the ParFish software, the data from the mud crab fishery were analysed. The results indicate the current fishery is close to the point where it is fully exploited. The results also indicate significant greater benefits could be obtained for fishers and others involved in the fishery and fisher support could be obtained for management action. The optimum fishing appears to be approximately 15% lower than currently applied.

However, there is no evidence that the mud crab stock is heavily overfished or that urgent corrective action is required. By not threatening drastic controls to improve the state of the stock, it should be easier to obtain co-operation of the fishers in developing and implementing management measures. The results also suggest that the expected preference of the fishers would favour adjusting effort downwards, which is expected to increase their catch rates. A management system would have to be in place to implement this.

As there was no scientific data available for the analysis, the results represent the interpreted views of the fishers only. In previous case studies, fishers have been found to be over-optimistic as to the productivity of their resource. Further work may suggest lower levels of control. As a result of the training workshop that was held in Mangalore from 25 – 29 July 2005, already the states of Karnataka, Orissa and West Bengal have expressed an interest and intention to use ParFish in their fisheries as well after having observed and discussed the results of the Kakinada case study.

EVALUATION AND FEEDBACK

Subsequent to the Mangalore workshop, a stakeholder meeting was held at SIFT, Kakinada, on 1st August 2005 to discuss the results of the assessment and options for management. The meeting was attended by 54 fishers, the research team, politicians,

Poster released at the Kakinada workshop

researchers, NGOs, fisheries and forest departments officials. The results obtained were explained to the stakeholders in order to get the feedback from all the stakeholders

(presentation given by Dr Paul Medley is attached to the end of this report). A poster (produced in Telugu and shown here in English) to encourage discussion about the present status of crab fishery was released at the meeting. The participants showed interest right from the beginning of the meeting and interacted on the results presented in the meeting by Dr. Paul Medley, Parfish specialist. After thorough discussions and brainstorming on different aspects of fishery and possible management practices, the following points represent the main conclusions.

1. Though there is no immediate danger to the stocks from overexploitation, it has been agreed to the point that some regulations are needed to increase the productivity of the stock size.

2. The M.S. Swaminathan Foundation accepted the point of view of the crab fishers that the channels, which were intended for the restoration of the mangroves, may have destroyed the crabs' nursery grounds, underlining the importance of co-management for the identification of management measures that involve all groups that use the mangrove area.

3. The fishers showed an interest in co-management after hearing the results of the assessment and the options of regulatory measures. They agreed in principle to form a committee to undertake management of the crab fishery. This would enable them to choose regulations which would not negatively impact on their livelihoods.

4. The village elders and fishermen's leaders who participated in the meeting agreed to the implementation of participatory management (co-management).

5. The following are the advantages found in co-management implementation:
   - Ideal size of the stock and limited geographical area;
   - The fishing methods are unique and specific which cannot be undertaken by other than the existing crab fishers easily;
   - There is a strong belief on the resource potential among the fishers;
   - At present, the fishers are enjoying the resources with informal hereditary rights;
   - There is a commitment among the fishers to protect the resources for their benefit;
   - The political support is equally good to sustain the resources as well as livelihoods.

CONCLUSIONS

The study provided an excellent opportunity to explore the status of crab fishery and the means by which the stock could be protected from the dangers of over-exploitation, habitat loss and pollution. The results obtained and the feedback received from the fishers suggest that ParFish is an appropriate stock assessment methodology in comparison with conventional scientific data based methods. ParFish will be a useful stock assessment method where fisheries co-management is implemented and supported by resources users and policy makers alike. The present study has provided us with a starting point for initiating management and involving fishers in the process, which is a key element for co-management. Trip interviews through a year will allow estimates of crab catch rates by size and gear, which is important information for monitoring the fishery and updating the assessments. However, the further evaluation of the crab stock with data from fishing experiments and historical catch-effort information will be needed to design the management programme more precisely through ParFish assessments, thereby improving the livelihoods of the fishing communities.

Presentation given by Dr P. Medley at the workshop at SIFT, on the results of the case study, to fishers, managers, local government and NGOs.

Research Activities

- Compilation of available information
- 21 days for
  - 110 stock assessment interviews
  - 35 preference interviews
- Stock assessment analysis
- Training

Over fished stock

Lightly fished stock

State of the Crab Fishery

Mean 50%   Range 0.1 – 1.0

Slow growth rate

Fast growth rate

Recovery Time

Recovery time: median 2 months range 0-36 months

2
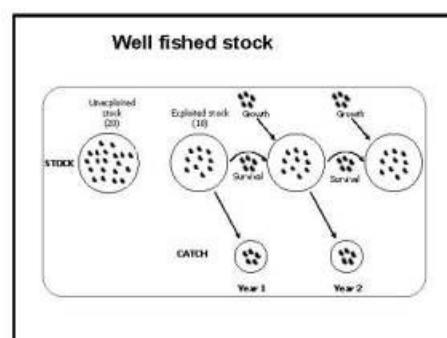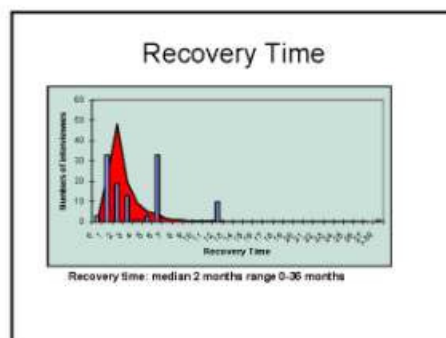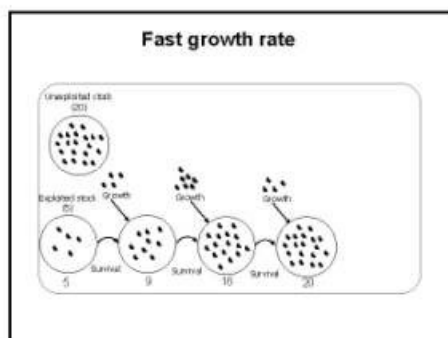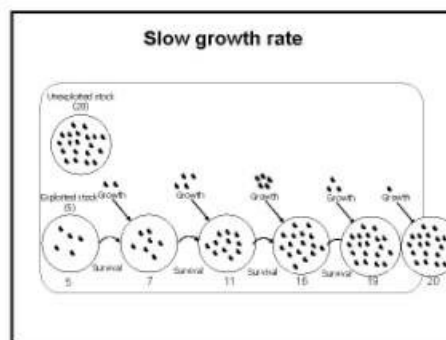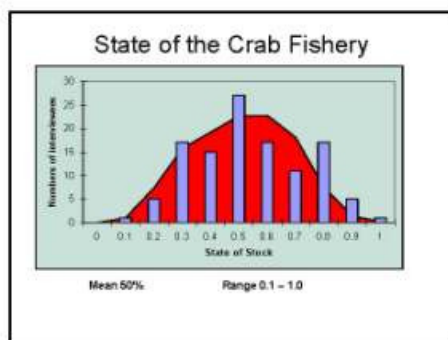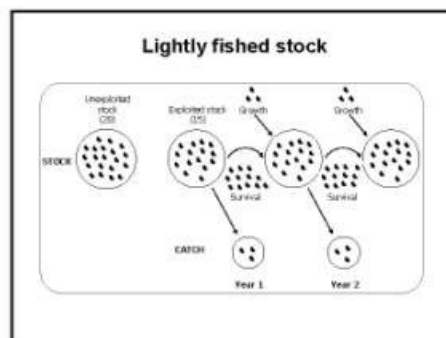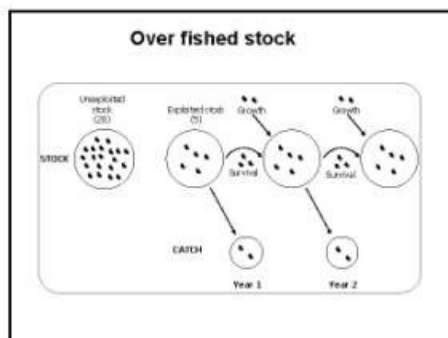
Results

- The stock is **not** heavily overfished
- Interviews indicate fishers would prefer the outcome of lower fishing effort
- Co-management probably best option

Building knowledge
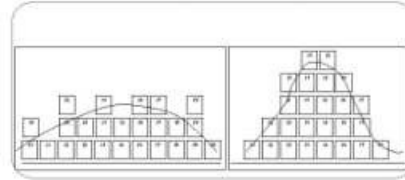
- Monitoring – Experiments - Interviews

Fishery Control Options

- Closed seasons
- Habitat restoration
- Minimum size controls
- Returning berried females
- Effort control
- Closed areas

Benefits of Management

- Sustainable catches
- Improved livelihoods

Additional Benefits of Co-Management

- Community development
- Improved Decisions
- Better enforcement
- Better understanding of resources

3

Annex 1.3: Background Information on Kenya Case Study

PARFISH: Proposed Diani-Chale Implementation
October 2005
CORDIO East Africa / Fisheries Department, Coast Province

Background Planning and Notes:

Context and Initial Site Selection:
The Diani-Chale Area has been impacted to a great extent by tourism and beach based tourism activities and a large portion of it is dominated by beach front tourism and recreational developments. Fisher folk in the area are considered a largely unorganized and disenfranchised group and many have lost their communal and historically owned lands, landing sites and beach access routes to development. Fishing however is still widely practiced in inshore area within and immediately beyond the fringing reef system to meet both subsistence needs with the excess serving small-scale local markets. There are about 12 designated fish landing sites in the area that cover a length of approximately 20 km along the shoreline. Many of these sites are on what is now private land, although the Department of Fisheries, still considers them as designated fish landing stations. The estimated area that is fished is approximated to be about 30 km^2. The individual dynamics and organization of fisher folk varies greatly amongst the landing sites as does the adherence of fishers to government fisheries regulations. Fishers at many sites are divided along lines of gear preference and origin and have formed formal and informal fisher groups to represent their interests. In addition, fishers from many landing sites fish relatively fixed geographic areas with some little overlap in fishing areas with closely associated landing sites. Given these conditions, it is thought that one single PARFISH assessment for the entire area would not be feasible, since there is too much variation and differences in capacity between sites to warrant what we think can be an effective implementation of PARFISH and its results.

In looking to an implementation in Diani-Chale, we have therefore looked at the possibility of a undertaking an implementation at a single site that shows some better organization of fisher-folk and that has potential to follow up on what results a PARFISH assessment may generate. There are at present also other dynamics playing into the management of artisanal fisheries resources in the country that will have a large impact on fisher folk in Diani-Chale. The government intends to gazette regulations relating to the formation and functioning of Beach Management Committes (BMCs). If implemented, BMCs will become the local institution at each landing site that will be responsible for managing various activities related to fishing at the landing sites. This includes area based management measures, under a co-management arrangement negotiated with the Director of Fisheries. In short, these regulations hold immense promise for making use of the results from the application of tools like PARFISH. We feel that the most probable candidate site is the landing site of Chale, on the southern end of the Diani-Chale area (Figure 1). CORDIO has conducted a participatory fish catch and ecological monitoring program at this landing site for the past 7 years, as well as conducted some socio-economic monitoring and resource mapping activities.

Background Information on Chale/Landing Site/Fishing Ground:

Approx. No. of Fishers	
Average No. of Fishers fishing/day	33.75 (northeast monsoon 2004)
	31.875 (southeast monsoon 2005)
Est. Extent of Inshore Fishing ground	3-4sq Km
Most widely Used Gears (NEM 2004)	Bunduki/Spear Gun (33%)

	Jarife (28.5%)
	Malema (25%)
Most Widely used gears (SEM 2005)	Bunduki (60%)
	Malema (19.6%)
	Nyavu (11.8%)
Average Catch/Fisher/Day (2004)	Bunduki 3.6kg/fisher/day
	Jarife 6.0Kg/fisher/day
	Malema 2.1 kg/fisher/day
	Nyavu 3.2Kg/Fisher/day

Top Five Target Species/Gear (BASED ON ALL OF DIANI, do this for Chale only)
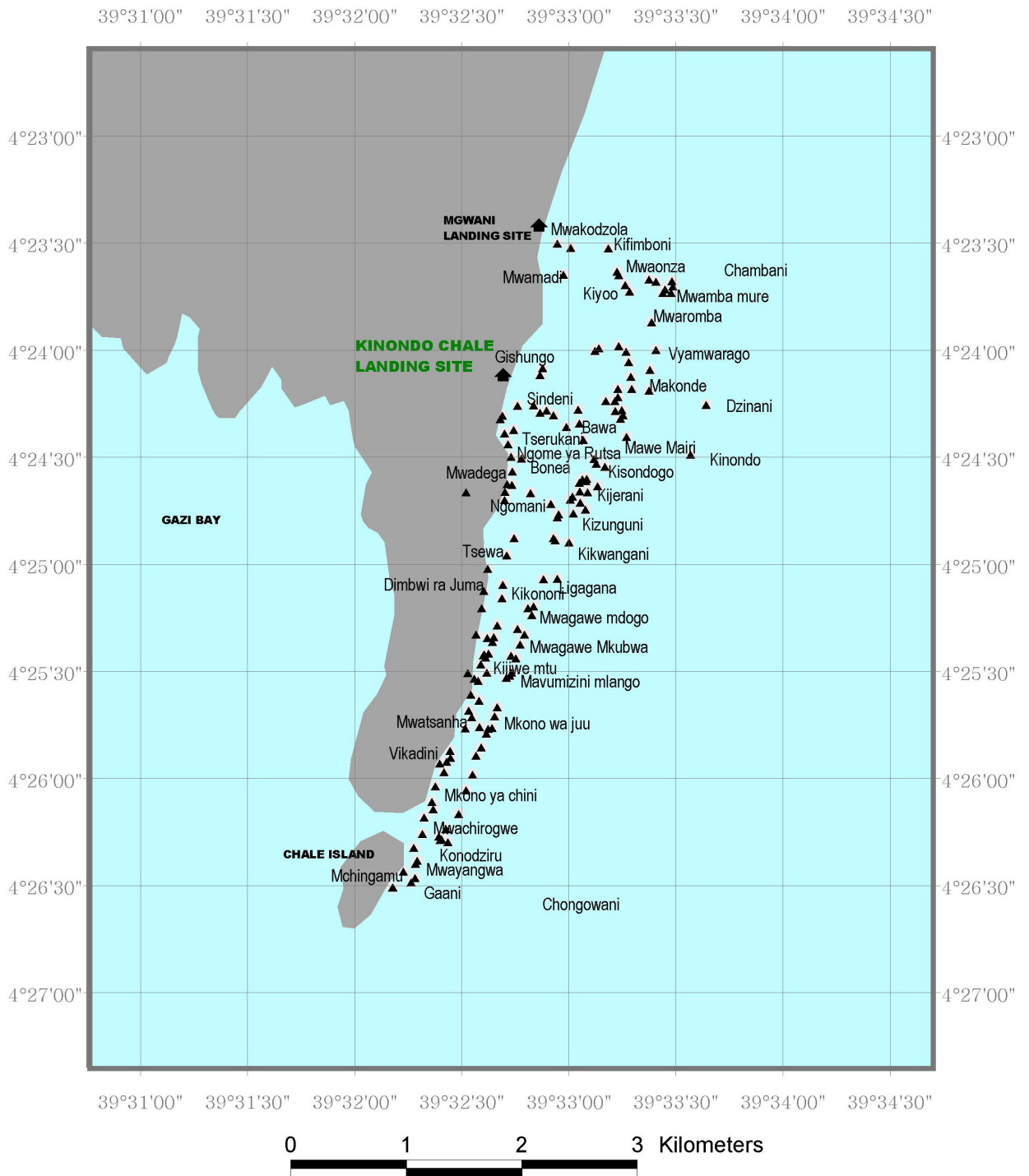Bunduki/Spear Gun: Octopus spp., Parrotfish, Triggerfish, Rabbitfish, Sweetlip/Grunt
Malema/Basket Trap: Rabbitfish, Goatfish, Emperor, Parrotfish, Octopus spp.
Jarife: Trevally, Cusk Eels, Shark, Stingray, Jack
Nyavu: Rabbitfish, Baraccuda, Halfbeak, Indian Squid, Parrotfish

Capacity to date for PARFISH assessment (October 21 2005):
- training of Fisheries Officer in charge (Mr. S. Ndegwa) in meeting in India – COMPLETED
- fisher interviews – NOT YET COMPLETED
- effort data – AVAILABLE FROM CORDIO DATABASE OF 7 YEARS
- experimental/depletion fishing – NOT FEASIBLE AS WHOLE AREA IMPACTED

39°31'00" 39°31'30" 39°32'00" 39°32'30" 39°33'00" 39°33'30" 39°34'00" 39°34'30"

4°23'00"   4°23'00"

MGWANI
LANDING SITE   Mwakodzola
4°23'30"   Kifimboni   4°23'30"
                                        Mwamadi   Mwaonza   Chambani
                                                Kiyoo   Mwamba mure
                                                        Mwaromba

KINONDO CHALE
LANDING SITE   Gishungo   Vyamwarago
4°24'00"   Makonde   4°24'00"
                                Sindeni   Dzinani
                                        Bawa
                        Tserukan   Mawe Mairi
                        Ngome ya Rutsa   Kinondo
4°24'30"   Mwadega   Bonea   Kisondogo   4°24'30"
                        Ngomani   Kijerani
                                        Kizunguni
                Tsewa   Kikwangani
4°25'00"   Dimbwi ra Juma   4°25'00"
                        Kikononi Ligagana
                                Mwagawe mdogo
                                Mwagawe Mkubwa
4°25'30"   Kijiwe mtu   4°25'30"
                        Mavumizini mlango
                Mwatsanha   Mkono wa juu
        Vikadini
4°26'00"   Mkono ya chini   4°26'00"
                        Mwachirogwe
                Konodziru
CHALE ISLAND   Mwayangwa
        Mchingamu
4°26'30"   Gaani   Chongowani   4°26'30"

GAZI BAY

4°27'00"   4°27'00"

39°31'00" 39°31'30" 39°32'00" 39°32'30" 39°33'00" 39°33'30" 39°34'00" 39°34'30"

0   1   2   3   Kilometers

Annex 1.4: Progress Report on ParFish implementation in Karnataka, India

Nethravathy Estuarine Resources Assessment

The river Nethravathi takes its birth in the Western Ghats –Shiradi ghat of Karnataka above Uppinangadi and flows down a distance of 130 km with a gradient of 2000 ft before joining the Arabian Sea off Mangalore at Old Port. Before joining the sea, it joins the Gurupur River flowing southwards to form the Nethravathi-Gurupur estuarine system. The width of the channel can go up to 0.5 km. It has an intrusion length of 19 km with an average depth of 2 m, except at the region of confluence of two rivers, where the depth can go up to 7m during the high tide. The Nethravathi estuary receives large quantity of fresh water from the 3657 km catchment area of the Nethravathi river basin. The waters are laden with a heavy load of suspended matter during the south-west monsoon season.

Participatory Approach to Assess the Resources

In order to assess fishery resources the estuary, we followed participatory approach (Parfish). To begin with, repeated meetings and consultation were organized with societies dealing with estuarine fishers. They are:

(1) Mangalore, Karavali fishermen's Marketing and Processing Cooperative Society®, (2) Nadadoni Fishermen's Cooperative Society

(3) Shree Vyaghra Chamundeshwari Cooperative Society (SVCP)

(4) Hadinaaru Patna Fishermen's Vyavasthapana Samiti (Committee)

The participation in the annual meeting of Mangalore Karavali Fishermen's Marketing and Processing Cooperative Society® gave us an opportunity to establish rapport with the estuarine fishers and to understand their fishing pattern. One of the promoters of the society namely Hadinaaru Patna Fishermen's Vyasthapana Samiti (Committee) agreed to provide the required information of the estuarine fishers who regularly market their catches. We short listed two main organizations namely SVCP and Hadinaaru Patna Fishermen's Committee based on the preliminary information gathered. It was found that 80-90 boats regularly harvest fishes in the estuary and sell the catch in the auction market. Although there are some fishers who market directly, majority of fishers are linked with these two organizations through credit. Thus, initial list of fishers was collected from these two cooperative organizations.

Sampling and Data Collection

Stratified Random Sampling was used with respect to time. The fishers start landing from 7.30 hr onwards until noon. Since we were concerned only with the fishers fishing in the Nethravathi estuary, sampling was confined to only fishers fishing in the

estuary. Thirty fishers were randomly selected from among a total of 85 fisher-members. The selected fishers belong to the communities (Catholics and Mogaveeras). In order to assess day-to-day variation, data of daily catches were recorded initially.

Trend

During the course of personal discussion with the fishers it was revealed that although *Sillago* species (lady fish) is harvested throughout the season, they dominate from November end onwards and reach a peak in December. Catfishes dominate during September to November and mullets progressively increase from November onwards. Based on the catch records for the month of October, the average catch of lady fish is 8.77kg/boat/day, ranging from 1 to 25 kg. The average catch of mullets is 22.06kg/boat /day, ranging from 1 to 75 kg. The average catch of catfishes is 6.17 kg/boat /day, ranging from 1 to 30 kg.

Data Analysis

FISH	RANGE (kg)	MEAN (kg)	NET TYPE
Lady fish	1-25	8.77	Bottom gill net
Mullets	1-75	22.06	Surface gill net
Catfish	1-30	6.17	Either type or cast net

Process of rapport building

At present discussions are being held with the individual fishers to assess the trend in catch rate. However in order to initiate a process of assessing the community opinion on the trend and future scenario, a process of rapport building is required which has been initiated by meeting them in smaller groups. A detailed framework to assess the scenario has been prepared and is being used for collecting the information.

Annex 2.1: Training Workshop Report

![parfish logo] PARTICIPATORY FISHERIES STOCK ASSESSMENT

Application and promotion of FMSP Participatory Fisheries Stock Assessment (ParFish)

Training Workshop Report

St Alyoises College, Mangalore, India
25 – 29 July 2005

MRAG

DFID Department For International Development

Introduction

Small-scale fisheries provide important contributions to the livelihoods of poor people in developing countries through income and food security. Stock assessments are an important component of managing fisheries, but existing methodologies require considerable historical data on the fishery, which are often lacking especially in developing countries. The result is that there is often no information available on which to base management decisions, which can result in the unsustainable exploitation of stocks, leading to associated social and economic problems.

Participatory Fisheries Stock Assessment (ParFish) has been developed to fill this gap by providing a resource-efficient and rapid stock assessment technique that does not require long-term time series data, can be applied with limited resources to provide a starting point for management decisions and contributes to co-management by involving the resource users in setting management objectives, data collection and management planning.

The previous projects R7947 and R8397 developed the ParFish methodology and a Toolkit to assist users in its implementation, consisting of Guidelines, Software, Software Manual and supporting materials. The projects also resulted in considerable interest in the methodology from a range of institutions. This training workshop run under current project R8464 aimed to increase capacity in ParFish in participating institutions and support its promotion and uptake.

Aims of the workshop & Learning objectives

The aims of the workshop were for the participants to:

- Understand the 6 stages of ParFish and how to implement them;
- Have a greater understanding of stock assessment theory and practice;
- Become familiar with the ParFish Software and analysis;
- Become familiar with various participatory techniques;
- Learn about each other's fisheries;
- Consider how ParFish can be applied in their fisheries;
- Provide feedback to improve and refine the ParFish training course and ParFish methodology.

Methods and teaching materials used in the workshop

The training methods employed in the workshop involved a mixture of lectures, practicals, participatory techniques, group work and discussions and computer practicals. All participants were provided with a copy of the ParFish Toolkit, and other teaching materials provided included an imaginary ParFish case study, and various practical experiments.

Participants and Facilitators

There were 14 participants, from a range of Indian state and national level fisheries management, research and teaching institutions from Andhra Pradesh, Orissa, West Bengal, Karnataka and Kerala, and from Kenya. The workshop was run by Dr Paul

Medley, Ms Suzannah Walmsley and Dr Narriman Jiddawi (Institute of Marine Sciences, Zanzibar). Dr Keshavanath (College of Fisheries, Mangalore) made organisational and logistic arrangements for the workshop. See Annex 1 for the full list of participants.

Participants' Expectations and Concerns

Participants were asked to write their expectations and concerns about the workshop on cards, which are summarised as follows:

Expectations

ParFish general	- Learn and understand ParFish - To know what ParFish is: Methodology, How to apply - To acquaint with the technology where the primary data for stock assessment is lacking - To know about the importance and usefulness of the ParFish software - To know its implementation including the fishers (co-management) - To know how ParFish is helpful in assessment of fish stock - To know what is ParFish and in what way it is useful to the fisheries sector - To know the methodology adopted for this stock assessment
Co-management	- Explore the possibility of implementation of co-management - Future plans follow up - Strategies that can be adopted should not hamper the profession in co-management - Better management practices - To study present level of resources exploitation through ParFish - To guide sustainable fisheries management through ParFish - To provide Mgt advice under uncertainty and encourage co-management
Software	- To get acquainted with ParFish software - To know the methodological details (Algorithms) - To have more number of programs to make the software popular - To make it more applicable in Par/comparison with other software available - Familiarise with ParFish software - Learn the difficulties experienced in its implementation - Know the basis behind the models used in its operation - To familiarise with the ParFish software tools
Tools	- To know best practices of ParFish from Zanzibar - How to do stakeholder analysis
Specific case studies	- To know the results of crab fishery that was done in AP - To apply the technique in an island nation - To understand how ParFish can be used in commercial fisheries - To find ways to get more catch to fishermen

Concerns

Concept understanding	- Implementation schedule - Level of interaction (statistical package)

	- Clarity of concepts - More statistics – mathematics
Implementation methodology	- Rest the data generated on crab fishery - Unable to do field work - Adequate financial and logistic support for collection of data from field - Implementation at field level - Positive response for co-management implementation an crab fishery - Data collection, Fisheries development
Reliability and testing	- To manage commercially important fish species exploited heavily - Selection of right software tools for different types of fisheries - Has the technique been tested in any other fisheries - Is it a reliable technique? - The method could lead to subjective conclusions
General logistic of workshop	- Time limitation 5 days too short understand ParFish clearly - Home work
Socio-economic aspects of community	- Poorness, Literacy, Drinking, Vulnerability - Poorness, More population, Less income

Teaching Schedule

A copy of the Agenda for the workshop can be found in Annex 2. A summary of the teaching sessions is provided below.

Introduction to ParFish
Dr Paul Medley and Ms Suzannah Walmsley gave an introductory lecture to ParFish, explaining the potential application of the methodology, data requirements and data collection, statistical techniques underlying the methodology and the participatory framework. The powerpoint slides can be found in Annex 3.

Previous experiences of ParFish
Dr Narriman Jiddawi gave a presentation about the experiences of developing and testing ParFish in Kizimkazi, Zanzibar. Mr G. Venkata Raju (Department of Fisheries, Andhra Pradesh) gave a presentation about the experiences of initiating testing of ParFish in the mud crab fishery in the Coringa Mangroves, East Godavari District, Andhra Pradesh. Presentations can be found in Annex 3.

Introduction to Bayesian Statistics
Dr Paul Medley gave a presentation introducing Bayesian Statistics, uncertainty, probability, decision theory and the theory underlying ParFish. The presentation can be found in Annex 3. Practical and participatory exercises were used to illustrate the concepts, such as estimating the number of oranges in a jar (or lemons in a jug in this case).

Understanding the context and collecting background information
Suzannah Walmsley introduced the first stage of ParFish, understanding the context and what background information should be collected and where to look for it. An imaginary case study had been developed that brings out various important lessons

that have been learnt in previous testing experiences of ParFish. Participants were split into three groups of four or five, with people from different states in each group, and asked to identify what is already known about the case study fisheries, what extra information they would look for or collect before starting to implement ParFish and where they would look for it or how they would collect it.

Dr Narriman Jiddawi led a session on stakeholder analysis, firstly explaining the background and how to do it. Participants then worked in their groups again to carry out a stakeholder analysis of the case study fishery. A similar process was followed by Suzannah Walmsley for the communications plan and the participants carried out the exercise for the case study.

The groups' work for all the above exercises is presented in Annex 4.

Data collection techniques

Interviews
The theory and models behind the stock assessment interview and preference interview were explained, and ways of adapting and presenting the questions to the fishers were discussed. Presentations can be found in Annex 4. The use of the binary tree for ranking the preference cards was explained and participants practiced carrying out the interviews on each other.

Fishing experiments – Box Experiment

A simulation of a fishing experiment was constructed, using a large cardboard box filled with shredded paper (being the area of the fishery, and the shredded paper being the medium, or water). The objective was to explain the principles behind the use of fishing experiments to estimate parameters of the fish stock in the ParFish Software. 35 ping-pong balls were added to the shredded paper, representing the fish stock, 10 of which had been numbered from 1 – 10. The numbered balls represented tagged fish.
A workshop participant was then asked to be a fisher, and to 'fish' for ping-pong balls for six successive 1-minute periods. During each period, he gathered as many ping-pong balls as he could find, which represented the total catch for each day of the fishing experiment.

The results (numbers of ping pong balls found during each 1-minute session) were then used in a modelling exercise to estimate the initial number of ping-pong balls in the box, or rather, the initial population size of the fish stock. The modelling results are shown below. The estimated initial population size was 34.8 ping pong balls.

			N0	q			
0.7	38.57143	36.6675205	34.76361	0.003583			SS
							0.00514092
Day	No. of Fish	Cumulative Catch	Nt	CPUE	Expected CPUE	Squares	
1	9	0	34.76361	0.15	0.124567	0.00064682	
2	5	9	25.76361	0.083333	0.092318	8.0722E-05	
3	2	14	20.76361	0.033333	0.074402	0.0016866	
4	5	16	18.76361	0.083333	0.067235	0.00025916	
5	2	21	13.76361	0.033333	0.049319	0.00025553	
6	4	23	11.76361	0.066667	0.042152	0.00060096	
		27	7.763612				

Generic instructions for conducting the Box Fishing Experiment and the models on which it is based are described below.

Objective
Demonstrate how simple depletion estimation works and how it can be used to estimate catchability and initial population size.

Basic Method
Any box can be used filled with a suitable medium and hidden objects to simulate a closed population which is depleted by fishing. A person over a fixed period should search through the medium for the objects, which he or she retrieves. The retreived objects are removed from the box, and are not replaced for subsequent 'fishing' periods. Over a number of fixed fishing periods, the objects in the box are depleted and the catch per fishing period should decline. This can be used to estimate the number of objects in the box without removing them all, as well as estimate the "catchability" of the objects.

Any box, medium and objects can be used, as long as the objects can only be found with the right difficulty, so that 5 - 7 periods are taken to reduce the numbers of objects to less than 50% of the initial number. This should give adequate level of decline in the catch per period to estimate the parameters.

A successful experiment has been conducted using a cardboard box approximately 60x40x40 cm filled with packing material consisting of shredded paper. The shredded paper was mixed up to avoid the medium clumping and 35 table tennis balls were then distributed reasonably randomly through the medium. Table tennis balls were not too dense so that they moved to the bottom of the box while searching was going on. It was found that 5-10 could be located in about a minute, so a minute was chosen as the standard effort for each fishing period.

The experiment can be set up in any convenient way, and need not involve table tennis balls or a box. A large jar and different types of beans could also be used. In general it needs to be designed so that:

- 30-70 objects are distributed randomly in some medium.
- The fishing is difficult enough so that each unit of fishing catches 5-10 objects at the beginning of the experiment.
- There should be between 5-10 fishing periods. You will need at least 5 fishing periods to fit the population model (5 data points for the regression). The more you have the better, but more than 10 periods may become too time consuming. 7 or 8 have been found to be adequate.
- On average, 60-80% of the total objects are caught by the end of the experiment.
- Only negligible time during the fishing is devoted to other activities apart from searching for balls (e.g. removing the object and placing it in a receptacle) unless the experiment aims to illustrate how effort should be recorded (e.g. the importance of removing handling or processing time from the effort measure).
- The objects which are being searched for can be tagged (optional depending upon whether tagging is being demonstrated).

Six fishing periods were conducted, and the catch was recorded in each period (Table 1). A simple depletion model was fitted to these data in a spreadsheet using Solver. The model can be written as:

$$N_t = N_0 - \sum_{i=0}^{t-1} C_i \qquad\qquad (1)$$

where N_t = the population size at the beginning of period t and C_i = the catch during each period i. The model describes each catch being subtracted from some initial population size which is to be estimated. This represents the simplest population model.

It should be pointed out that when N_0 is set lower than the total catch, the population becomes negative. That is, it is obvious (when pointed out) that the population size must be equal to or larger than the total removals. Also, it can be noted that as N_0 gets very large the impact of the catch on the population becomes very small. The index is therefore unlikely to be able to detect the difference between two large population sizes. This lack of contrast (i.e. no depletion) is a common problem in fisheries data. In fishing experiments we can avoid this problem by ensuring the impact of fishing is significant.

The model can be fitted in this case by minimising the squared difference between the observed and expected CPUE. The expected CPUE can be calculated using the linear formula:

$$CPUE_t = qN_t f_t \qquad\qquad (2)$$

Where q = the catchability coefficient, and f = the optional number of units of effort. If a standard, fixed unit of fishing is applied (e.g. allowing 1 minute "fishing"), f can be left out as it is fixed at 1.0.

Table 1 Spreadsheet set up to analyse the table tennis ball fishing experiment.

			N0	q				Sum of Squares
			32.293336	0.004063				0.00345
Day	No. of Fish		Cumulative Catch	Nt	CPUE	Expected CPUE		Squares
1	9		0	32.293	0.150	0.131		0.00035
2	5		9	23.293	0.083	0.095		0.00013
3	2		14	18.293	0.033	0.074		0.00168
4	5		16	16.293	0.083	0.066		0.00029
5	2		21	11.293	0.033	0.046		0.00016
6	4		23	9.293	0.067	0.038		0.00084
			27	5.293				

This model for depletion can be used to explore several aspects affecting fishing, such as varying the effort time, tagging, handling time, aggregation, natural mortality, immigration and so on. Statistical properties could also be explored, using other log-likelihoods such as the Poisson or different weighting schemes, or mid-period timing for the population.

For example, a simple additional part to the experiment can be added by tagging. Some known number of the balls could be marked, and marked balls recorded when they are caught. Because the number of tagged balls is known at the beginning of the experiment, the population of tagged balls is known throughout the experiment as caught tagged balls can be removed from the total. This improves the estimate of catchability (q), as this is only parameter that needs to be estimated in the tagged population model (see Table 2). The full population and tagging models can be combined by minimising the two log-likelihoods added together.

Table 2 Additional columns which are added to Table 1 to analyse the table tennis ball fishing experiment with tagging. The sum of squares from the tagging model can be added to the sum of squares for the whole model. This combined sum-of-squares can be minimised to estimate the parameters. The tagging data has no direct influence on N0, but is used directly to estimate q.

	N0	q
	32.293336	0.004063

Day	No. of Tagged Fish	Cumulative Tagged Catch	Tagged N	CPUE	Expected CPUE	Squares
1	3	0	10	0.300	0.041	0.067
2	2	3	7	0.286	0.028	0.066
3	3	5	5	0.600	0.020	0.336
4	0	8	2	0.000	0.008	0.000
5	1	8	2	0.500	0.008	0.242
6	0	9	1	0.000	0.004	0.000
		27				5.293

Log-Likelihood and Model Fitting

A more sophisticated approach can be used to illustrate the concept of likelihood and model fitting. In this case, the box experiment would form the practical part of a day developing a single model in detail to illustrate modelling, estimation and Bayesian statistics. The simplest likelihood is the binomial distribution, which can be developed from coin tossing and can be applied directly to the box experiment described above. Instead of using least-squares, a full binomial likelihood function can be written as:

$$L(C_t) = \frac{N_t!}{(N_t - C_t)!\, C_t!} p^{C_t} (1 - p)^{N_t - C_t} \qquad (3)$$

where p = probability a fish is caught and C_t = the observed catch in period t. Not only can a maximum likelihood approach be used to illustrate the use of this function, but it can also be used to illustrate Bayesian estimation, in conjunction with, for example, the method for generating priors below. Note that the factorials (e.g. $N_t!$) can be calculated using the log-gamma function available in a spreadsheet, rather than the factorial function which is likely to cause errors.

Generating Priors

The box experiment can also be used to demonstrate how subjective prior information can be used in estimation. The method follows the same principles and method as that used in ParFish, but can be carried out in a spreadsheet as the data set is likely to be small and there is only one variable.

The method requires asking participants how many table tennis balls are in the box before fishing has begun. Participants should write their own estimate on pieces of paper handed to the facilitator without conferring, so estimates are independent. Participants should use such information as the size of the box to provide their estimate. A minimum of 12 estimates are required, with better results obtained the more estimates that are available. For illustrative purposes, more than one estimate could be illicited from each person, or the facilitator could add some "estimates" in. The estimates should then be plotted in a histogram and displayed to the participants.

It is possible that estimates with little information provided to the participants will vary too widely to form a reasonable prior probability. In this case, the whole process can

be repeated, but with a little more information (e.g. a maximum amount spent to purchase the balls, maximum number of balls and so on) to exclude the wilder estimates. It can be pointed out that wildly varying estimates indicate that there is little prior knowledge and an uninformative prior could be used (e.g. uniform PDF on some reasonable range) instead of opinions.

The individual estimates can be converted to a probability density function (PDF) using the kernel smoothing method. The basic normal kernel function can be written as:

$$\Pr(N_0) = \sum_{i=0}^{n-1} \exp\left(-(N_0 - x_i)^2 / \sigma^2\right)\left(\sqrt{2\pi}\,\sigma n\right)^{-1} \qquad (4)$$

where x_i = the estimate of N_0 of the ith person, n = the number of data (participant estimates), σ = the smoothing parameter which can be fitted by eye for the illustration, and N_0 = the random variable, the initial number of table tennis balls in the box. The smoothing parameter can be fitted by eye using a graph of the PDF in a spreadsheet and trying different smoothing values until a value is found that is large enough so that the distribution is no longer spiky, while still allowing the smoothed PDF to reflect the pattern in the histogram.

The log of the smoothed prior PDF can be added to the likelihood as generated with or without the tagging information and the parameters fitted in the usual way. Applying least-squares in this way is not strictly Bayesian, but will find the mode of a posterior PDF, which could be used as an estimate. Alternatively the more sophisticated binomial likelihood could be employed. In this case, a uniform prior could be applied to the probability of capture (uniform PDF between 0.0 – 1.0) and the subjective prior as developed used for the initial population size. This is fully Bayesian and simple enough so that the prior, likelihood and posterior PDFs can be plotted. The joint distribution with a uniform prior would simply be equation (4) multiplied by a constant value, in this case 1.0 so that volume of the joint PDF adds to 1.0. Again the log-likelihood for the data model would be added to the log of the prior PDF.

Software
A day was spent on the use of the ParFish software. Participants were taken through, step-by-step, the 6 steps of the software, from entering background information, setting up models and drawing posterior samples, checking their data, entering preferences and controls and carrying out the analysis. Each step was explained on the overhead projector and individual support was given to participants throughout. The Turks and Caicos conch data was used as an example. Some participants then moved on to look at the Dimbani data from Zanzibar.

Feedback and management planning
The interpretation of the analysis outputs was explained and ways of feeding back the results to fishers was discussed.

Evaluation of the Workshop
Stage 6, Evaluation of the ParFish process, was discussed.

Evaluation of Workshop
In general, participants felt that their expectations for the workshop had been

satisfied. They expressed a greater understanding of the overall ParFish process, the use of the ParFish software and how and when it can be applied, and how it can support co-management. After being concerned about the reliability and applicability of ParFish at the beginning of the workshop (identified in the Expectations and Concerns exercise), at the final evaluation, participants said they were 90% satisfied that ParFish is applicable and reliable. They also felt that the mathematical background provided was sufficient for software understanding. However, there will often be some participants that would like to go into the underlying models in more depth, and a sub-seminar could be organised on this in future workshops for those interested, while the others continue to practice the use of the software.

Participants felt that the length of the workshop, 5 days, was good, but that more time spent on the software would be useful. The possibility of field work to practice the interviews would also be useful, although this would require a longer workshop. Video footage of carrying out interviews with the fishers (translated / with subtitles) and other data collection activities would be useful for training. Some participants also expressed the need for evidence of the success of co-management and/or the implementation of ParFish for policy makers to adopt the co-management approach.

Annex 1: Participants list

Participants list – ParFish Workshop Mangalore 25-29 July 2005

Name	Position	Organisation	Address	Email	Tel	Checked ?
Dr Satyajit Kumar Bhuyan	Fishery Extension Officer	Orissa State Fisheries Dept	Assistant Director of Fisheries (Marine), Kujanga, Jagatsingpur, Orissa	satyajit99@rediffmail.com satyajit10@yahoo.co.in	09437 160510 06722 236243	yes
Subrat Kumar Dash	Junior Fisheries Officer (Marine)	Dept of Fisheries, Orissa	Jr Fisheries Officer (Marine), Sector 21, Paradeep (Orissa)		094371 83412	Yes
P.Sreeramulu	Fisheries Development Officer	Andhra Pradesh State Fisheries Dept.,	State Institute of Fisheries Technology, Kakinada	sreeramulupaningipalli@yahoo.co.in	9441011836 0884 2378552(o) 0884 2379836(r)	Yes
B.L.Narasimha Raju	General Secretary	United Fishermen's Association	Boddu China venkatayapalem-533461 East Godavari District (AP)		9390209023	yes
P.Ram Mohan Rao	Assistant Director of Fisheries	AP State Fisheries Dept	State Institute of Fisheries Technology, Kakinada-2, Andhra Pradesh	rammohanrao_p@sify.com mohanrrp@hotmail.com	98851-44557	yes

Name	Position	Organisation	Address	Email	Tel	Checked?
G. Venkata Raju	Assistant Director of Fisheries	AP State Fisheries Dept	c/o the Commissioner of Fisheries, Masab Tank, Santhi Nagar, Hyderabad	gvraju_fisheries@yahoo.co.in	9440814708	yes
Stephen W. Ndegwa	Fisheries Statistical Officer – Marine	Fisheries Dept / Cordio East Africa	PO Box 90423, Mombasa (80100), Kenya	ndegwafish@yahoo.com	+254 722 659446 +254 733 488015	Yes
Suzannah Walmsley	Fisheries Consultant	Marine Resources Assessment Group Ltd (MRAG)	18 Queen Street, London W1J 5PN, U.K.	s.walmsley@mrag.co.uk	+44 20 7255 7785	Yes
Narriman S. Jiddawi	Senior Research Fellow	Institute of Marine Sciences (IMS)	PO Box 668, Zanzibar, Tanzania	jiddawi@ims.udsm.ac.tz n_jiddawi@yahoo.com	+255 741 259126 +255 24 2230741	
Paul Medley	Fisheries Consultant	Marine Resources Assessment Group Ltd (MRAG)	C/o- 18 Queen Street, London W1J 5PN, U.K.	paul.medley@virgin.net	+44 1347 838236	yes
Uttam Kr. Panja	Deputy Director of Fisheries	Fisheries Dept, Government of West Bengal	'Meenbhawan' Sepay bazaar, P.O Midnapore, West Bengal	Panja_uttam@sancharnet.in	03222 275610 9434004342(M)	Yes
Dr P. K. Jana	Deputy Director of Fisheries (ME & MS)	Fisheries Dept, Government of West Bengal	Office of the Joint Director of Fisheries (ME&MS), 60A Colootala Street, Kolkata-73, India	wbjdmems@vsnl.net	033 2215 6711	Yes

Name	Position	Organisation	Address	Email	Tel	Checked ?
Dr M. Srinath	Principal Scientist & Head, FRA Division	Central Marine Fisheries Research Institute	PBN01603, Cochin 682018	mudumby@yahoo.com	0484 239 4867	Yes
Dr R.S.Biradar	Principal Scientist & Head, FITET Division	Central Institute of Fisheries Education	Versova, Mumbai 400061	rbiradar@hotmail.com	022 2636 1446	Yes
Prof. K.S.Udupa	Professor of Fishery Statistics	College of Fisheries	Darbar Hill, Padil, Mangalore 575007	udupa47@hotmail.com	0824 2243503	Yes
Prof. N. Jayabalan	Professor of Fishery Biology	College of Fisheries	1-5 3/26 Darbar Hill, Padil, Mangalore-7	maljaya2@yahoo.com	0824 2432328	

Annex 2: Agenda
ParFish Training Workshop
Mangalore, 25 – 29 July, 2005

Agenda

Day 1		
08.30 – 09.00	Registration	
09.00 – 09.15	Opening Ceremony	
09.15 – 10.30	Introductions Participants' expectations and concerns Brief introduction to ParFish and workshop learning objectives	PM/SW
10.30 – 11.00	*Coffee Break*	
11.00 – 13.00	Introduction to ParFish Previous experiences of ParFish - Kizimkazi, Zanzibar (Dr. Narriman Jiddawi, Institute of Marine Sciences, Zanzibar) - Kakinada, Andhra Pradesh (G. Venkata Raju, Department of Fisheries, Andhra Pradesh)	PM/SW NJ GR
13.00 – 14.00	*Lunch*	
14.00 – 15.30	Background to stock assessment and Bayesian Statistics	PM
15.30 – 16.00	*Coffee Break*	
16.00 – 17.30	Practical stock assessment and concepts: key ideas of depletion, biology, modelling and uncertainty.	PM/SW (oranges in jar etc)

Day 2		
08.30 – 10.30	Stage 1: Understand the Context - Background information - Stakeholder Analysis	 SW NJ
10.30 – 11.00	*Coffee Break*	
11.00 – 12.00 12.00 – 13.00	Stage 1 cont. - Communications Planning Stage 2: Engaging Stakeholders - Meetings with fishers, key informant interviews and participatory mapping	SW SW & NJ
13.00 – 14.00	*Lunch*	
14.00 – 15.30	Stage 3: Undertake ParFish stock assessment Planning – what data needs to be collected?	PM
15.30 – 16.00	*Coffee Break*	
16.00 – 17.30	Data collection methods I: Stock assessment interviews	PM

Day 3		
08.30 – 10.30	Data collection methods II: Preference interviews	
10.30 – 11.00	*Coffee Break*	
11.00 – 13.00	Data collection methods III: - Catch-effort data - Fishing Experiments	**PM. Computers needed.**
13.00 – 14.00	*Lunch*	
14.00 – 15.30	Stock assessment techniques: Modelling in MS Excel	**PM. Computers needed.**
15.30 – 16.00	*Coffee Break*	
16.00 – 17.30	Modelling in MS Excel cont.	**PM. Computers needed.**

Day 4		
08.30 – 09.00	ParFish Software introduction: inputs and outputs to the software	PM

09.00 – 10.30	The ParFish Software practical: Data input to Excel and setting up simulation models	**Computers needed.**
10.30 – 11.00	*Coffee Break*	
11.00 – 13.00	The ParFish Software practical cont: Importing data and setting up Probability Models	**Computers needed.**
13.00 – 14.00	*Lunch*	
14.00 – 15.30	The ParFish Software practical cont: Analysis	**Computers needed.**
15.30 – 16.00	*Coffee Break*	
16.00 – 17.30	The ParFish Software practical cont: Analysis and interpretation	**Computers needed.**

Day 5		
08.30 – 10.30	Stage 4: Interpret results and give feedback: Recommendations from the analysis outputs	SW
10.30 – 11.00	*Coffee Break*	
11.00 – 13.00	Stage 5: Initiate management planning: Feeding back results to fishers and building consensus Stage 6: Evaluating ParFish implementation	SW
13.00 – 14.00	*Lunch*	
14.00 – 15.30	Planning ParFish implementation back at 'home'	
15.30 – 16.00	*Coffee Break*	
16.00 – 17.30	General discussion, workshop evaluation and Closing Ceremony	

Evening: Final dinner for participants

Annex 3: Presentations

Management Plans

- Process of developing and implementing a management plan requires institutional support and commitment to co-management

Evaluation

- Aims:
  - To assess what the process has achieved and what we have learnt
  - To learn from the experience and improve planning for future assessments
- Process:
  - Discussions with various groups
  - Independent evaluations

FMSP software

- CEDA, LFDA, YIELD, ParFish

- www.fmsp.org.uk

2

Welcome to the

parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT

Training Workshop

25th –29th July 2005

College of Fisheries, Mangalore

What is ParFish?

- An approach to stock assessment
- Involve fishers and other stakeholders
- Suitable for small-scale fisheries
- Rapid assessment
- Appropriate for data-poor situations

ParFish Process

5. Initiate management planning

4. Interpret results and give feedback

6. Evaluate ParFish process

3. Undertake ParFish stock assessment

1. Understand the context

2. Agree objectives with stakeholders
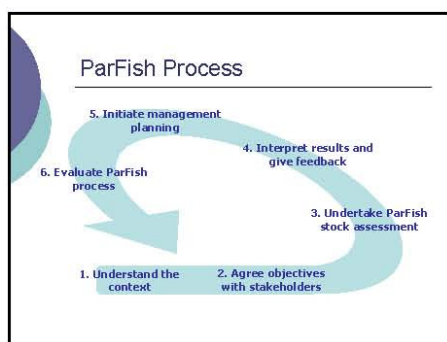
ParFish Toolkit

- Guidelines: guidance for carrying out the process, data collection, assessment and management planning

  parfish

- Software for carrying out the stock assessment and Software Manual

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Overview of the Assessment

Stock Assessment Interviews

Fishing Experiments

Catch-effort

Fisher preferences

ParFish software → State of the fishery resource + Recommended levels of control

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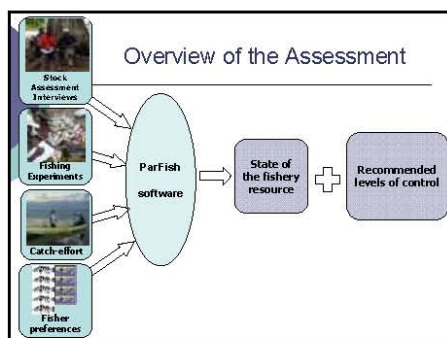
Learning Objectives

- By the end of the workshop, you will:
  - Understand the 6 stages of ParFish and how to implement them;
  - Have a greater understanding of stock assessment theory and practice;
  - Be familiar with the ParFish Software and analysis;
  - Become familiar with various participatory techniques;
  - Have enjoyed yourself !

1

Other objectives

- Learn about each other's fisheries;
- Consider how ParFish can be applied in your fisheries;
- Provide feedback to us to improve and refine the ParFish training course and ParFish itself.

Software Structure
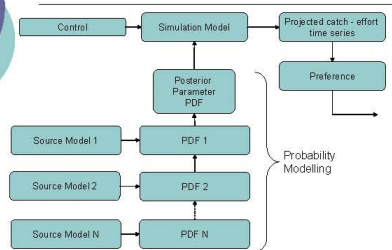
Generating Parameter Probabilities

- ParFish software takes frequency observations, and estimates the underlying probability distribution from which they were drawn
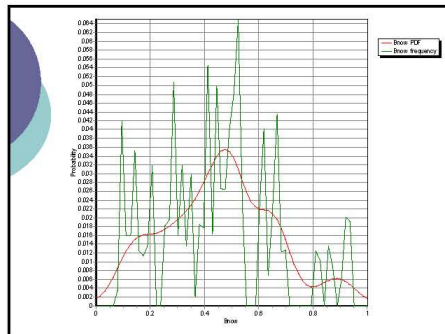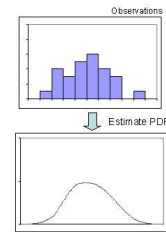
- Probability density functions from various data sources can be combined into a single 'posterior' PDF

2
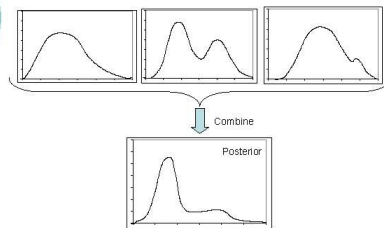
Conventional and Novel Information Sources

- Current version uses logistic (Schaefer) as simulation model: r, B_{cur}, B_{inf} and q_j
- Various data types and sources can be combined e.g.
  - Long term catch-effort data models
  - Interviews
  - Fishing experiments
  - Biological parameters
  - Others?
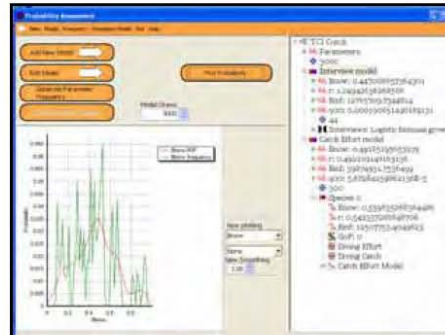
Fishing Experiments

- Estimate population size and catchability
- Fishers concentrate their fishing effort in a specific area, catches and effort are recorded
- Complemented by underwater visual surveys of fish population
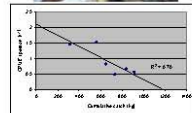
Interviews

- Stock assessment interviews gather fishers' knowledge about the resource and provide a starting point for the stock assessment
- Preference interview indicates how much fishers would like or dislike different outcomes of catch and effort

Utility & Decision Theory

- **Utility** refers to how good something is for someone
- Modelling provides a variety of possible **outcomes** from different decisions

- **Decision Theory** helps us decide which of a set of actions to take, based on their expected utility (probability of happening times cost)
- **Bayes action**:
  Choose the action which will **maximise the expected (average) utility**
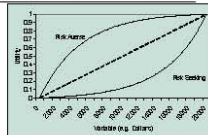
Preference Interviews

- Scenario cards - different levels of catch and effort
- Pair-wise ranking then scoring
- Score indicates 'utility'
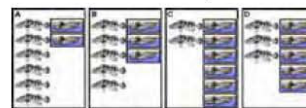
Example pairwise comparison

- Keep current work level in the fishery, but get 25% more income/fish, OR
- Keep fishery income the same, but for 25% less time which could be used for other work.
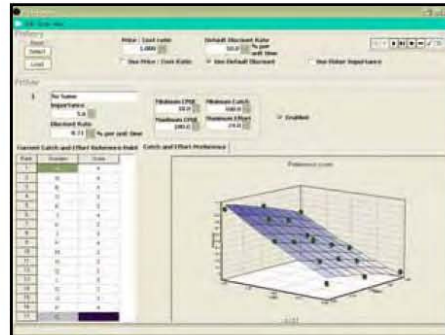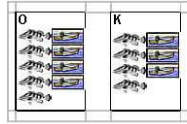
Outputs of Analysis

- Output reference points, fishery states etc. as probabilities
- Limit and target control levels:
  - Recommended (target) control levels
  - Limit control levels with acceptable chance of overfishing

Participatory Framework

- Involve fishers at an early stage
- Helps their acceptance of assessment results
- Participatory framework draws on Adaptive Learning, Participatory Action Plan Development, Consensus Building Methodology, participation literature
- Supports co-management

Understanding the context

- Fishery and management context
- Stakeholder Analysis
- Communications Plan

→ Gather background information

Engaging stakeholders

- Set objectives for the assessment
- Introduce concepts: uncertainty, fish stock dynamics, probability, overfishing
- Participatory techniques

4

Feedback and Planning

- Communicating the results of the assessment to fishers and fisheries management institutions;
- Building consensus on problems and possible solutions for the fishery;
- Developing a management plan or action plan;
- Evaluating the process

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parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT

Next: Nariman

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PARTICIPATORY FISHERIES STOCK ASSESSMENT

Next: PM

Bayesian Approach

A brief introduction

Summary

- Introduction to probability
- Likelihood
- Bayes rule
- Decision theory and utility
- A practical application: ParFish

Mathematical Probability

- Probabilities are between 0 and 1.0
- 0 = impossible
- 1.0 = certainty
- Probabilities often defined as sets of possible events or outcomes
- A set of exclusive events, one of which must occur, sum to one

5

Subjective Probability

○ People assess a risk even without direct observations
○ Some events we may wish to estimate we do not wish to observe, such as nuclear war or overfishing.

Discrete → Continuous
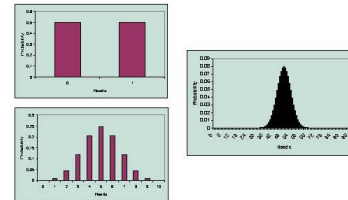
Example Probability Density
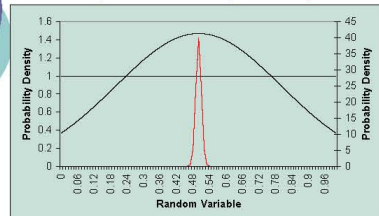
Likelihood

○ Probability when p is known:
  • Pr(H) = p
  • Pr(T) = 1-p
○ Likelihood when H/T is known
  • Pr(p ¦ H) = p
  • Pr(p ¦ T) = 1-p

Binomial Likelihood

$$\Pr(p \mid r\ Heads) = {}^{n}C_{r}\ p^{r}(1-p)^{n-r}$$

$$\text{where} \quad {}^{n}C_{r} = \frac{n!}{r!\,(n-r)!}$$

○ nCr is the number of ways (combinations) r heads could occur in n trials.

Likelihood: 8 Heads 2 Tails

6
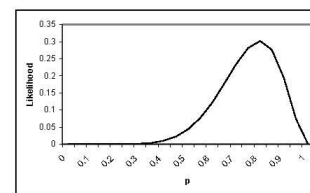
Fishing Experiment

- Population size on day 0 = n
  - We catch C_0 fish on day 0
- Population size on day 1 = n - C_0
  - We catch C_1 fish on day 1
- Population size on day 2 = n - C_0 – C_1

- Population size on day t = n - $\Sigma_t C_i$

Fishing Experiment

$y = -0.1949x + 8.3521$
$R^2 = 0.9033$
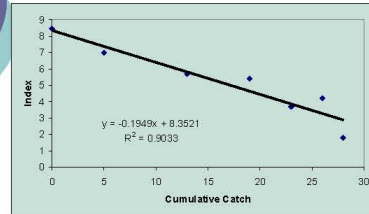
Lake Fishing Likelihood
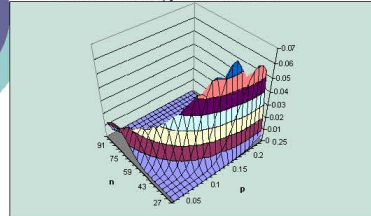
$$\Pr(p,n \mid r\ Fish) = {}^nC_r\ p^r(1-p)^{n-r}$$

Bayes Rule

- Posterior $\propto$ Prior * Likelihood

- $\Pr(p, n \mid Data) \propto \Pr(p, n) * L(Data \mid p,n)$

Updating Using Bayes

$\Pr(p, n \mid Data) \propto$
$\qquad \Pr(p, n) * L(Data1 \mid p,n)*$
$L(Data2 \mid p,n)$

Which gives

$\Pr(p, n \mid Data) \propto \Pr(p, n \mid Data1) *$
$L(Data2 \mid p,n)$

Lake Fishing Experiment

7

Lake Fishing Experiment

Prior for n and p
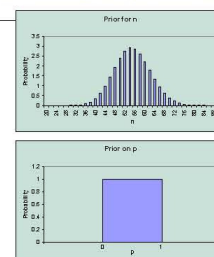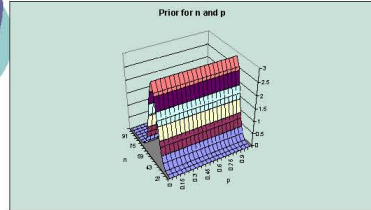
Lake Fishing Likelihood
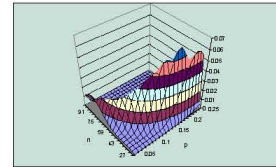
Lake Fishing Posterior
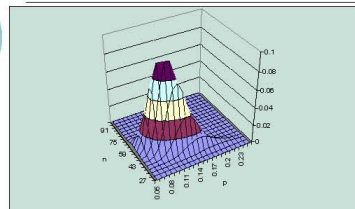
Utility

o Score cost / benefits of outcomes in one dimension
o Not monetary
o Used in economics to manage risk
o Explains why people enter games where they expect to lose money

Example Utility Curves
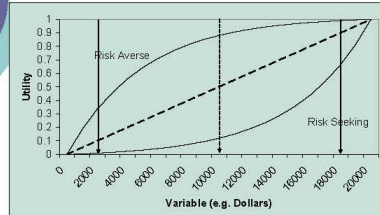
Decision Theory

Combines probability and utility
o Bayes action:
o Choose the action which will maximise the expected (average) utility

8
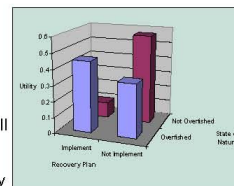
Parfish stock assessment approach on
Coringa mangrove mud crab fishery
in Andhra Pradesh

PRESENTATION LAYOUT

• Selection criteria for fishery

• About crab fishery

• General impression of fishers

• Collection of background information

• Preparation and finalization of data collection system

• Interviews and compilation of data

• Problems during interviews

• Relevance of Parfish tools

• Expectations

SELECTION CRITERIA FOR FISHERY

Crab Fishery has been chosen to apply ParFish tools since:

• It is a small fishery

• Easy to take up pilot study

• Needs immediate attention as it is over-exploited

• Easy to understand and communicate to all stakeholders.

• Easy accessibility

• Small group of fishers

ABOUT CRAB FISHERY

• *Scylla serrata*, the mud crab is available in mangrove and is much in demand in the domestic market and fetches a good price, compared to other species of crab.

• The mud crab fishery is an export oriented.

• Crabs stay alive out of water for a maximum of about 72 hours, and are sent to major cities by train and export by airlift

• crabs are packed in bamboo baskets, each basket accommodating about 20-25 kg.

• Types of Gear employed:
    Rod [Hook]
    Ring
    Lines
    Stake nets

ABOUT CRAB FISHERY

• Peak Season : September – January

• Lean Season : February – August

• No. of Fishing Days : 20 per month
• 90% of the berried females in November – December
• 10% berried females throughout the year
• Egg laying period in May month
• Size distribution
    Small (about 50 g) – in June & July
    Medium (about 150 g) – in August & September
    Big (300 g and above) – in November December

COLLECTION OF BACKGROUND INFORMATION

• Training on stakeholder and situation analysis

• Preparation of key informants formats

• meets with crab fishers in different villages

• visits to fishing grounds

• Met the forest and MS Swaminathan foundation to gather information on the activities taken up for the growth of mangroves

• Information from Fisheries Dept

• BOBP and CMFRI publications

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Name of Village	Boats	Crab Fishers	Lines	Rods	Stake Nets	Rings
Pedavalasala	350	1200	200	1200	10	1
Chinna valasala	50	250	4	250	10	---
Gadimoga	15	100	1	100	10	6
Kothuru	13	40	10	1	5	3
Lakshmi pathipuram	20	60	4	9	5	1
PBV Palem	20	80	1	35	5	8
CBV Palem	15	65	2	27	2	2
Ramanna palem	20	80	-	20	30	31
Chollangipeta	20	40	-	6	-	30
Total	523	1915	222	1648	77	82

DATA COLLECTION SYSTEM ADOPTED

- Field trials were conducted to finalise the appropriate questionnaire

- Questionnaires prepared in two formats
  - Stock assessment format
  - Preference interview format
- Preference cards prepared
- Cooperation for providing data was sought from fishers
- Targeted to collect data from 100 fishers
- Resource mapping

INTERVIEWS AND COMPILATION OF DATA

- Conducted 110 stock assessment interviews

- Conducted 35 preference interviews

- conducted 1 group interview for both stock assessment and preference interviews
- Resource map prepared
- Compiled data in excel sheet
- Poster on status of crab prepared
- Information was kept in website of Fisheries Dept
  www.ap-fisheries.org

PROBLEMS DURING INTERVIEWS

- Understandability of questions is found to be difficult

- Time taken for interviewing the fisher is tedious

- Fishers are panic to certain questions like recovery

time etc,

GENERAL IMPRESSION OF FISHERES

- Increase in the no. of boats / fishers

  (increasing effort)
- Destruction of nursery areas
- Destruction of mangrove areas for shrimp farms and other uses
- Pollution from factories
- Natural disturbances (cyclone, tsunami)
- Cattle no longer allowed to graze on the island resulting in less input of nutrients

RELEVANCE OF PARFISH TOOLS

- Appropriate to the present system of data availability
- Rapid assessment
- Inexpensive
- Participatory
- Enhance the capacity building on fishery

2

EXPECTATIONS

• Testing the data on Parfish software

• Interpret the results with fishers

• Feedback from fishers on management options

• Explore the possibilities of Co-management

• Plan for implementation of a pilot project

3

Welcome to the

parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT

Training Workshop

Day 2

25th –29th July 2005

College of Fisheries, Mangalore

Objectives

- Context and background
  - What background data to collect; how to obtain background information on the fishery; planning stakeholder engagement
- Engaging stakeholders
  - Meetings with fishers; management objectives
- Data collection options for stock assessment
- Stock assessment interview

Characteristics of a suitable fishery

- Sedentary local species (not highly migratory e.g. tuna)
- Fishers responsible for the majority of fishing mortality can be identified
- One or more fishing villages involved (depending on resources)
- Co-management situation or wishing to develop co-management
- Fishery can be spatially defined as a 'management unit'

But …

- Uses tried and tested stock assessment theory and models
- Can be used on any fishery that conforms to the underlying model

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Question:

What background information do we need about the fishery before we start?

How can we get it?

STAKEHOLDER ANALYSIS

- 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:
- Understanding the fishery;
- Identifying stakeholders;
- Therefore: One important aspect in Parfish is to identify which are the individuals or organisations that will be affected by or influenced by fisheries Management

Who is a stakeholder

- 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.
- Eg fisheries Management

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.

Why use it?

- ParFish will succeed by engaging the right people during the different stages of the process who will collect information, understand the assessment, and plan feasible actions. Therefore it is important to do the proccess with various stakeholders eg beach recorders, fishers, etc Can keep updating

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.

Therefore need to do SHA which can help to choose people who will be affected or who have an influence and who could be engaged in various activities

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

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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.

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.

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

○ Indicate the relative priority and influence of each stakeholder

○ Take a sheet and divide into four chambers
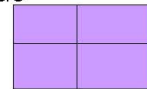
Indicate the relative priority and influence of each stakeholder

Influence is the power which stakeholders have over the process – how much can stakeholders persuade or manipulate (coerce) others into making decisions or doing things?

Priority is the importance given by the ParFish process to satisfying the needs and interest of each stakeholder

○ (H-L) High priority- High influence
○ (L-L) Low priority –Low influence
○ (L-H) Low priority – High influence
○ (H-H) High priority – High influence

Priority and Influence matrix for the Stakeholder Analysis

Priority →	High priority – Low influence (H-L)	High priority – High influence (H-H)
	Low priority – Low influence (L-L)	Low priority – High influence (L-H)
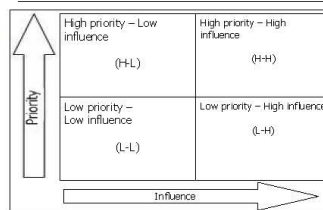
Influence →

Figure 1: Priority and Influence matrix for the Stakeholder Analysis

○ 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.

An example of a table that can be used to record the Stakeholder Analysis

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

Stakeholder engagement plan

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.

Communications plan

- Identify the communications objective for each stakeholder
- Define communications messages for each stakeholder
- Assess appropriate materials for each stakeholder
- Define communication channels
- Define monitoring indicators

Key informant interviews

- Who are key informants?
- What can you find out from key informant interviews?
- How do you prepare one?
  - Who, when, where, what?

Engaging stakeholders

- Techniques for collecting background information also help involve stakeholders

Meetings with fishers

- Concepts
  - Why management is important
  - Why stock assessment is needed
  - Fish stock dynamics and behaviour
- Participatory mapping
- Problem census

What data is needed?

- Interviews
- Catch-effort data
- Fishing experiments
- Other data

Welcome to the

parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT

Training Workshop

Day 3

25th –29th July 2005
College of Fisheries, Mangalore

ParFish Process

5. Initiate management planning

4. Interpret results and give feedback

6. Evaluate ParFish process

3. Undertake ParFish stock assessment

1. Understand the context

2. Agree objectives with stakeholders
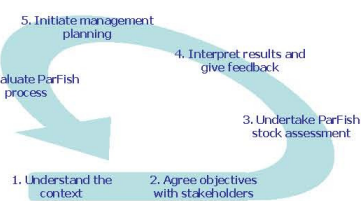
Stock Assessment Interview

- The time, catch and effort units need to be identified and used consistently for all interviews.
  - Month, weight/numbers, days fishing
- The total effort in this fishery over the last year (f_{t-1}).
- For each interviewee:
  - Identify each interviewee's main gear, then last years CPUE (qB_{t-1}) and this year's CPUE (qB_t) for each gear.
  - A catch rate range for the unexploited stock (U_j, U_k).
  - The time for recovery (T).

5

Step 1

o The individual catch rates are regressed towards the mean of the sample. For the *jth* fisher:

$$\left[\hat{q}B_t\right]_j = \left(\left[qB_t\right]_j + \left(\sqrt{N}-1\right)\overline{qB_t}\right)\Big/\sqrt{N}$$

where $\overline{qB_t}$ = mean CPUE of the interviews

Step 2

o Estimate current state of stock based on ratio of current to unexploited catch rates:

$$\hat{q}B_\infty = \frac{U_l + U_h}{2}$$

$$B_{now} = \frac{\hat{q}B_t}{\hat{q}B_\infty}$$

Step 3

o For each fisher, calculate the intrinsic rate of increase (*r*) by solving the non-linear projection equation for the unknown *r*:

$$X_1 = X_0\left(1+r\left(1-X_0\right)\right) \cdots X_T = X_{T-1}\left(1+r\left(1-X_{T-1}\right)\right)$$

$$X_0 = \frac{\hat{q}B_t}{\hat{q}B_\infty}, \quad X_T = \frac{U_l}{\hat{q}B_\infty}, \quad \text{and } \hat{q}B_\infty = \frac{U_l + U_h}{2}$$

Step 4

o With *r* defined, catchability can be estimated from the current catch rate and effort adjusted for stock change due to production and catch:

$$\hat{q} = \left(\frac{\left(\hat{q}B_{t-1} - \hat{q}B_t\right)}{S} + r\,\hat{q}B_{t-1}\left(1 - \frac{\hat{q}B_{t-1}}{\hat{q}B_\infty}\right)\right)\Big/ f_{t-1}\,\hat{q}B_{t-1}$$

Step 5

o Unexploited biomass can be estimated from $(U_l+U_k)/2$ and the estimate of q.

$$B_\infty = \frac{\hat{q}B_\infty}{\hat{q}} = \frac{\left(U_l + U_k\right)}{2\hat{q}}$$

Getting Utility

o Contrast two variables to obtain function shape
o Primary variables are catch (income) and effort (work done)
o Rank various outcomes defined as combinations of variable values
o Score relative difference between outcomes

6

Preference Interviews

- Scenario cards - different levels of catch and effort
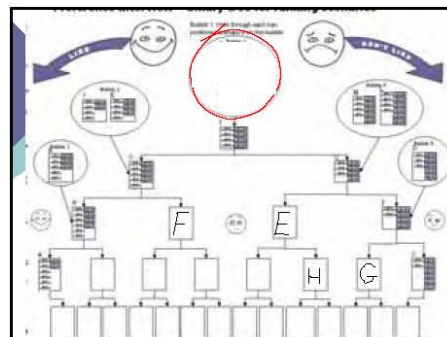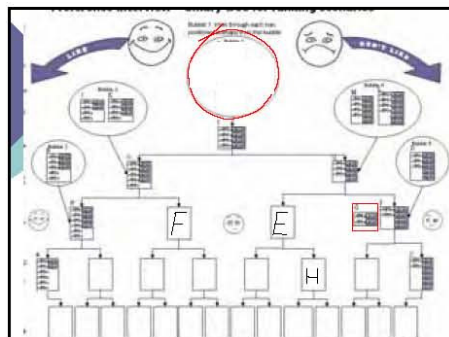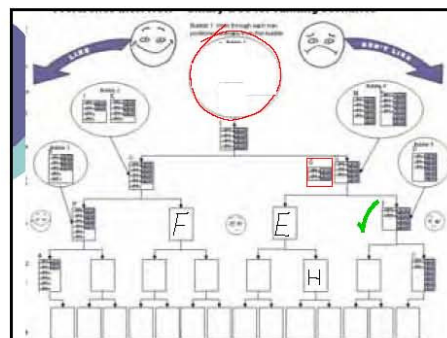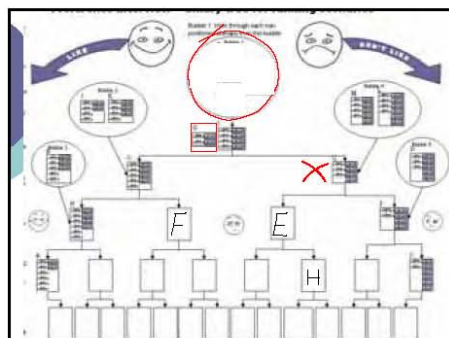- Pair-wise ranking then scoring
- Score indicates 'utility'

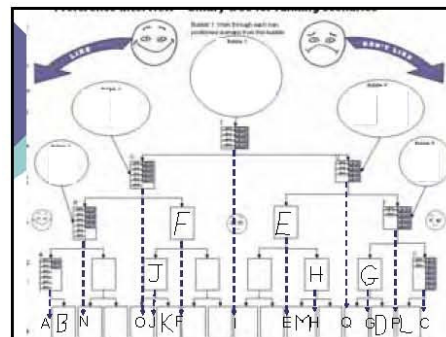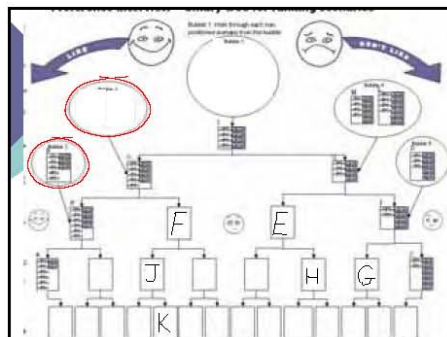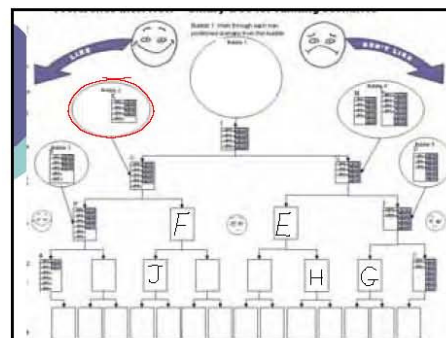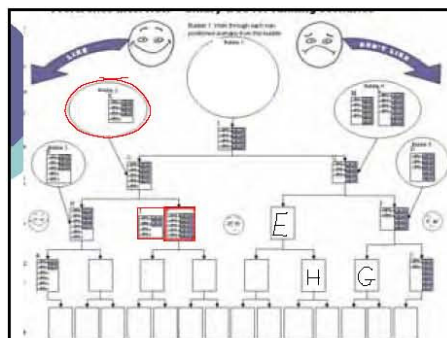
Example pairwise comparison

- Keep current work level in the fishery, but get 25% more income/fish, OR
- Keep fishery income the same, but for 25% less time which could be used for other work.
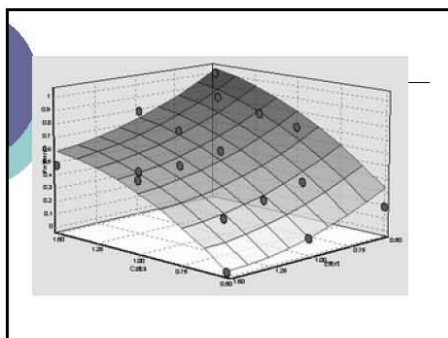
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Example Rank Order

11

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parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT
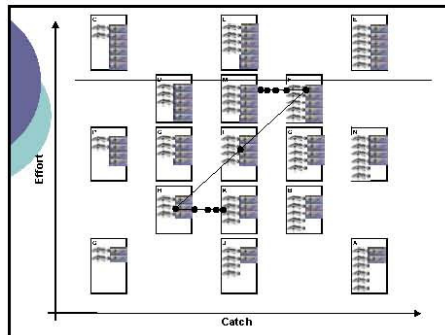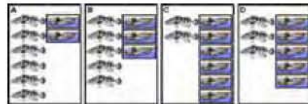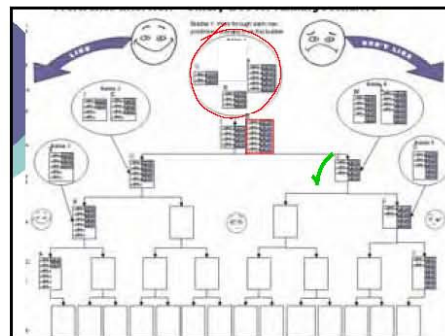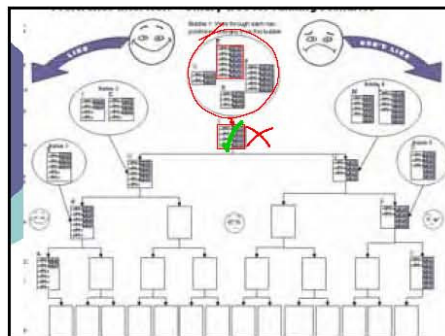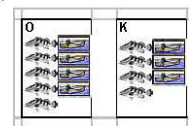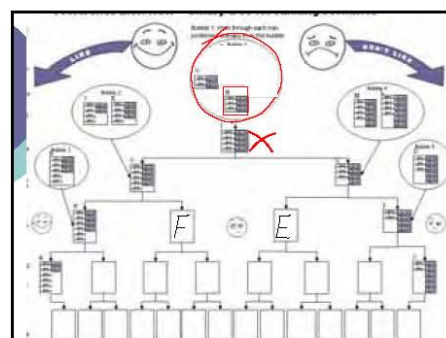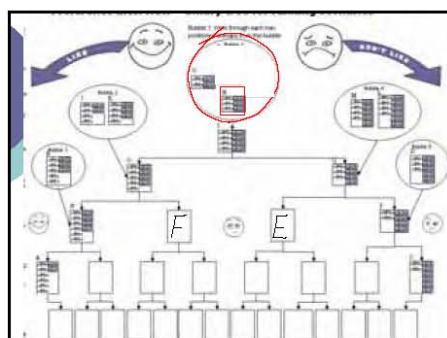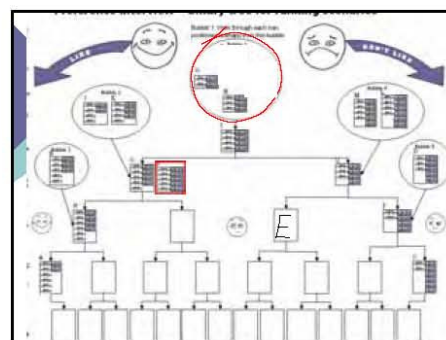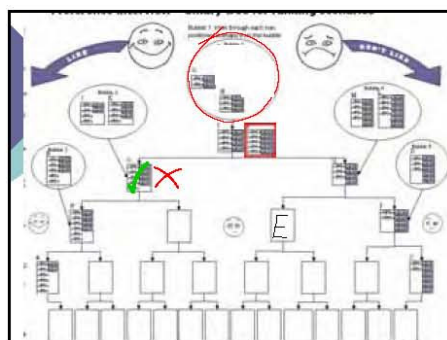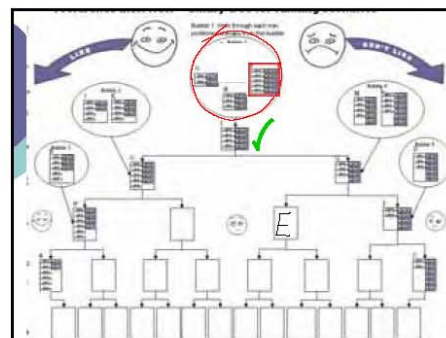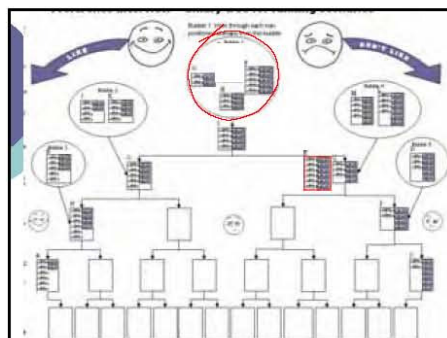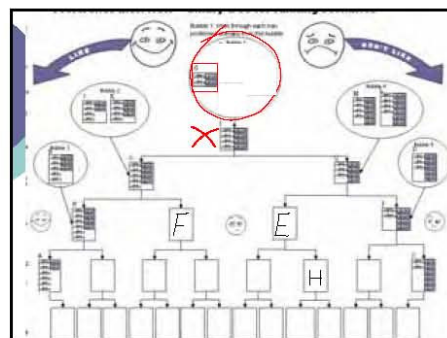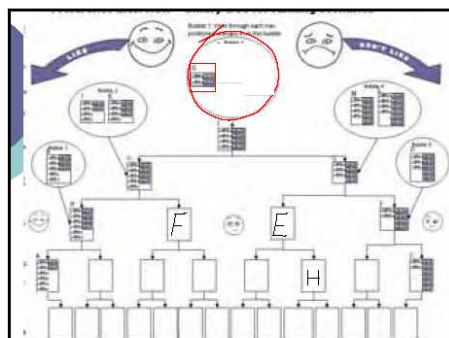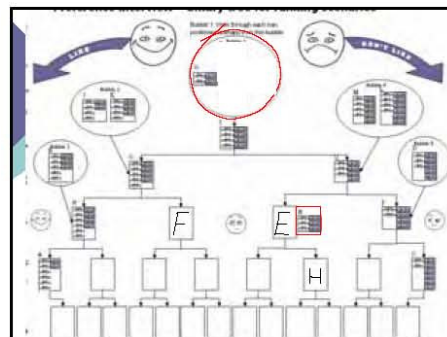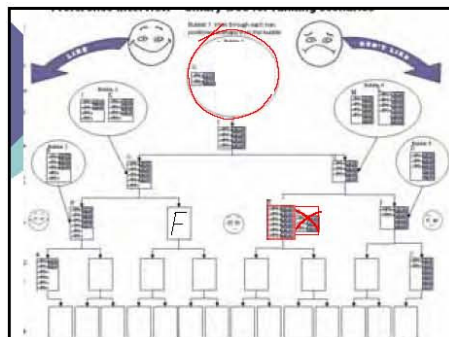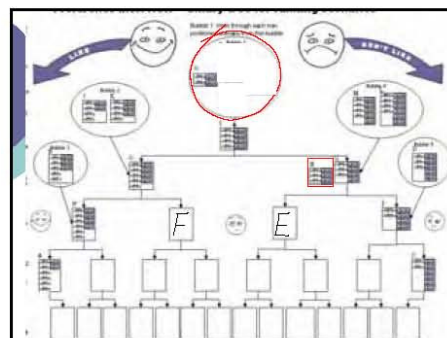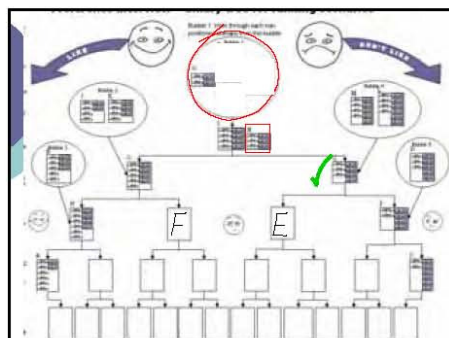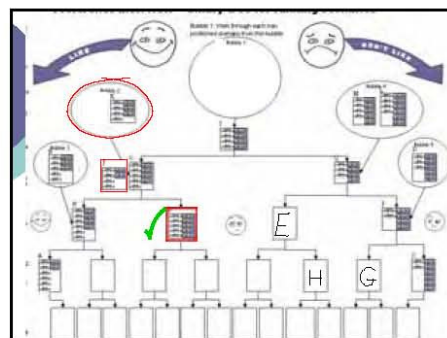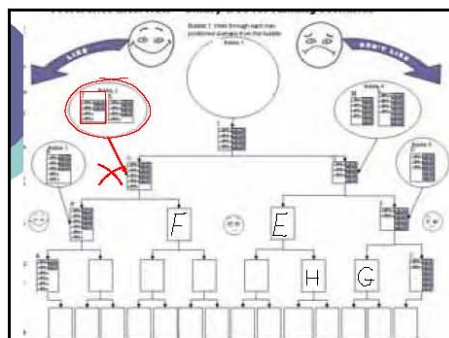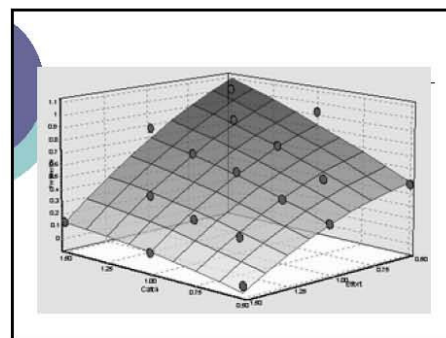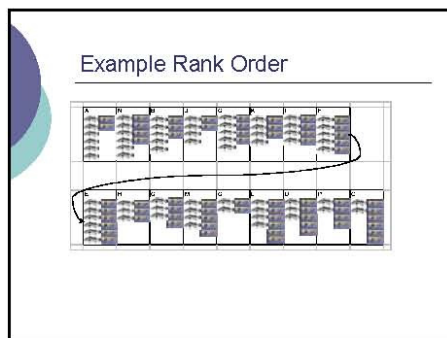
Training Workshop

Day 5

25th -29th July 2005
College of Fisheries, Mangalore

Giving feedback on the results

- Important so that fishers understand the results
- Understanding is necessary for co-management

Review the ParFish assessment

- Recap on how the assessment was carried out
  - Interviews
  - Fishing experiments
  - Catch-effort data

State of the Stock

- Review concepts
- Chance that the stock is overfished
  - recap uncertainty, oranges, number of people that would believe it is overfished
- Is more information needed?
  - What information?

Recommended controls

- Levels of control relative to current situation
- Target control i.e. would be preferred by fishers
- What the expected impact on CPUE would be
  - Use of preference cards
- Compare scientific vs. fisher information

Prioritising issues and developing an action plan

- Workshop process, participatory, all relevant stakeholders involved
- Identify the issues and problems in the fishery, considering the assessment results
- Prioritise and identify possible solutions
- Plan for implementation

1

Management Plans

- Process of developing and implementing a management plan requires institutional support and commitment to co-management

Evaluation

- Aims:
  - To assess what the process has achieved and what we have learnt
  - To learn from the experience and improve planning for future assessments
- Process:
  - Discussions with various groups
  - Independent evaluations

FMSP software

- CEDA, LFDA, YIELD, ParFish

- www.fmsp.org.uk

2

Annex 4: Group exercises

Background information on ParFish case study
After reading the case study the participants were requested to identify the information they would need to do ParFish and where will they get that information

GROUP 1

Information needed	Source of data
Population in each village- men, women, children, migratory fishers	Published material
	Group interviews
Number of fishers- Active/ Part time/ Migratory	Fisheries department
Particulars on crafts and gears, Number and types	Market people
Annual catch statistics, species, gear, craft	NGOs
Seasonality, peak, lean	Hoteliers
Biology of important fishery	Cooperatives
Market information Local and export)	
Management issues if any	
Infrastructure	
Other livelihood opportunities	
Stakeholders involved	
Organisation involved	
Conflict measurement measures	

GROUP 2

Information needed	Source of data
Other livelihoods- Agriculture, Animal husbandry, Tourism Handicraft,	Village elders
	Fisheries department
Types of gear hook and line, traps, nets	Village elders
Type of fisheries-mixed pelagics, demersal, octopus	Fishers (men, women)
Organisation involved fisheries department, NGO, Cooperative society	Other stakeholders
Financier-NGO	
Fishing conflict between Net and trap fisher, large vessels from outside vs local traditional, visiting fishers vs locals, Between villages	
Future scope –scuba diving by men on reefs	
Infrastructure	
Group 2 **Background elaborated by Group-**-4 villages, Fishery important livelihood activity Nearest market (Kanosh),done by women, nearby tourist Hotel (Octopus), exports Control by village elders There is Major road for Kanosh, Minor road for Demosa graded, Tourist lodge	

GROUP 3

Information needed	Source of data
Frame survey Number of fishers No of craft and gears Spatial distribution of fishery Information on species composition Information on actual effort Information on management regime	Published material Other organisations Research and Academic organisations, NGOs, CDOs, Fisheries department, cooperative societies Key informants, fishers other stakeholders Primary data collection Money lenders, financier Internet Maps
Is the fishery suitable for ParFish? (Fishery 3 which is localised and sedentary is suitable but fishery one and two which are mixed gear and migratory arte not suitable)	

STAKEHOLDER ANALYSIS
Stakeholders analysed

Stakeholders' interests and influence
The participants were then asked to categorise the stakeholders into Primary and Secondary stakeholders and write what interests each has in the fishery and in ParFish and whether ParFish is expected to have a positive or negative impact on them.

GROUP 1

Stakeholder	Interests	+ve or-ve impact
PRIMARY		
Fishers	Catching fish sustainable	+
Purchaser	Regular supply	+/-
Fish trader/Vendor	Collection and transport of fish	+/-
Consumers	Availability of quality product	+/-
Financier	Regular income	+/-
Fisheries Department	Sustainability Socio economic development	+
SECONDARY		
Craft makers Gear makers/Vendors Scuba makers	Continued work/business/income	-/+
|Researchers	Data analysis	?
Hotelier	Business	+/-
Village leaders	Village harmony	+/-
Tourusts	Entertainment	?
Policy makers	Sustainability/Socio economic upliftment	+
Coops	Welfare	+
NGO	Capacity building Alternate employment Savings/thrift	?

GROUP 2

Stakeholder	Interests	+ve or-ve impact
PRIMARY		
Local Fishers Traders Dpt of fisheries	Catching fish earning livelihood marketing profits Management Sustainability Welfare	+ + + -/+ + + +
Exporters Migratory fishers Large fishing vessels owners	Marketing (overseas), profits Livelihoods, Catching fish, Catching fish, profits	-/+ -/? -
SECONDARY		
NGO Hoteliers Tourists	Resource sustainability Business Fish food	+ + +
Co-op Crafts and gear makers SCUBA- markers	Livelihood Management Business Business	+ + -/+ -/+
Financial Institutions	Credit facility	+/-
Village leaders	Income, management Dispute settlement	-,- +
Villagers Consumers	Economics of village Food	+ +

GROUP 3

Stakeholder	Interests	+ve or-ve impact
PRIMARY		
Fishers trap net hook and lines octopus	Continue fishing sustainable catch rates livelihood security alternative employment	
Fish traders (including women)	Regular supply Higher marketing margin Less marketing channels	
Consumers	Regular supply Accessibility Cost Quality	
Boat/Net Makers	Increased fishing activity	
Fuel suppliers	Regular fishing without break	
Fishing cooperatives	Higher productivity Greater participation in fishing Socioeconomic welfare and members Avoidance and middlemen	
Large vessel operators	Increased resource utilisation	
SECONDARY		
Migrant fisher	Higher productivity	
Hotels and restaurant	Regular and timely supply of fish at reasonable rate and of good quality	
Tourists	Quality of fish Pristine ecosystem cleanliness	
NGOs	Enhance microfinancing system Welfare activities	

Fishery Department	Evolve management strategies Data collection Ensuring livelihood security	
Scuba supplier	Increased octopus fishery	

The participants then categorised the stakeholders according to their priority and influence each would have on ParFish

Group 1	
H-L Fishers Purchasers Fish traders	**H-H** Fishery Department Policy makers
L-L Consumer Financier Makers of crafts and gears Tourists Hoteliers	**L=H** Village leaders NGO Fisher cooperatives

PRIORITY (vertical axis, upward arrow)

INFLUENCE ---→--------→

Group 2	
H-L Fishers traders exporters NGOs Craft and gear makers Consumers	H-H Fisheries Department Cooperatives Money lenders
L-L Migratory fisher Hoteliers Tourists SCUBA makers Villagers	L=H Large vessel owners village leaders

PRIORITY (vertical axis, upward arrow)

INFLUENCE --→--------→

Group 3	
H-L Fisher traders Consumers Hotel suppliers Hotels and restaurants	**H-H** Fishers Fishery cooperatives NGOs

P R I O R I T Y	L-L Boat and net makers Migrant fisher Tourists SCUBA suppliers	L=H Large vessel operators Fisheries Department
	INFLUENCE --→--------→	

COMMUNICATIONS PLANNING

GROUP 1

Stakeholders	Fishers	Fish Traders	Fisheries department	NGOs/CBOs
Communication objectives	To understand ParFish process Need for S.Ass Data collection methods Results and management	What and why ParFish Data collection	Understand ParFish tools, approach and application Data collection and interoperations of results	Application of Par fish assessment
Communication message	Present state of fish stock through ParFish Results from Data	Present Yield	Planning and management options	Capacity building
Communication material	Village level meetings, posters, handouts, mass media	Meetings, handouts	Training, workshops, publishing material, software	Posters, handouts
Communication channels	NGOs. CBOs Fisheries Dpt (extension), Village meetings. Fishermen's cooperatives societies	Fisheries Dpt, NGOs. CBOs/Associations	MRAG website	Fisheries Department
Monitoring indicators	Meetings attendance and distribution of publicity material	Meetings attendance and distribution of publicity material	Implementation	meetings arranged , number of attendance

GROUP 3

Stakeholders	Fishers	Fish Traders	Consumers	Co-op Soc
Communication objectives	To understand importance of	Sustainable fish supply will	Ensuring regular fish supply and	Par fish will increase

	ParFish to fishery management	be ensured by management through ParFish	easy accessibility	cooperation in the village
Communication message	Guidelines for fisheries management plan and results of ParFish	Inform results and utility of ParFish	Sustainable management ensures sustainable supply	Success story of co-management
Communication material	Interactive meetings, posters, pamphlets, audio video, street plays	Pamphlets and meetings	Posters and Pamphlets	meetings, reports, interviews
Communication channels	NGOs. Co-op Societies, Fisheries Dpt, Local bodies	NGOs. And traders organisations	Radio, TV advertisement	Direct meetings
Monitoring indicators	Attendance in meetings	Intensity of trading activities	Consumer preference? Behaviour	Increase in membership and activity

Example provided by Suzannah	
Stakeholders	**Fishers**
Communication objectives	To understand ParFish process Why stock assessment and management are important Data collection Results of the assessment and management options
Communication message	ParFish is a way of understanding the stock -Results of the assessment
Communication material	Newspapers, meetings, Posters ,Road/street plays
Communication channels	Via NGOs/CBOs/Cooperative Societies
Monitoring indicators	Number of fishers at meetings Number of posters distributed etc

Annex 3.1: Project Flyers

parfish
PARTICIPATORY FISHERIES STOCK ASSESSMENT

Flyer #2   *March 2005*

Introduction

This is the second of a series of flyers giving updates on the development and application of Participatory Fishery Stock Assessment (ParFish).

This flyer covers:

- The ParFish Toolkit;
- Experience of ParFish in Zanzibar & Turks Caicos Islands
- Further use of ParFish in India, Kenya and Gabon.

The ParFish Toolkit

The first version of the ParFish Toolkit has now been completed and is available to any individuals or institutions as guidance to undertaking a Participatory Fisheries Stock Assessment. See contacts below.

The Toolkit consists of the following elements:

ParFish Guidelines: describe the overall approach for implementing ParFish to assist fishers and other stakeholders enter a cycle of learning, management planning, implementation and evaluation

ParFish Software: allows data from the ParFish assessment to be entered and analysed

ParFish Software Manual: explains how to use the software with step-by-step instructions

Experience of ParFish in Zanzibar

ParFish has been used in **Zanzibar** to assess a mixed species fringing reef and a patch reef fishery. The case study has now reached Stage 5 and has involved representatives from the Institute of Marine Sciences, Zanzibar Fisheries Department, and State University of Zanzibar.

Stages 1-3 involved understanding the background to the fishery, engaging fishers and other stakeholders, and data collection. The data was analysed using the ParFish software to provide information on the fishery and a range of management control options.

Results have been fed-back to fishers and other important stakeholders through a series of meetings and workshops in September 2004 (Stage 4).

The ParFish Approach

5. Initiate management planning
- ✓ Build consensus
- ✓ Plan management and enforcement actions and responsibilities
- ✓ Plan monitoring & evaluation criteria

6. Evaluate ParFish process
- ✓ Assess impacts of management actions
- ✓ Evaluate ParFish assessment & data collection
- ✓ Evaluate participatory process

4. Interpret results and give feedback
- ✓ Interpret ParFish assessment
- ✓ Feedback stock assessment results to stakeholders

3. Undertake ParFish stock assessment
- ✓ Identify information requirements
- ✓ Data collection
- ✓ Data analysis using ParFish software

1. Understand the context
- ✓ Assess the fishery and management context
- ✓ Identify stakeholders
- ✓ Identify appropriate communication channels

2. Engage stakeholders
- ✓ Encourage participation
- ✓ Explain ParFish to stakeholders
- ✓ Set management objectives

Management planning (Stage 5) was initiated through a multi-stakeholder workshop in January 2005, involving representatives of fishers, Department of Fisheries, Marine Parks, Department of Environment and local NGOs.

It was first time such a range of stakeholders had jointly discussed the Kizimkazi fishery and a number of options for management and recommendations were outlined. Examples include controlling the number of fishers, improving patrols, establishing a community based organisation, developing alternative livelihoods such as seaweed farming and providing environmental education. Further meetings will be required to prioritise and agree actions, taking into consideration the results of the ParFish assessment and the opportunities to improve the results with further data collection.

Experiences of ParFish in the Turks & Caicos Islands

In the **Turks and Caicos Islands** the conch fishery was assessed using the ParFish Software.

Data inputted into the software included fisher interviews and available catch and effort data.

The assessment revealed that the current quota for the fishery is adequate and fits with the optimal control level suggested by ParFish.

It also illustrated that using fisher interviews alone produced a sensible result that could have been used in isolation if catch and effort data had not been available.

The case study indicated that if ParFish had been used 30 years ago using only fisher interview data it would have prevented the crash in conch stocks witnessed in the 1970s.

Further use of ParFish in India, Kenya and Gabon

Following on from the successful use of the ParFish approach in Zanzibar and the Turks & Caicos Islands, the DFID FMSP programme is supporting further testing of the approach in India, Kenya and Gabon.

Training in the ParFish approach will be given to a number of fisheries departments in India followed by a case study within a selected fishery in Andhra Pradesh.

This is being conducted in partnership with the Andhra Pradesh Fisheries Department and the Bay of Bengal Programme Intergovernmental Organisation (BOBP-IGO).

The Andhra Pradesh Fisheries Department is looking for tools to support the development of a co-management framework for coastal fisheries and BOBP-IGO is keen to see if lessons learned from this case study can inform the other states in the Bay of Bengal region.

The ParFish software will also be further tested using data collected from fisheries in Kenya, in partnership with CORDIO (Coral Reef Degradation in the Indian Ocean Project) and in Gabon in partnership with the WCS (World Conservation Society).

CORDIO is currently working in Diani to support monitoring programmes and a developing an Integrated Coastal Area Management Institution. WCS is working in Gabon to support sustainable fisheries management.

Obtaining the ParFish Toolkit

To obtain a copy of the ParFish Toolkit:

1. Request electronic or hardcopy versions of the Toolkit from MRAG (see contacts below);

2. Download the Toolkit from FMSP website: http://www.fmsp.org.uk [Go to Current Projects and search under R 8464: Application and Promotion of FMSP Participatory Fisheries Stock Assessment.]

Further Information

For further information, also request or download:

- ParFish Flyer 1 (September 2004): gives an overview of the ParFish Approach

- ParFish Brief 1 (September 2004): describes the scientific background to ParFish

- ParFish Brief 2 (March 2005): describes the relevance of ParFish to management
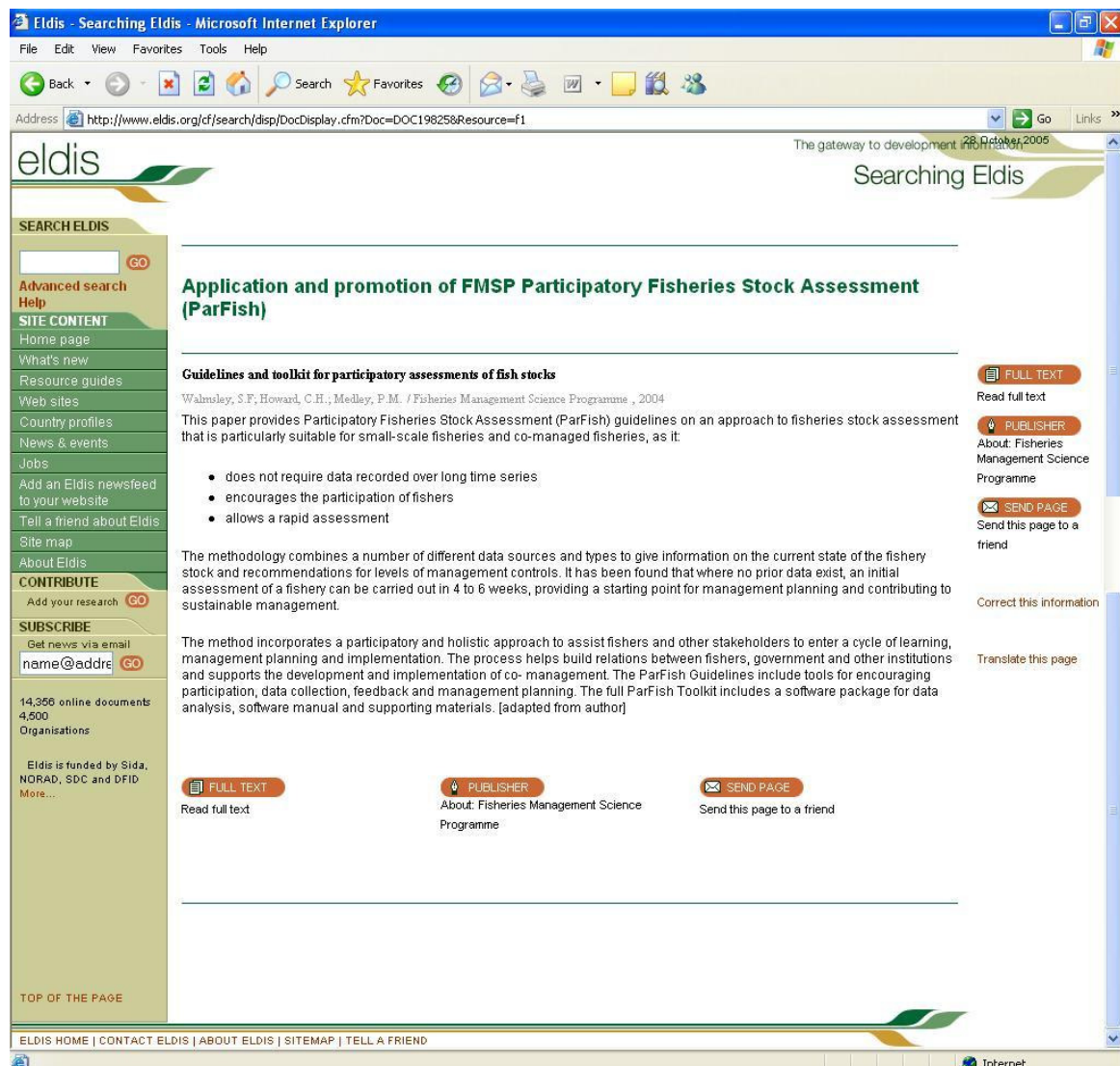
CONTACT DETAILS

For further information or to give feedback please contact:

- **General queries:** Suzannah Walmsley or Charlotte Howard, MRAG (s.walmsley@mrag.co.uk, c.howard@mrag.co.uk Tel: +44 207 255 7755)

- **Zanzibar queries**: Dr Narriman Jiddawi, IMS (jiddawi@ims.udsm.ac.tz Tel: +255 24 2232128)

- **Software queries:** Dr Paul Medley. (paul.medley@virgin.net)

parfish

PARTICIPATORY FISHERIES STOCK ASSESSMENT

Introduction

This is the third in a series of flyers on the development and application of a Participatory Fisheries Stock Assessment methodology.

ParFish is an approach to fisheries stock assessment which uses Bayesian statistics and multi-criteria decision-making theory, and provides a tool for involving fishers in the management process (see Flyer 1).

ParFish can be used where there is a lack of long-term data, and can use a range of information sources including local knowledge. The approach is participatory and looks at the most preferred outcomes for fishers. It provides management recommendations based around controlling effort, quotas or closed areas.

The **ParFish Toolkit,** comprising a set of guidelines, software and software manual, is available for individuals or institutions interested in undertaking a Participatory Fisheries Stock Assessment (see reverse of flyer).

Andhra Pradesh Case Study

The crab fishery

The focus of this case study is the mud crab (*Scylla serrata*) fishery in the Coringa mangroves near Kakinada, East Godavari District, Andhra Pradesh. The crab fishery forms an important contribution to people's livelihoods in the area, involving nine villages bordering the mangrove belt and supporting 5000 fishers.[1]

The importance of the crab fishery in India

In India, the crab fishery is small scale and is based mainly on capture fishery, providing substantial income to the artisanal fishing households. *Scylla serrata*, the edible mud crab, is available along the estuarine regions of maritime states of India. It has good demand in the domestic and export market and its availability in live condition fetches good prices.

Why is ParFish needed for the crab fishery?

In recent years there has been a gradual reduction in the landings of the mud-crab. This is likely to be due to increased levels of fishing effort and environmental changes, leading to over-exploitation.

ParFish will be used to provide a participatory method for assessing the stock and involving fishers in collecting data and developing management plans to improve landings.

Current progress

The Department of Fisheries in Andhra Pradesh, with the State Institute of Fisheries Technology (SIFT), the United Fishermen's Association (UFA), Marine Resources Assessment Group (MRAG) and the fishermen themselves, are carrying out a stock assessment of the fishery, using the ParFish approach,

The Department of Fisheries, SIFT and UFA have held meetings with the fishermen and have carried out interviews to obtain information about the number of days they fish and their average catches.

During a training workshop, held in July, the data was analysed. The findings will be communicated to the fishers, and the management options discussed.

2005 HIGHLIGHTS

◊ ParFish presented to FAO, May 2005

◊ ParFish Toolkit completed & distributed, July 2005

◊ Training on ParFish held in India, July 2005

◊ ParFish applied in the mud crab fishery, Coringa Mangroves, Andhra Pradesh, June – September 2005

◊ ParFish planned in Diani, Kenya with CORDIO and the Dept of Fisheries — August 2005

◊ ParFish planned in Gabon, West Africa, September 2005

◊ ParFish considered for lake fisheries in Cote d'Ivoire, West Africa, September 2005

◊ ParFish planned for use in World Bank funded projects, Tanzania - August 2005

1 Studies conducted by Bay of Bengal programme (BOBP) and Central Marine Fisheries Research Institute (CMFRI)

Where else has ParFish been tested?

ParFish has been tested in:

Conch fishery in Turks and Caicos, Caribbean

This case study provided recommendations on altering fishing quotas and allowed the method to be tested with a long-term time series of catch and effort data.

Mixed reef fishery, Zanzibar

The Zanzibar case study provided recommendations on levels of effort. The participatory approach of the assessment built understanding of the fishers and the fisheries department, and provided a basis to begin discussions on management planning for the fishery.

ParFish Training workshop

A ParFish training workshop was held in Mangalore from 25th to 29th July 2005. The workshop included 14 participants representing fisheries departments and research organisations from Andhra Pradesh, Orissa, West Bengal, Kerala, Maharashtra and Karnataka in India, Tanzania and Kenya.

The five-day workshop covered an overview of stock assessment and Bayesian statistics, the scientific background and ParFish software, participatory methods, analysis, management planning and providing feed-back to fishermen.

For further information on training or training materials please email one of the contacts at the end of this flyer.

Obtaining the ParFish Toolkit

There are two ways of obtaining a copy of the ParFish Toolkit:

1. Request electronic or hardcopy versions of the Toolkit from MRAG (see contacts below)

2. Download the Toolkit from the FMSP website: http://www.fmsp.org.uk and select 'Software Downloads' or http://www.ahj00.dial.pipex.com/FTRs/r7947.

Further Information

For Further information also request or download:

*   ParFish Flyer 1 (September 2004): gives an overview of the ParFish Approach

*   ParFish Brief 1: September 2004: describes the scientific background to ParFish

*   ParFish Brief 2: March 2005: describes the relevance of ParFish to management

CONTACT DETAILS

For further information or to give feedback please contact:

*   **General queries:** Suzannah Walmsley or Charlotte Howard, MRAG (s.walmsley@mrag.co.uk, c.howard@mrag.co.uk Tel: +44 20 7255 7755)
*   **India queries:** Mr G. Venkata Raju, Andhra Pradesh Department of Fisheries (gvraju_fisheries@yahoo.co.in)
*   **Zanzibar queries**: Dr Narriman Jiddawi, IMS (jiddawi@ims.udsm.ac.tz. Tel: +255 24 2232128)
*   **Software queries:** Dr Paul Medley. (paul.medley@virgin.net)

Annex 3.2: Eldis website dissemination of ParFish Toolkit

Annex 3.3: FMSP Poster

Annex 3.4: Newspaper article on Andhra Pradesh workshop

Call for concerted strategy to conserve mangrove crabs

Seminar expresses doncern over depletion in population

Correspondent

KAKINADA: The need for taking effective steps to conserve the brackish water crabs, Scylla Serrata, popularly known as 'Manda Peetha,' which grow in mangroves along the coastal areas and whose population is dwindling in recent years, was suggested by several speakers at a seminar held here on Tuesday under the auspices of the State Institute of Fisheries Technology.

Representatives of fishermen societies and non-government organisations participating in the deliberations expressed concern over the depletion of the Manda Peetha population and the plight of fishermen who depend on them for their livelihood. Studies taken up by the Fisheries Department in cooperation with the Department for International Development of UK, Marine Resources Assessment Group (MRAG) in the name of participatory fisheries stock assess-

- Experts for better managerial practices
- Conservation important in view of good revenue potential
- Fishermen asked to follow advice of scientists

ment and the information gathered were explained to the participants.

Managerial practices

The MRAG fisheries specialist, Paul Medlay of the UK, while giving a power point presentation said that better managerial practices could ensure conservation and proliferation of the Manda Peetha population.

The Joint Director of Fisheries and also the incharge Principal of the State Institute of Fisheries

Technology, Y.Prakasa Rao, who chaired the seminar, said that fishermen should unitedly strive for developing the Manda Peetha population that grows in the mangroves along the coast.

He said the Manda Peetha fetches a good income to the fishermen. He said special meets were being conducted to create awareness among the fishermen on conservation of the marine seed. Marine fisheries Joint Director Ch Seshasayana Rao said the Manda Peetha yields better revenues on the lines of prawns and lobsters. DRO Suryanarayana advised the fishermen to follow the advice of scientists in the conservation of the Manda Peetha population.

Local MLA Gopalakrishna and Thallarevu MLA Dommeti Venkateswerlu said nine fishermen villages were dependent on the Manda Peetha catches for their livelihood and every effort should be made for developing these mangrove crabs.

Annex 3.5: Feedback from FAO FishCode STF

Some comments on ParFish

Recently (September 2005) FAO in collaboration with WorldFish Center organized a workshop on the development of Interdisciplinary Approaches to the Assessment of Small-Scale Fisheries. This as it is recognized that many small scale fisheries, particularly in developing countries are not well monitored and consequently not adequately considered in the development of plans and policies for fisheries. Therefore the development of cost-effective methods for acquiring and validating data on small scale and multi species fisheries, including rapid appraisal methodologies and other approaches for data-poor situations and participatory processes that closely associate fishers and their organizations to data collection schemes is urgently required.

The development of ParFish fits exactly in this process and ParFish can be considered as the one of the first tools available and the initiative to develop it should be highly acknowledged.

However, there are some critical points to address in ParFish, some of them were discussed with the Developers of ParFish during a presentation of ParFish at a meeting in Rome

- The selection of a Surplus Production model as the internal mathematical model behind ParFish. Using this model on reef fisheries in most cases automatically leads to successful depletion experiments as was the case in the Dimbani experiment presented. However this can be misleading as applying ParFish in a non reef fisheries would not automatically lead to similar results.
- ParFish has been tested in two field cases only, it is realised that budgetary restrictions are the reason for this but it still leads to a major concern: Is ParFish tested and validated enough and ready for distribution ?

It is my personal feeling that the latter is not the case and that further development of ParFish should be supported through:
- More extensive field testing in different type of fisheries
- Validating the results of ParFish in data-rich situations
- Investigate if alternative mathematical models can be used

Rome, 28/10/2005

Dr. Gertjan de Graaf
Senior Projects Management Officer
FishCode Programme
FAO Rome

Annex 3.6: ParFish Synthesis Document

parfish

PARTICIPATORY FISHERIES STOCK ASSESSMENT

Synthesis Document

Fisheries management decisions with **limited resources** and **data**
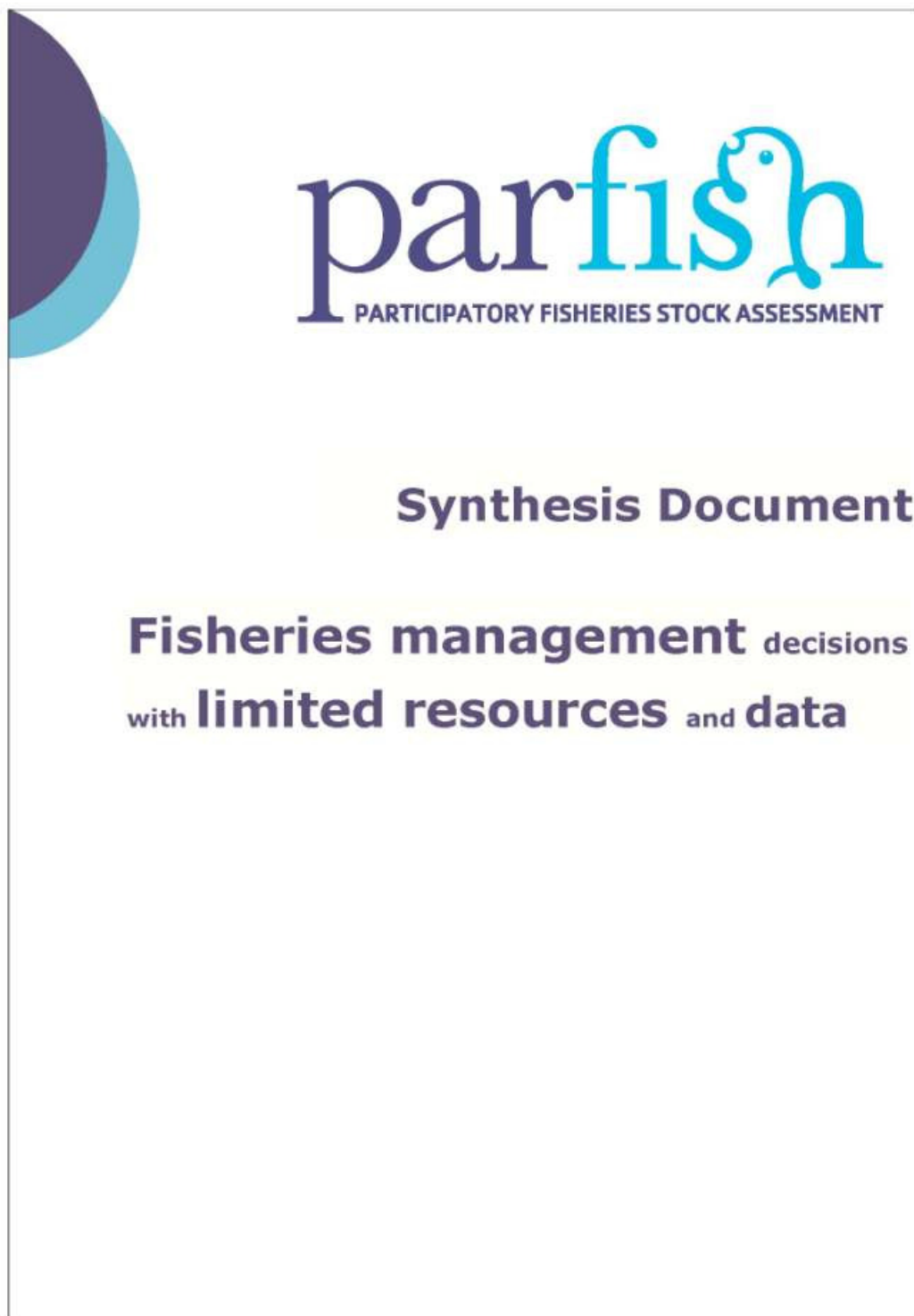
Fisheries management decisions with limited resources and data

The aim of this document is to:

Draw attention to the importance of small-scale fisheries and the need for information-based management;

Raise awareness about ParFish, a new methodology for carrying out stock assessments in small-scale fisheries that does not rely on long-term data, involves fishers in the assessment and promotes co-management;

Outline recommendations for managers, policy makers, scientists and facilitators, to improve information-based management decisions for small-scale fisheries.

This document is aimed at:

Fisheries decision-makers, scientists, managers and facilitators, including government and non-government organisations.

Contents:

Summary

Fisheries management decisions with limited resources and data

Key points:

- *Small-scale fisheries are important to livelihoods but often lack resources for information collection and management;*

- *ParFish is a new approach to stock assessment that is suitable for small-scale fisheries and promotes participation and co-management*

- *More information and the ParFish Toolkit can be obtained from www.fmsp.org.uk*

Fisheries play a vital role in the livelihoods of millions of people and provide the main source of animal protein for nearly one billion people, predominantly in developing countries. An estimated 100 million people depend on fishing, many of them among the world's poorest, and small-scale fisheries are particularly important for employment and income generation in rural areas.

The valuable contribution that small-scale fisheries make to people's livelihoods and the economy are often not taken into account. This results in many small-scale fisheries being under-represented in fisheries policy and lacking the resources required for effective management. Information is key to sound policy making and responsible fisheries management, to maximise the benefits that fisheries can provide to livelihoods and the economy. The FAO Strategy for Improving the Status and Trends of Capture Fisheries highlights the need for improving data and information for the small-scale fisheries sector.

Stock assessment provides information on sustainable levels of exploitation of fish stocks, and is a key part of fisheries management, helping determine what management measures should be applied to achieve the required outcomes. However, conventional approaches to stock assessment tend to be data-intensive and costly, and are difficult to apply especially in small-scale fisheries.

New approaches to fisheries management and assessment are needed for the small-scale sector, which is already seeing a move towards participatory and co-management.

Participatory Fisheries Stock Assessment (ParFish) is a new approach to stock assessment that addresses many of the problems of applying stock assessment to small-scale fisheries. It is based on conventional models, but does not require long time series of data, using instead Bayesian Statistics to incorporate fishers' knowledge on the resource, which is collected through structured interviews.

An assessment can be carried out rapidly, and the participatory process that surrounds the data collection and stock assessment supports co-management by bringing together fishers, scientists, managers and other stakeholders in a dialogue for more effective resource management.

More information and the **ParFish Toolkit**, which contains guidance on the approach and a software package for data analysis, are available from Marine Resources Assessment Group Ltd or the Fisheries Management Science Programme (FMSP) website:

Web: www.fmsp.org.uk
Email: enquiry@mrag.co.uk
Tel: +44 (0) 20 7255 7755
Fax: +44 (0) 20 7499 5388

The importance of small-scale fisheries

✓ Small-scale and multispecies fisheries play a vital role in the livelihoods of millions of people, predominantly in developing countries.

✓ Information is key to sound management and policy making, but limited resources results in a lack of information concerning these fisheries.

✓ ParFish is a tool that enables management recommendations to be identified quickly, based on an initial stock assessment, even where no previous data exist.

✓ ParFish supports co-management by bringing together scientists, fishers, government and NGOs.

Fisheries are the main source of animal protein for nearly one billion people, predominantly in developing countries. There are an estimated 10 million full-time, traditional fishers in developing countries, and a further 10 million part-time fishers. When families and dependents are included, an estimated 100 million people depend on fishing, many of them among the world's poorest. The employment and income generation that small-scale fisheries provide in often-remote coastal areas is important to livelihoods and the rural economy.

For example, in Tanzania, there are an estimated 92,000 people employed full or part time in commercial and subsistence fishing and aquaculture activities. Although fisheries often only contribute a small amount to a country's GDP compared to other sectors, in some regions they can be the most important activity, providing the main source of employment, income or tax revenue in a certain province or district. For example, in the Rufiji Delta in Tanzania, 61% of households are involved in fishing. Fish also provides an important source of protein that can be bought in small quantities, which is important to poor consumers who may not be able to afford to purchase other types of protein sold in larger quantities such as chicken.

Fishing boat at Kizimkazi, Zanzibar

The need for stock assessments

Information is key to sound policy making and responsible fisheries management. The FAO Strategy for Improving Information on the Status and Trends of Capture Fisheries recognises the importance of small-scale and multispecies fisheries, particularly in developing countries, and highlights the need for improving data and information for this sector. The use of rapid appraisal methodologies and participatory processes are specifically identified.

Many fish stocks are under increasing pressure due to growing human populations. Responsible fisheries management is needed to ensure their sustainability. This should be based on the best available information so that appropriate decisions can be made that take into account the social, biological and economic aspects of the fishery.

However, due to a lack of investment in management, many fisheries, especially in developing countries, lack the resources to collect and analyse data for management, such as stock assessments. This results in a lack of information on which to base management decisions, which may jeopardise the sustainability of the fishery and put many people's livelihoods at risk. This lack of information concerning their importance in turn often results in small-scale fisheries in particular being under-represented in fisheries policies, and their valuable contribution to people's livelihoods and the economy is not taken into account in political decisions.

Conventional approaches to fisheries stock assessment work well where resources are available, such as in large-scale commercial fisheries. However, they tend to require large amounts of data, are complex and costly, and as a result they are often not feasible for many fisheries. Different approaches to stock assessment are needed for small-scale fisheries. Flexible approaches are required, which use minimal resources and should involve the fishers through co-management (see box).

Co-management

Co-management is increasingly being introduced as a solution to the problems encountered in centralised, top-down management approaches. Co-management is the sharing of responsibility and/or authority between the government and local resource users to manage a specified resource such as a fishery, coral reef or waterbody.

Often the role of government in co-management is to support the process, and co-ordinate policy and data collection activities across several co-management units. Information and stock assessments are still required for co-managed fisheries, so that decisions taken for management are based on sound information.

How ParFish can help

ParFish, or Participatory Fisheries Stock Assessment, is a new approach to stock assessment that addresses many of the problems associated with stock assessments for small-scale fisheries:

- It does not require long time series of data, but instead uses fishers' knowledge to provide a starting point for the stock assessment;
- An initial assessment can be carried out quickly through the use of rapid data collection techniques;
- The approach brings together fishers, managers and other stakeholders helping them enter a cycle of learning, management planning and implementation, that can support co-management.

Conventional vs ParFish Stock Assessments

✓ ParFish is an extension of traditional approaches to stock assessment and uses the same models and principles.

✓ Traditional stock assessments are very data intensive. ParFish stock assessments are based on fishers' knowledge of the resource and an initial assessment can be carried out in a matter of weeks.

✓ Traditional stock assessments are the realm of scientists, whereas ParFish brings together fisheries scientists, facilitators, managers and fishers and takes social and economic concerns into account.

✓ A principal objective of ParFish is to involve fishers and other stakeholders in a participatory process to carry out the stock assessment and develop management actions based on the results of the assessment.

Conventional stock assessments require large amounts of data that may take years or decades to collect. They are not usually suitable for small-scale fisheries, which are difficult to sample because of their dispersed nature, and often lack financial and human resources for data collection and analysis. ParFish is an alternative approach to stock assessment that is appropriate for small-scale fisheries.

Rapid assessment

ParFish can be applied rapidly, even in fisheries for which no previous data exist, providing a starting point for management decisions, which can later be reviewed in an adaptive process. This is achieved by collecting data through rapid techniques including interviews and fishing experiments.

Use of fishers' knowledge

ParFish achieves a rapid assessment by incorporating fishers' knowledge on the resource into the stock assessment. Fishers are in day-to-day contact with the resource and have a wealth of information about it that is usually not harnessed in conventional stock assessments.

Based on conventional models

ParFish is based on the same models as conventional stock assessments. Currently the logistic biomass model is used, and a yield-per-recruit model is being developed. The difference from conventional methodologies is in the way ParFish is able to combine data from different sources, including information from fisher interviews, in a single assessment.

Combines different data sources

ParFish uses Bayesian Statistics to combine data from different sources (see p11). As a result, ParFish can incorporate conventional stock assessment data where they are available, such as long-term catch and effort time series, with interview data and fishing experiment data.

Promotes participation & co-management

Participation of resource users and other stakeholders is key to the ParFish process. This starts with the identification of problems in the fishery and objectives for the assessment, to their participation in data collection and the identification and implementation of management measures.

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Incorporating social and economic aspects

ParFish uses Decision Theory to incorporate social and economic aspects into the stock assessment and to identify the outcome in the fishery that would be most preferred by the fishers. This is used to identify the expected best control measure to apply. Fishers indicate their preferences for scenarios of different levels of fishing effort and associated catch (i.e. costs and benefits), which reflect relative trade-offs each individual faces between fishing and other livelihood activities that he or she could be engaging with instead. If fishers have few other livelihood options they may prefer to be able to fish every day, even if their catch rates are lower, than to be able to fish only one or two days a week with a higher return. In this way, ParFish incorporates the social and economic trade-offs and priorities of fishers in the assessment and takes account of them in the recommendations.

Fisherman examining preference cards

Comparative matrix of Conventional vs ParFish stock assessments:

	Conventional Stock Assessments	ParFish Stock Assessments
Models used	Many models exist and are being developed for available data e.g. production models for catch and effort data, length frequency data analyses, and catch-at-age data models.	In principle, can use all the same models as conventional stock assessments. Currently available: production models for catch and effort data. In development: models able to use length frequency and weight data. Other models can be incorporated on demand.
Data requirements	Data intensive. Long time series of data needed, e.g. catch-effort or length-frequency.	Data can be rapidly collected. Required: interview data. Optional: catch and effort, fishing experiments and other available data
Involvement of fishers & other stakeholders	Not usually. Dependent on management structures.	Yes, integral to process.

Case study - Andhra Pradesh

ParFish enabled a stock assessment to be carried out where none had been done before, and for management issues and recommendations to be discussed amongst stakeholders

The mud crab fishery in the Coringa mangroves in Andhra Pradesh, India, is a valuable export-orientated fishery. The larger crabs are exported to Japan, Malaysia and Singapore. Smaller crabs are sold on the domestic market. Despite its value, no assessments or monitoring are carried out and no specific management measures are currently in place.

A ParFish assessment was carried out over a period of 6 weeks through interviews with fishers. The assessment results indicated some uncertainty but did not suggest that the stock was currently over-fished. It was recommended that management should be put in place to avoid future problems and maintain the productivity of the fishery for those that rely on it.

The process, including a meeting that brought together fishers, managers, scientists, politicians and NGOs, brought other broader management issues to the surface, such as mangrove rehabilitation by an NGO that may have negatively affected the crab nursery grounds.

Recognition of these issues is the first step towards their resolution. Stakeholders supported co-management in principle for the fishery, and are keen to gather more data to improve and update the assessment.

The use of fisher knowledge in ParFish

✓ Fishers are in day-to-day contact with the resource and have a lot of knowledge about its behaviour, which provides the starting point for a ParFish stock assessment.

✓ Fishers' knowledge is gathered through structured interviews to collect information that directly relates to parameters of the stock assessment models.

✓ Fishers' knowledge is balanced with other rapidly-collected data, or previously collected data.

There is increasing interest in the use of fishers' knowledge in fisheries management and assessment. Movements towards co-management are one part of this, where fishers have a greater say in how the fishery is managed. The development and increasingly widespread use of participatory techniques is also part of this movement, but these usually provide only qualitative information. ParFish enables the formal incorporation of fishers' knowledge into a stock assessment framework in a quantitative manner.

Case study - Turks and Caicos Islands

Use of fishers' knowledge through a ParFish stock assessment would have prevented the queen conch stock collapse of the 1980s in the Turks & Caicos Islands

Queen conch (*Strombus gigus*) is a high value mollusc that is fished in the Caribbean by divers. It is principally aimed at the export and tourist markets. The stock was heavily overfished in the 1980s, resulting in temporary closure of the fishery and the loss of livelihoods for the people that depended on it.

ParFish interviews were carried out with the fishers. The Department of Fisheries also had good data on catch and effort dating back to 1974. These data were used to compare the results of a conventional stock assessment using catch and effort data with a ParFish stock assessment using only fishers' knowledge.

The results showed that using fisher interviews alone produced a sensible result that could have been used in isolation if catch and effort data were not available.

If ParFish had been carried out in the 1970s or early 1980s, using only fisher interviews, and the recommended quota had been implemented, it would have avoided the crash in the conch stock, together with the associated negative impacts on people's livelihoods. This assumes that the fishers would have known the same amount about the resource in 1974 as they did in 2003 when the assessment was carried out.

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Carrying out an interview with a fisherman in the Coringa mangroves, Andhra Pradesh, India

Structured interviews to gather data for the stock assessment

Structured interviews are used to collect specific information for the stock assessment. The answers from the interviews are converted by the software into information on each parameter in the stock assessment model. In the case of the logistic biomass growth model, this involves questions about fishers' current catch rates, previous catch rates, what catch rate they would expect if they were to fish in an unexploited area, and how long they think the stock would take to recover to the unexploited state. As many fishers as possible are interviewed, to gain a representative sample, and the answers are converted into probability functions for each parameter (p11) using the ParFish Software.

Building up a common understanding

There needs to be a common understanding of key concepts involved in the assessment. This enables the fishers to participate fully in ParFish, for their knowledge to contribute to the assessment, for them to understand the assessment results and be able to contribute to management decisions based on them. Tools and techniques have been developed in ParFish to discuss concepts such as fish stock dynamics, stock assessment and probability with the fishers. One of these is the 'oranges in a jar' example to demonstrate uncertainty. Fishers are asked to guess the number of oranges in a jar in different situations (without seeing inside the jar, and after seeing inside the jar). The range of estimates is used to demonstrate the uncertainty surrounding the estimate, and how this is affected by the prior information available.

Can fisher knowledge be relied upon?

For ParFish, fishers are not expected to know the 'correct' answer, or to all give the same answers to the interview questions. Because the analysis is based on probabilities, the range of answers and opinions is used to construct probability density functions to estimate the model parameters.

Experience suggests that most fishers do not try to distort the results, but this concern underlines the importance of building up a relationship of trust between the fishers, scientists and other stakeholders involved, and ensuring the fishers understand the objectives of the assessment and how it will benefit them.

How ParFish promotes participation

✓ ParFish is based on a six-stage process (see diagram below) that brings stakeholders together.

✓ Interviews incorporate fishers' knowledge and preferences in the stock assessment.

✓ Participatory techniques help support the building of a good relationship between scientists, fishers and managers, and can contribute to co-management.

✓ Results are discussed with the fishers and other stakeholders and management options are planned together.

Participation of fishers and other stakeholders in the stock assessment helps ensure their support for the process and increases their understanding of the results enabling them to take an active role in planning management actions.

Based on participatory principles

The ParFish process (see diagram) brings stakeholders together to discuss the management of the fishery. Participatory techniques are used to encourage stakeholders to engage with the process and to explain stock assessment concepts to fishers. This helps them understand the implications of the management recommendations from the stock assessment.

Participatory data collection

The data collection techniques in ParFish involve resource users. The interviews and fishing experiments help fishers consider different aspects of their fishery, its sustainability and the trade-offs they face.

Supports co-management

ParFish supports co-management by guiding resource user involvement; sharing information with relevant stakeholders (e.g. local government, NGOs); and providing a forum for discussion of possible management options.

5. Initiate management
- Build consensus
- Plan management and enforcement actions and responsibilities
- Plan monitoring & evaluation criteria

6. Evaluate ParFish process
- Assess impacts of management actions
- Evaluate ParFish assessment & data collection
- Evaluate participatory process

4. Interpret results and give feedback
- Interpret ParFish assessment
- Feedback stock assessment results to stakeholders

3. Undertake ParFish Stock assessment
- Identify information requirements
- Data collection
- Data analysis using ParFish software

1. Understand the context
- Assess the fishery and management context
- Identify and engage stakeholders
- Identify appropriate communication channels

2. Agree objectives with stakeholders
- Encourage participation
- Explain ParFish to stakeholders
- Set management objectives

The six-stage process for implementing ParFish

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Case study – Kizimkazi, Zanzibar

ParFish helped build a relationship of trust between fishers and scientists, increased the knowledge of fishers on responsible management, and the fishers felt they really had their voice heard

The fishery at Kizimkazi, Zanzibar, is a mixed species coral reef fishery on the fringing reef and outer patch reefs. The fishers use mainly handlines and traps, and some nets.

For ParFish, the fishers were involved in introductory meetings and collecting background information about the fishery. Interviews were carried out with the fishers to gather data for the stock assessment. Fishers also participated in a depletion fishing experiment, where they concentrated fishing effort on a defined area of reef for 8 consecutive days, and their catches were weighed and measured each day.

The whole process illustrated a commitment for cooperation between fishers and scientists and built up a relationship of trust. The interviews provided a forum where fishers could think about and discuss the impact of a range of scenarios on their fishing incomes. One of the local scientists involved felt it laid down firm ground for *"establishing a knowledge base on responsible resource management in the participating communities"*.

Jamhuri, a fisher from Kizimkazi who fishes with handlines and sometimes nets, said *"I have been able to voice my concerns on the fisheries and to discuss with them how to make effective marine protection measures"*.

Participatory techniques are also used in ParFish to gather background information about the fishery. This includes: the species fished, fishing areas and techniques, estimated current effort, management structures and regulations, problems encountered in the fishery, and socio-cultural background to the communities in question. This helps frame the stock assessment and direct the data collection. Participatory identification of issues in the fishery and objectives for the stock assessment also helps define a common vision and ensures fishers and other stakeholders are involved in the assessment from the start.

Management planning

The ParFish process includes a stage for management planning for stakeholders to discuss the results of the ParFish assessment, other problems encountered in the fishery and to consider possible management solutions. This stage, which is not necessarily covered by conventional stock assessments, helps ensure that the results are translated into practical actions for fishery management.

Measuring catches during the fishing experiment, Zanzibar

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The inside workings of ParFish

✓ ParFish is based on Bayesian Statistics and Decision Theory.

✓ ParFish Software is available for data processing and analysis.

✓ All available data are converted to information (probability density functions) relating to the parameters of the stock assessment model.

✓ Data from different sources (e.g. interviews, catch-effort, fishing experiments) can be combined in a single assessment.

✓ The Software gives outputs on the state of the stock, standard fisheries management parameters such as MSY and F at MSY, and the level of control (e.g. effort or quota) that would be most preferred by fishers.

The ParFish Software

The ParFish Toolkit includes a software package, for analysing data, assessing the state of the resource and recommending the best actions that balance the risks between losses and gains of each decision.

Bayesian Statistics

The ParFish Software uses Bayesian Statistics which is a technique for calculating the probability of an unobserved event based on probability estimates from samples or observations. It can be applied to estimate the probability of certain outcomes in a fishery, such as overfishing, based on estimates obtained from fishers themselves and existing data about the fishery. Data are converted to estimates of model parameters, and used to construct probability density functions (PDFs). PDFs from different data sources for each parameter can easily be combined to an overall estimate. The analysis and outputs are based on probabilities so uncertainties are explicit in the result.

Decision Theory

ParFish uses Decision Theory to identify the best management action under uncertainty. Each action (i.e. management/control measure)

as an expected outcome (on the state of the stock and resulting catch per unit effort). For each action considered, the probability of each outcome happening and its utility (preference) can be calculated. Combining these allows calculation of the average or expected utility for each management action. The best action is that which maximises the expected utility i.e. balances the risks and benefits.

Models available

- Logistic model: ParFish (Version 2.0) is based on the logistic biomass growth model, which represents the basic biological behaviour of populations. It is broadly applicable to most fisheries, and serves as the introductory model for ParFish.

- New software versions: a yield model incorporating mortality rates, von Bertalanffy growth and Beverton and Holt recruitment. More data analysis support will also be made available in new versions.

- Programmers' version: A programmers' version of the software will be released that will enable people to customise the software. Any model can in theory be incorporated into the ParFish Software and approach.

Probability and uncertainty

The outputs from the software are given as probability density functions, rather than point estimates. In this way the uncertainty inherent in the estimates is explicit rather than hidden, allowing the user to assess the confidence in the results and whether more data should be gathered to improve the stock assessment. Mean, median and modal values with confidence limits are also specified for each indicator.

Controls

Currently, the control types that can be explored with the ParFish Software are: effort controls, catch quota controls and closed area controls (protecting a proportion of the stock).

Software Outputs

The software provides the following outputs:

Standard stock assessment indicators and reference points:

- State of the stock in relation to the unexploited state
- Maximum Sustainable Yield (MSY)
- Fishing mortality (F) at MSY
- Effort at MSY
- F at Maximum utility

Recommended control levels

- Limit control: control level (effort, quota or closed area) that would reduce the chance of the stock being overfished to a defined probability.

- Target control: control level (effort, quota or closed area) that would result in expected rates of catch and effort most preferred by fishers.

The ParFish Software main interface

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Key Challenges & Recommendations

- ParFish as a tool can help bring fishers, managers and scientists together to promote dialogue, providing a starting point for information-based participatory management and decision-making.

- Information is key to responsible and effective fisheries management. However, for many small-scale fisheries, the necessary information is absent due to a lack of human and financial resources.

- ParFish addresses this technical gap in fisheries science by enabling rapid stock assessments to be carried out for fisheries where no previous data exist, based on fishers' knowledge and other rapid data collection techniques. If good conventional stock assessment data exist, ParFish can also incorporate them into the assessment.

- There is an increasing recognition of the need to incorporate fishers' knowledge in fisheries management. ParFish provides a methodology for doing this in a quantitative manner.

- For ParFish to fulfill its potential in supporting the identification and implementation of management measures between government and resource users, there needs to be a commitment to co-management, from all sides and especially from the government to implement the necessary policies, otherwise resource users do not have the authority or support to implement management decisions. Long-term commitment is needed to effectively translate recommendations into management plans.

- Government should support co-management by providing resources for expert advice to co-management bodies, such as through stock assessments; resource users should contribute to the process through their participation and the identification and implementation of acceptable management measures.

- Participatory processes are time-consuming and require dedicated people to work at local level, but have the benefits of building trust among the stakeholders, and establishing a common dialogue.

- ParFish interviews can be lengthy and some interview questions can be difficult for fishers to understand, so well-trained and patient interviewers are needed who are able to explain concepts in ways that the fishers can relate to.

- ParFish has been developed and tested in small-scale fisheries involving a defined fishery area and up to 10 villages, although the approach is broadly applicable to any fishery, subject to appropriate sampling strategies. Strategies for scaling up implementation to larger spatial scales, such as across districts or provinces, could be developed to enable its implementation on a wider scale.

- ParFish can be customised for specific fisheries. Please contact us for more details.

DFID MRAG

Annex 3.7: ParFish webpage

Participatory Fisheries Stock Assessment (ParFish) is an approach to fisheries stock assessment which uses Bayesian statistics and multi-criteria decision making theory, and provides a tool for involving fishers in the management process. It is the product of several FMSP research projects which developed the background methodology for undertaking ParFish (R7947) and developed and tested a Toolkit to support its application in Zanzibar (R8397). The projects are:

- R7947 – Integrated fisheries management using Bayesian multi-criterion decision making;

- R8397 – Uptake of Participatory Fisheries Stock Assessment (PFSA) Toolkit;

- R8464 – Application and Promotion of FMSP Participatory Fisheries Stock Assessment (ParFish).

ParFish is a particularly suitable methodology for co-managed fisheries in developing countries as it:

- Does not require data recorded over long time series;

- Encourages the participation of fishers; and

- Allows a rapid assessment.

At the centre of ParFish is software for stock assessment that can combine a number of different data sources and data types to give information on the current state of the stock and recommendations for levels of management controls. Surrounding the software is a holistic approach to assist fishers and other stakeholders to enter a cycle of learning, management planning and implementation:
Within the current project (R8464) the approach will be further tested in India (Andhra Pradesh), Kenya and Gabon. The results and lessons learned from these case studies will be used to produce a revised version of the ParFish Toolkit.

The **ParFish Toolkit** consists of:
1. **ParFish Guidelines:** describe the overall approach for implementing ParFish to assist fishers and stakeholders enter a cycle of learning, management planning, implementation and evaluation;

2. **ParFish Software:** allows data from the ParFish assessment to be entered and analysed;

3. **ParFish Software Manual:** explains how to use the software with step-by-step instructions;

4. **Supporting materials:** provide data collection forms, interview sheets and preference cards.

Stages involved in the ParFish approach
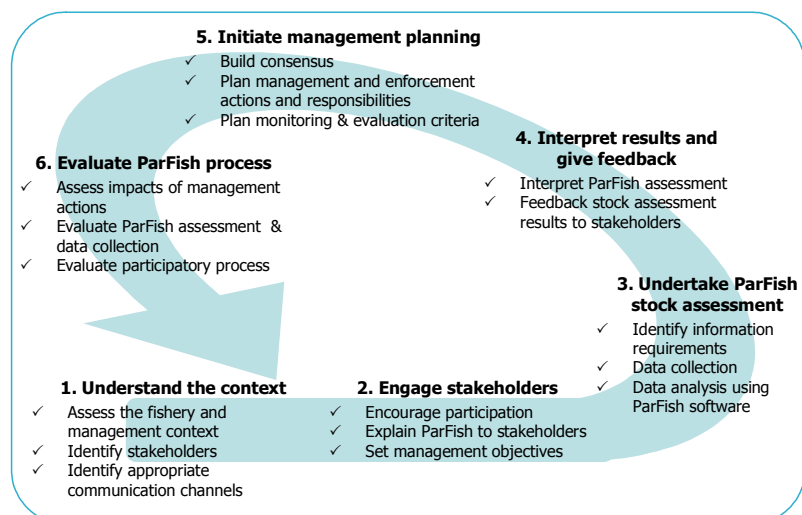
Downloads

PARFISH TOOLKIT	
ParFish Guidelines	
ParFish Software	
ParFish Software Manual	
Supporting materials (data collection forms, preference cards)	
Feedback Form	
PARFISH FLYERS AND BRIEFS	
ParFish Flyer 1 (September 2004)	
ParFish Flyer 2 (March 2005)	
ParFish Brief 1 (September 2004)	
ParFish Brief 2 (March 2005)	
TECHNICAL REPORTS	
Final Technical Report – Application and Promotion of Participatory Fisheries Stock Assessment (ParFish) (Project R8464) – will be available December 2005. Final Technical Report - Uptake of Participatory Fisheries Stock Assessment (PFSA) Toolkit (Project R8397) *[link to other project page, depending on website structure?]* Final Technical Report – Integrated fisheries management using Bayesian multi-criterion decision making (Project R7397) *[link to other project page, depending on website structure?]*	

Contacts
- **General:** Suzannah Walmsley or Charlotte Howard, MRAG (s.walmsley@mrag.co.uk c.howard@mrag.co.uk Tel: +44 207 255 7755)
- **Software:** Dr Paul Medley. (paul.medley@virgin.net)
- **Zanzibar case study**: Dr Narriman Jiddawi, IMS (jiddawi@ims.udsm.ac.tz Tel: +255 24 2232128)

Annex 3.8: Email Communications

EMAIL RESPONSES: PARFISH – MARCH – OCTOBER 05

Category	Name	Email Response	Contact Details	ACTION
International Research Institute – WorldFish Mekong	Blake D. Ratner, Ph.D.	Please send 5 copies if possible to WorldFish at the address below. 1 hard copy, 4 CDs. Please address to Dr Eric Baran. Thanks much, Blake	Blake D. Ratner, Ph.D. Regional Director, Greater Mekong Subregion WorldFish Center b.ratner@cgiar.org Mail: P.O. Box 1135, Phnom Penh, Cambodia. Phone: (+855-23) 223 208 Fax: (+855-23) 223 209	
International Research Institute – WorldFish Malaysia	Dr. Mark Prein	Dear Suzannah, Many thanks - may I reques a copy on CDROM, please? Greetings from the WorldFish Center in Penang, Malaysia. Mark _____	Dr. Mark Prein WorldFish Center GPO Box 500 10670 Penang, Malaysia m.prein@cgiar.org Tel: +60-4-6261606 switchboard Tel: +60-4-6202-190 direct, -139 assistant www.worldfishcenter.org	
Consultant – Tanzania	Jim Anderson	Greetings All, As I mentioned a while back the Japanese money for Rufiji, Mafia and Kilwa districts is due to come on-stream any day now. I am working with WWF (who won the contract for implementing the coastal mgt planning in those 3 districts) on a preliminary survey of the fishing grounds/gears/seasonality/fisher migration. We are due to go to the field in about 2 weeks time and are currently planning to visit 18 villages along the coast (7, 4 and 7 in the 3 districts respectively - Mafia has fewer because the Marine Park covers many sites already). I am planning on doing basic more RRA-type mapping work for the grounds (with GPS and boat-work to follow) and the more detailed PRA work on defining how the proposed management units should be established/interact along the coast etc etc will be done soon after, by a socio-economist from Moshi University I gather. Given that it is hoped that ParFish will be important in contributing to the mgt planning, at least in some of the area, I		

was wondering if you have any sort of checklist of information that you'd want to have at a minimum before you got involved with the ParFish work proper. Stuff that I should keep in mind.

All the best,

Jim

Dear All,

I've heard unofficially that there will be some funds available for the application of Parfish to the Rufiji/Mafia and Kilwa districts in cental Tanzania later this year. I'll keep you posted and no doubt you'll be fully involved when the details are more clear, along I hope with Narriman etc.

Just thought I'd let you know.

I'll be in the UK thru July so perhaps catch-up with you then.

All the best for now.

Jim

Hi Zaz,

Thanks for the email. If you could send the information to me at PO Box 78736, Dar es Salaam. And any shortened electronic version of the background information to compile would also be useful given that the postal service here is not always reliable (although it is not bad). If you can write on the envelope that the material is not commercial then I won't have to deal with customs. We are due to start the field-work around Oct 3rd.

Yeah the FADs film on the Beeb. Although I was the one who started the ball-rolling with EarthReport and got them on-board, of course I'm not now involved with the FADs anymore, but it seemed a good piece to put out. The FADs should really be coming on line just about now as the tuna start appearing in this area so hopefully there should be loads of reports coming in of vast new wealth being generated from these handy little devices.

A general question...a vessel has turned up here (28m) to do some sort

		of touristy/eco/expedition-type holidays at around 2.5k for a 10-day leg. The boat has all the toys including re-breathers, fibre-optics for deep-water filming, media-centre for real-time display, a micro-light for whale-spotting etc etc and has the idea that it can involve 'tourists' in 'scientific expeditions'. They want to do a 2-month (ie about 6 legs) 'Pelagic' expedition but seem to have little idea of what that might entail and what they could actually do with the punters on-board. I was onboard on Sunday and they asked me for ideas...so I was just wondering what, off the top of your wise-heads, ideas you all might have. Just a thought to ask you seeing as we are on-line. Maybe you've see this sort of expedition before...? I've copied this to John as well wrt his involvement with BIOT/IOTC. Any ideas John? All the Best, Jim		
Research International (EU)	Cornelia E. Nauen	Dear Charlotte Howard, thanks for sending the two flyers. Looks potentially very interesting and I wonder whether this should not be promoted also massively among social scientists as much as among natural scientists, managers and NGOs. You use the term stock assessment - do you really mean stocks or do you deal with species caught in an ecosystem context? At the recent MARE Conference in Amsterdam (People and the Sea) Daniel Pauly as opening keynote speaker leveled criticism at 'the social sciences' for having failed to use their research on lore and customs to document what s/s fishers catch and how much to create a framework both for their own work and links to what other sciences do. It was argued that, as a result of not documenting the material aspects of fishers interaction with nature an essential opportunity was missed to show how important they were. Empirically, indeed, we observe that most political processes ignore or abhor s/s fisheries as marginal or too complicated or both. At the conference Ratana Chuenpagdee presented an updated idea of building a global database on s/s fisheries first sounded at the World Fisheries Congress in Vancouver a	Dr. Cornelia E. Nauen Principal Scientific Officer International Cooperation (INCO) Research Directorate General (DG RTD) European Commission 8, Square de Meeûs - SDME 1/20 B-1049 Brussels Belgium Tel +32-2-299.25.73 Fax +32-2-296.62.52 E-mail: cornelia.nauen@cec.eu.int	

		year ago. It might be worthwhile to look into opportunities of mutual benefits from combining different initiatives in suitable ways. Wonder whether you see your methodology and field collaboration with 'grass roots' projects as suitable in such a context. The well-publicised results of the Millennium Ecosystem Assessment add an even greater sense of urgency to efforts. Looking forward to your feedback. Best regards, Cornelia Nauen		
International Research Organisation – FAO	Gertjan de Graaf	Dear David The meeting is 04-06 July 2005 Below a copy of the mail we sent last friday (You were in the loop) This morning saw the nice presentation of PARFISH. Those are the things we are looking for, could elaborate further on it and do more field validation Hope to see you in Rome Friendly Greetings Gertjan de Graaf Dear all, Some of you may already know by discussing with Serge Garcia that the Food and Agriculture Organization of the United Nations (FAO) and the World Fish Center are developing a joint activity towards a theory, methodology and tools for rapid integrated assessment of costal/small-scale fisheries. The overarching objective of this activity is to significantly enhance the capacity of individuals and institutions to assess small-scale fisheries in developing countries within the context of developing more appropriate strategies for enhancing their role in food security and in reducing poverty and vulnerability and sustainable use of aquatic resources, as reflected in the FAO Guidelines for Enhancing the Contribution of Small-Scale Fisheries to Poverty Alleviation and Food Security and the Strategy for Improving Information on Status and Trends of Capture Fisheries	Gertjan De Graaf FishCode programme & FishCode STF project (FIPD) Viale delle Terme di Caracalla, 00100, Rome, Italy Tel: +39 0657054129 Email: Gertjan.degraaf@fao.org	
International Research	Jorge Csirke	Dear Charlotte,	Jorge Csirke Chief, Marine	

Organisation – FAO		I am glad to refer to your message below addressed to my colleague Richard Grainger, which had been circulated among several Officers within the FAO Fisheries Department. As you rightly anticipated the methodology and software you have developed is of interest to several staff in the Fisheries Department and am sure that several of us would like to hear more about it. Probably the best way to organize this would be for you to give a short seminar (approx. 1 hour, including presentation and time for questions and answers), to be followed by one-to-one discussions depending on interest and availability of other Officers. In my view it would be better to organize such a seminar during the week 9-13 May. Do you have any preference or date/time constraints during that week? With this information we can proceed to reserve a suitable meeting room prior to fixing the exact date and time for the proposed seminar. In order to make the announcement of this seminar, I would require a brief Curriculum Vitae of yourself or whoever will be making the presentation (no more than 15 lines), as well as a summary (half a page) of the presentation itself. If you have an electronic version of a publication on the subject this can also be circulated in advance. Best regards,	Resources Service Fishery Resources Division Food and Agriculture Organization of the United Nations (FAO) Viale delle Terme di Caracalla 00100 Roma, Italia Email: Jorge.Csirke@fao.org Tel. (direct): +39 0657056506 Fax (direct): +39 0657053020 Visit our web page http://www.fao.org/fi	
International Research Organisation – FAO	Serge Michel GARCIA	THIS WOULD BE USEFUL ALSO IN THE PERSPECTIVE OF THE STF PROJECT ON SSFs	Serge Michel GARCIA Directeur Division des Ressources Halieutiques Département des Pêches de la FAO Viale delle Terme di Caracalla, 00100, Rome, Italie Tel: +39 0657056467 Fax: +39 0657053020 Email: serge.garcia@fao.org	
International Research Organisation – FAO	Richard Grainger	Jorge, I pass this message to you as it is more within the remit of FIRM (and possibly FIRI also for lake resource assessment). Charlotte called me and I told her I would pass her message to you.	Fishery Resources Division Food and Agriculture Organization of the United Nations (FAO) Viale delle Terme di Caracalla 00100 Roma, Italia	

		Richard	Richard.Grainger@fao.org	
Independent (previously at FAO)	John Caddy (not an enthusiast!!)	Dear Suzannah, Thanks for the thought, but I am no longer in FAO. Frankly, apart from being out of date on stock assessment methods, I am not a great enthusiast for Bayesian approaches which assume that the underlying relationships of parameters in your model are known, which is not ncessarily the case. I suggest you send a copy to Kevern Cochrane, Fisheries Department Rome, who is keen on this approach. All the best to Ian and the others at MRAG, John Caddy		
National Research Institute	Gerald K. Mwatha	Dear Howard, I am a fisheries scientist working with the Kenya Marine and Fisheries Research Institute, Mombasa, Kenya. Please send me a CD of The ParFish Toolkit, which I believe will facilitate me in my work. Regards Gerald K. Mwatha	Kenya Marine and Fisheries Research Institute P. O Box 81651, 80100, GPO. Mombasa, Kenya Tel: 254 41 475157 Mobile: 254 722596211	
Fisheries Management _National (Galapagos)	Alex Hearn	Dear Suzannah, I have received the ParFish software and toolkit. Thanks a million, it looks really interesting. We have just written a proposal to evaluate the Galapagos Fisheries Calendar, and where it went wrong, and to try to incorporate the fishers' knowledge and perceptions in future management models, along with the scientific info, so I certainly think there will be scope to use it in that aspect. I can keep you updated periodically with this once we start (should be January, but we'll probably do some things earlier) Thanks once again Alex Dear Suzannah, I am writing to request a CD-rom copy of the parfish software, as I would be most interested to attempt to apply it in the Galapagos Marine Reserve where, after several years of conflicts and collapsing resources, there appears to be a new opportunity to change the	Alex Hearn, PhD Coordinator of Fisheries Research Area de Investigacion y Conservacion Marina (BIOMAR) Estacion Cientifica Charles Darwin Puerto Ayora, Santa Cruz Galapagos, Ecuador Tel: +593 52 526 146/7 ext. 123	

		system and make it truly participatory. Could you send me a copy to the address below? Thanks for your help Alex		
Research - independent	Tim Daw	From: Tim Daw [mailto:tim_daw@yahoo.com] Sent: 25 July 2005 16:35 To: Suzannah Walmsley; Paul.Medley@virgin.net Cc: 'Selina Stead'; Tim S Gray Subject: Parfish Aspects of Seychelles work Hi Suzannah and Paul, I enclose a revised overview of my work out here and some questionnaires which i am trialling now one of which incorporates the ParFish stock assessment interviews. The aim is to do a ParFish assessment in collaboration with SFA on the sea cucumber and trap fisheries (and perhaps some stock assessment interviews on a 3rd). This will allow me to compare results between different fisheries. I'll also be doing some cognitive interviews-about-the-interviews (last questions on the CPUE/ParFish questionnaire) with a subset of the sample to investigate how they went about constructing answers for the less-straightforward answers. The preference interviews will depend on time and SFA's interest/support but will probably only be done with the sea cucumber guys. The other files are interviews aiming to find out about CPUE hyperstability (technical and effort creep and range expansion) and the ways fishers understand and model their fishery. Have either of you ever come across anyone trying to quantify technical creep other than comparing it to standardised effort? Thinking to try to get valuations out of fishers of how much they'd be willing to pay for different improvements and then using fish price (and discount rate from ParFish interviews) to get estimates of % efficiency increases for each as well as asking fishers directly. I'd be grateful for any feedback on any of the enclosed or if you had any specific questions that you would like me to focus on.		Ask Tim to give us contact details so we can follow up

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		Regards from here, Tim Tim Daw MSc. Hi again guys, just given your FAO presentation to the director and research staff of SFA and got a very positive response. The suggestion was that, rather than the schooner fishery as originally suggested, they'd like to trial ParFish on the sea cucumber fishery (so that'd be a holothurian to add to your mollusc, fish, crustacean trials!). This would be quite an interesting and straightforward assessment, as they've already been involving stakeholders in developing management (funded by EU) and have just recently done a standing stock assessment. But they only have a 2-3 year timeseries of good data and no idea of how their standing stock relates to Binf. There's also only ~25 boats i think so the stakeholder group is quite well defined. I'm leaving the Seychelles on 11th August and will be back on the 3rd September so the suggestion is to set up and trial some interviews before I go away and then do the assessments when i get back. they're interested in both the stock assessment and preference interviews and willing to commit staff time to getting it done. So good news from here - I'm meeting Jan next week to discuss more specific plans. Meanwhile they'd like a couple of copies of the toolkit if possible. I'll send you both more details of how this fits in with my PhD at the weekend, Cheers from here, Tim		

| Consultant – Gabon | Oli Taylor | From: oli taylor [mailto:taylor_ojs@yahoo.com] Sent: 14 September 2005 18:24 To: Suzannah Walmsley; Charlotte Howard; Paul Medley Subject: Gabon update

Hello ParFish folk,

Well its all go here. We are translating the interview into french so i will send you a copy of that for future projects before long. Dont suppose you happen to have a french version of the manual hot off the press?? Might be something to consider for other projects in this part of the world.

Just had the first key informant interview to determine the units for the interviews and gain a bit of background. We will start on the inshore net fishery which is the main stay here and the fishery WCS are keen to pilot with.
Industrial trawlers appear to be the main concern.
Other fisheries for ParFish here include a lagoonal oyster fishery which should be relatively straight forward once they are up and running here, and there is already some C/E data being collcted. We have recruited at least one competent local staff to take on the interviewing role and he is keen to go. Fisheries also have a guy who we hope to include before too long.
Otherwise, we have met with the Dept of Fisheries representative for the region and he is keen that we go ahead. There is also rumoured existing data which I will try and track down and have inputted and sent on to you.
Tomorrow is interview training and an initial village meeting so we are moving forward.
Im aiming to get 20-30 interviews for the testing and that should serve the training purposes for at least the interviews.
Two weeks to go and lots to do!
More on this soon,
Cheers,
Oli | Oliver Taylor Environmental Consultant Five Oceans Environmental Services LLC PO Box 660 Postal Code 131 Muscat Oman

Office Tel/Fax: (968) 24696918 Home: (968) 24571622 Mobile: (968) 92117061 | Consider having toolkit translated into French |

Implementing management – National / Regional CORDIO	David Obura	Dear Suzannah, Okay, thanks very much for your understanding and faith, we will certainly get it done. I have had a chance to look with more detail at the guidelines for undertaking ParFish and I am very impressed. I think there are many situations in which it can be applied, and some in a more simulation-oriented manner that are lighter on the interview side where good historical datasets are available, for example contrasting multiple fish taxa against the same set of perceptions/attitudes. I will try and get my staff and Mr. Ndegwa to explore this a bit, and probably interact with you more once we start into this. All best, and thanks, David	dobura@cordioea.org	
Implementing management / Research – National Suganthi Devadson Marine Research Institute	J.K. Patterson Edward	Dear Dr.Suzannah Walmsley, Greetings. I hope that you had a nice time in Mangalore and also the Workshop was successful. Now I am in Japan as Visiting Professor in the University of Tokyo to study the "Tsunami impacts and coastal protection measures in Japan". I will be returning to India by the end of October 2005. I hope to work with your team of experts for the Vellpatti Crab Fishery. Also, I would like to have a copy of the workshop shop manual, if any and ParFish tookit. With best regards, J.K. Patterson Edward	edwardjkpatterson@yahoo.co.in Suganthi Devadason Marine Research Institute, 44-Beach Road Tuticorin - 628 001, Tamil Nadu, INDIA Tel: +91 461 2323007	
Management Organisation _ National - Orissa state Fishery Department India	Dr. Satyajit Bhuyan Fishery Extension Officer Orissa state fishery department India	Dear Dr.Suzannah, Thank you for your mail and sorry for delay in replay. Hope thing going fine for you.Till now we have not tested the ParFish tool in our fishery but we have given a proposal for assessment and management for some fishery of Chilika lagoon of the state of Orissa to our Government and hoping for an early approval. Also proposal is also there for some important marine fisery off Orissa coast with other FMSP stock assessment tools. Future development will be conveyed to you soon. Covey my regards to Dr. Paul also. Thank you. With regards,	Orissa state Fishery Department India satyajit99@rediffmail.com	

Management organisation_ National (West Bengal)	Dr. P.K. Jana	Dear Suzannah, Many thanks for your e-mail on 21 September 2005. For your information we (I and U. Panja) have tried to apply Parfish software to our "Kansabati reservoir". We have conducted interview 25 fishers. As a result we are not able to get desire result. We are trying to get more fishers. One problem- how we can get the printout of different results with diagram? Also we are trying to apply this tool to our cold water fisheries. But it is not possible to inform the time schedule. Another problem to demonstrate the parfish software to grass root level. It will be better if you provide one lap tab for this purpose. Best wishes,	Dr. P.K. Jana Deputy Director of Fisheries (ME & MS) Govt. of West Bengal wbjdmems@vsnl.net	
Research National - College of Fisheries, Karnataka, India	Dr Jayabalan	To: Ms. Suzannah Walmsley Thank you for the workshop report. I could download it. I will establish contact with Dr. Oliver Taylor and try to implement it here in Oman. Thank yu once again. Regards, N. Jayabalan	jayabalan nachiappan [maljaya2@yahoo.com]	
Research National – College of Fisheries, Mangalore, India	K.S.Udupa	Daer Ms.Walmsley, I am just reminding you that I am Prof.K.S.Udupa from college of Fisheries, Mangalore, India, who took part in the Parfish programme inlate July, 2005 at Mangalore. Dr. Keshavanath might have written to you regarding a project for parfish here. We have selected a species namely *Scomberomorus commersonii* which is caught here by gill netting. Fishing is done from marine waters like overnight fishing or multiday fishing using gill nets. For overnight fishing fishermen go by small mechanized boats and for multidays fishing they take bigger boats. About 150 fishermen take part in the fishery. Fishermen also get some other species which are not our target species during fishing. We could identify the groups of participatory fishermen from a fish cooperative society here. The fishermen of this society will give the catch details to their society from where we can get catch details for our data input.	K.S.UDUPA UDUPA [udupa47@hotmail.com]	

		Whether the above fishery can be taken up for parfish project? How many fishers can we select for participatory survey, preference survey and recording catch details? I hope that fishers may be in any or all groups. Is it OK if catch details are on weekly basis for overnight fishing and tripwise for multiday fishing? We have to separately record the 2 types of fishing and feed for parfish. Yes? I am happy if you clarify the above doubts and still happy if you can give more informations to take up the work. Any more informations I am happy to provide. Dr PK is busy and yesterday his daughter's marriage so I cold not talk to him. Hence I am taking the liberty of writing to you. May I expect an early reply from you? With regards, UDUPA		
International Research – FAO Asia and Pacific	Simon Funge-Smith	Dear Suzannah, Thanks - yes we did receive it and my colleague Derek Staples is interested in possible applications. We do not have any direct suggestions right now but since we have several 'information for management' type projects there may be an opportunity to try it out. Derek may respond directly further to this. best regards Simon.	Simon.FungeSmith@fao.org	Contact Derek Staples and discuss uptake
Implementing Management – National (Cote d'Ivoire – SFLP/FAO)	Alain Kodjo	Dear all, The Pilot Project Kossou Team of the SFLP (Sustainable Fisheries Livelihoods Programms) will test the participatory Fisheries Stocks Assessment (ParFish) on the Kossou Lake in the coming quartly (3rd) in order to develop a participatory method for fish assessment. This activity has a linkage with one of the major outputs of the project (A participatory management plan and fonctional	KODJO Alain Team Leader +(225) 30 64 04 74 pp1kossou@aviso.ci kodjoalain@yahoo.fr	

		institutions framework in place). Lake Kossou is an inland lake with 900 Km² wide. In september 2004 I receive the flyer # 1 on an experience leads in Zanzibar. The Team Management will be very happy to have some more details on the ParFish approch, the tools to conduct the ParFish. We also need the software and the manual. Best regards. KODJO Alain Dear Suzannah, May God bless you for sending me the ParFish tooklist and the software. I think I could now start working on that subject and also share some results with You. Once again thank you for your cooperation. Best regards, KODJO ALAIN PP1 Kossou Team Leader		
Implementing Management – national Fisheries Department, Kenya	Peter Wekesa	Dear Susana, Pherhaps should begin by introducing myself. I am Peter Nyongesa a fisheries officer working for Kenya's department of fisheries in Nairobi Kenya. I was introduced to you by Dr. Colin Barnes who is presently engaged by the Department of fisheries as a consultant and informed me that you are collegues at MRAG. I learnt from Dr. Collin that you have wide experience on biological modelling of fish stocks especially for artisanal fisheries co-management. The purpose of this letter is to kindly request you to send me an electronic copy of PAR FISH and its accompanying instructions. I am a young fisheries biologist now working at the statistics section of the department and believe that your positive response will expose me to new participatory models for fisheries management and develop my carrear. You may also consider me for training on the same should a training opportun	peter wekesa [penyongesa@yahoo.co.uk]	

		ity arise in future. Regards. Peter.		
Research – National South Africa	Olaf LF Weyl PhD Senior Lecturer	Hi Suzannah, So it's finished!!! Congratulations. Thanks so much for the toolkit. Primarily I will be using it as a teaching tool within the department and as I do quite a lot of work in Southern Africa, I am sure that Parfish will be a useful tool. I'll provide feedback as I use it. Thanks again, Olaf	Department of Ichthyology and Fisheries Science Rhodes University PO Box 94 Grahamstown 6140 South Africa Tel: +27 (0) 46 603 8824/603 8415, Cell: +27 (0) 83 461 5434	
Research International (International Ocean Institute)	Ratana Chuenpagdee	Dear Charlotte, I am following the e-mail commuication below and wonder if it would be possible to obtain the ToolKit that you referred to in your message. It would be great to have both the hard copy and the CD-ROM if possible. My mailing address is included below. Many thanks. Ratana ---	Ratana Chuenpagdee International Ocean Institute Dalhousie University 1226 LeMarchant St. Halifax, Nova Scotia Canada B3H 3P7 Tel. 1-902-494-7162 Fax. 1-902-494-1334 Ratana.Chuenpagdee @dal.ca	

Fisheries Management Science Programme Logical Framework August 2004-March 2006.

NARRATIVE SUMMARY	INDICATORS OF ACHIEVEMENT	MEANS OF VERIFICATION	RISKS AND ASSUMPTIONS
SUPER GOAL			
Poverty eliminated in poorer countries through sustainable development	Measures of empowerment	National and international poverty monitoring	
GOAL			
Livelihoods of poor people improved through sustainably enhanced production and productivity of land/water interface systems.	- Food security indicators - Measures of change in capabilities, assets and activities.	- National and local level monitoring of poverty and livelihoods (household surveys, employment statistics etc.) - WHO reports - DFID evaluations	Political stability maintained.
PURPOSE			
Benefits for poor people generated by application of new knowledge to fisheries management systems.	By 2005, evidence of application of FMSP research products, in S Asia (Bangladesh & West Bengal) and SE Asia (Cambodia, Laos and Vietnam) for inland fisheries, and East Africa (Kenya and Tanzania), Indian Ocean SIDS and S. Asia (Orissa and Andhra Pradesh) for marine fisheries by at least two of the following: • Poor people • Institutions supplying services to the poor • Employers of the poor • Policymakers - to benefit target communities by achieveing, for at least one EFZ, coastal or inland capture fishery, and for two enhanced fisheries, one or more of the following: - less variable capture fisheries production, and yield stabilised at sustainable level to support sustainable livelihoods - fisheries productivity increase/improvement for enhanced fisheries leading to increased livelihood benefits - improved fisheries employment (numbers, income, quality) - improved access by poor people to fisheries knowledge generated by the Programme.	National and local level surveys of production, employment, food markets, nutrition in fisheries sector, including: - reports of target institutions - national production statistics - evaluation of fisheries management programme - research programme reports - Monitoring against baseline data	Poor people invest benefits to improve livelihoods.
OUTPUTS			
Existing FMSP research outputs relating to: the contribution of <u>capture</u> and <u>enhancement</u> fisheries to the livelihoods of the poor; fisheries management tools and strategies that could benefit the poor; and, the means to realise improved management, further developed, disseminated and promoted to relevant stakeholders at all levels.	1. By 31 March 2006, at least three fisheries information products developed to inform management research and influence policy (in target countries, international knowledge systems and DFID) 2. Project and programme level monitoring systems provide further benchmarking baseline data, record the take-up and adoption of FMSP products, and contribute to fisheries information products by 31 March 2006. 3. Information systems to support the co-management of fisheries important to the poor field tested with target groups and institutions in at least three locations in two countries, adapted, and widely promoted (in target countries, international knowledge systems and DFID) by 31 March 2006. 4. Fisheries assessment methods to inform sustainable management for improved livelihood benefits further developed with target institutions in at least two countries, widely promoted (nationally and internationally), by 31 March 2006. 5. Pro-poor <u>capture</u> fisheries	• Project FTRs • Programme highlights • Publications and other communications materials • Teaching materials • Fisheries management tools • Quarterly and annual reports • FMSP project database • FMSP Website • Requests for manuals and guidelines received • Uptake of research products by target institutions monitored and reported in Annual Report • National statistics and publications • International networks, databases and publications	Policy makers remain receptive to information on fisheries management Government policies continue to support co-management Government policies continue to support pro-poor approaches Target beneficiaries remain receptive to management approaches proposed. Stock enhancement process cost effective and socially appropriate.

NARRATIVE SUMMARY	INDICATORS OF ACHIEVEMENT	MEANS OF VERIFICATION	RISKS AND ASSUMPTIONS
	management strategies actively promoted into at least four target institutions (including the DFID bilateral country programmes) in two target countries and widely promoted (nationally and internationally) by 31 March 2006. 6. Pro-poor <u>enhancement</u> fisheries management strategies actively promoted into at least four target institutions in two target countries and widely promoted (nationally and internationally) by 31 March 2006.		

ACTIVITIES	SUB ACTIVITIES	INPUTS	IMPORTANT ASSUMPTIONS
1. Fisheries management-research and policy relevant products developed and promoted.	1.1. Databases of information for development planning and management of lake and river fisheries further promoted through Programme level uptake promotion activities (*cross cuts to 1.6*).	Existing projects: Cluster 1	**For all activities:** Target institutions and groups are able to mobilise and engage in uptake promotion activities within the time-frame of the Programme
	1.2. Information on the importance of fisheries within complex livelihood strategies of the poor, and the factors influencing their livelihood choices further promoted through Programme level uptake promotion activities (*cross cuts to 1.4 and 1.6*).	Existing projects: Cluster 2	Target institutions remain receptive to knowledge products
	1.3. New knowledge on the impact of climate change on fisheries and the people dependant upon them further developed and promoted, and related to similar outputs from other sectors, e.g. plant protection.	Existing projects: Cluster 3 Project R8475 7m 04/05-10/05	⇦
	1.4. A synthesis of information on fisheries within Common Pool Resource (CPR) issues, including access to them by the poor, co-management and, consensus building methods for their management, highlighting the importance of fisheries to the poor, drawing on existing FMSP material (activities 1.2 and 5.1), complementary material available from NRSP, and new sources.	Existing projects: Cluster2, Cluster 7, NRSP LWI PD104 i. Project R8467 7m 04/05-10/05 (CPRs) ii. Project R8470 7m 04/05-10/05 (co-management)	⇦ ⇦
	1.5. Further develop the Programme level communications capability to include: 1.5.1.Upgrading the FMSP website, and agreeing with DFID a strategy for its maintenance, and any software tools contained on it, beyond March 2006;	Existing activities: R4778 (Programme Development) R4778A Ongoing to 03/06	✦ ✦
	1.5.2. Further development and maintenance of an in-house electronic library of FMSP technical reports and software tools that will safeguard the FMSP database of knowledge for future use.	R4778A Ongoing to 03/06	
	1.5.3. Identification of Programme 'highlights' demonstrating the achievements of the Programme (by project or project cluster) and their promotion via appropriate media to DFID and national country policy makers, and more widely (e.g. via id21).	R4778A Ongoing to 03/06	✦
	1.6. Develop searchable database containing: summary project information; a bibliography; details of knowledge products; and, details of key research and policy messages, and make available for use by DFID, national country policy makers, and others, on the FMSP website.	Existing projects: information from all projects and Clusters R4778A. Dbase developed by 10/05, updated with new information till 03/06	✦
	1.7.1 Compile and synthesise relevant materials relating to participatory approaches in natural resources research from FMSP (particularly co-management), NRSP, PSP, CPP and FRP (and other programmes as appropriate)	Planned FMSP activities: R8470 R4778S: Develop a 6 page policy brief to DFID by 12/05.	✦
	1.7.2 Contribute as appropriate to other cross programme synthesis studies (climate change; CPRs; communications).	Planned FMSP activities (R8475); R8467	

ACTIVITIES	SUB ACTIVITIES	INPUTS	IMPORTANT ASSUPMTIONS
2. Project and programme level monitoring systems adapted and applied.	2.1. Evaluate and adapt project level monitoring to provide further benchmarking baseline data, record the take-up and adoption of FMSP products, and synthesise the information for DFID.	Existing activities. R4778 & Programme Management Programme Management & R4778 ongoing to 03/06	
	2.2. Assessment of the impact of the Fisheries Management Science Programme	Existing activities: R4778C R4778C extension to 12/05	✦
3. Information systems to support the co-management of fisheries important to the poor field-tested and widely promoted.	3.1. FMSP guidelines for designing and implementing fisheries data collection and sharing mechanisms for co-management applied with target institutions, adapted and with lessons learnt, widely promoted, including relevant DFID bilateral country projects.	Existing projects: Cluster 4 (*cross cutting, Cluster 6*) Project R8462 8m 03/05-10/05 (*4.2 cross cuts*)	⇦
	3.2. Synthesis of lessons learned in activities 3.1, 4.2 and 6.2	Defined activity within Projects 05/03 and 05/05 *cross cut to 05/09* and activity 1.4.ii PLs to collaborate.	
4. Existing FMSP fisheries assessment methods to inform sustainable management further developed and widely promoted	4.1. Synthesis of existing FMSP stock assessment tools and guidelines (incorporating management guidelines, *cross cuts 5.1*) further developed into relevant communication and teaching products for wide uptake promotion (within and beyond existing geographic targets) and their application to a range of fisheries tested and documented.	Existing projects: Cluster 5 (*Cluster 7 cross cuts*) Project R8468 7m 04/05-10/05	⇦
	4.2. FMSP participatory fisheries stock assessment tools, implementation tool kit, applied at target sites (Phase II, management planning and implementation), adapted and with documented experience, widely promoted, including to relevant bilateral projects such as the West Africa Sustainable Fisheries Livelihoods Project.	Existing projects: Cluster 6 Project R8464 8m 03/05-10/05 (*Cross cuts to 3.1 and 1.4.ii / 3.2*)	⇦
5. Existing pro-poor FMSP <u>capture</u> fisheries management strategies promoted nationally and internationally	5.1. Generic fisheries management guidelines contribute to cross cutting activities (including CPR), and further promoted through Programme level uptake promotion activities (*cross cuts to 1.4*).	Existing projects: Cluster 7 (*Cross cuts to 1.4 Project 05/02, and, 4.1*, Project 05/04)	
	5.2. Models generating national economic benefits through the control of foreign fisheries promoted for the benefit of East African countries outside the original study sites.	Existing projects: Cluster 8 Project R8463 8m 03/05-10/05	⇦
	5.3. FMSP guidelines for floodplain fisheries management and sluice gate control actively promoted to relevant target institutions including DFID bilateral country projects (e.g. Bangladesh, 4th Fisheries Project)	Existing projects: Cluster 9 (Also NRSP LWI, Bangladesh Suite 3 projects – Integrated Floodplain Management) Project 05/07 7m 04/05-10/05	⇦
6. Existing pro-poor FMSP <u>enhancement</u> fisheries management strategies promoted nationally and internationally	6.1. Develop and widely promote a decision support tool, and appropriate teaching and communications materials, enabling a wide range of target end users to apply existing FMSP quantitative assessment methods for fisheries enhancement.	Existing projects: Cluster 10. Project R8469 7m 04/05-10/05	⇦
	6.2. Adaptive learning approaches to enhancement fisheries management further promoted through Programme level uptake promotion activities and contributes to synthesis of information for co-management (3.2) (*cross cuts- 1.4.ii 1.6*).	Existing projects: Cluster 10, and inputs from projects R8462 and R8464 (see 1.4.ii)	⇦
	6.3. Further investigate the technical, economic and livelihood implications of pro-poor Fish Aggregating Devices (FADs), adapt guidelines for their deployment and use, and widely promote project findings, including beyond target locations.	Existing projects: Cluster 11 Project R8331, extension to 10/05	⇦

Key: Programme Development activity: ✦ ; Project activity (uptake promotion / synthesis): ⇦