ParFish: A Rapid Stock Assessment with Stakeholder Participation

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ABSTRACT

Information is key to responsible and effective fisheries management, but for many fisheries, particularly within small-scale fisheries, the necessary data are often absent due to a lack of human and financial resources. The Participatory Fisheries Stock Assessment (ParFish) methodology aims to address this issue by enabling a rapid stock assessment and also has the specific purpose of encouraging involvement of local fishers in the decision-making and management of the resource. ParFish is designed to be an adaptive and ongoing management process that can provide resource managers an opportunity to determine the likely status of the stock while developing data collection programs necessary to reduce the level of uncertainty in the results. The ParFish process can be summarized in six key steps: understand the context of the fishery; identify key stakeholders and agree objectives of management; undertake an assessment of the stock using existing stock assessment models; provide feedback and management planning; assist in the management planning; and, evaluate the ParFish process. Each of these steps is designed to encourage and facilitate/maximize the involvement of resource users and other stakeholders in the process. This paper introduces the ParFish methodology and describes real-world examples taken from pilot studies to illustrate each step in the process.

KEY WORDS: ParFish, rapid assessment, stakeholder, participatory

ParFish: Evaluación de Stock Rápida para Pesquerías con Participación de Usuarios

La información es la clave para una gestión pesquera responsable y eficaz, pero para muchas pesquerías, en particular para las islas estado pequeñas, no se dispone de la información necesaria sobre muchos stocks pesqueros debido a la falta de recursos humanos y financieros. Las herramientas de Evaluación Participativa de Stocks Pesqueros (ParFish) tienen como meta mejorar esta situación al prestar una rápida evaluación de stocks pesqueros y también tienen como objetivo específico incentivar la participación de los pescadores locales en el proceso de toma de decisiones y gestión del recurso. ParFish está designado como un proceso de gestión concurrente y adaptativo que puede proveer a los gestores de recursos una oportunidad de determinar el posible estado del stock mientras desarrolla programas alternativos de recolección de datos necesarios para completar formas de asesoramiento más tradicionales que pueden ayudar a reducir el nivel de incertidumbre en los resultados. El proceso de ParFish se puede resumir en seis pasos clave. Entender el contexto de la pesqueria, identificar los usuarios clave y acordar los objetivos de la gestión, completar la evaluación del stock utilizando modelos existentes, proporcionar comunicación y planeamiento de gestión, asistir en el planeamiento de gestión y evaluar el proceso ParFish. Este articulo introduce la metodología de ParFish y describe ejemplos reales provenientes de estudios piloto para ilustrar cada paso del proceso.

PALABRAS CLAVES: ParFish, Evaluación rápida, participación, usuarios

ParFish: Une Evaluation Rapide des Stocks avec Participation des Depositaires

L'information est primordiale pour une gestion responsable et efficace de la pêche, mais pour beaucoup de pêcheries, en particulier dans de petits états des îles de l'Archipel de la Mer Caraïbe, les données objectives sont souvent incomplètes ou totalement absentes à cause d'un manque de ressources humaines et financières. La méthodologie d'évaluation des stocks des pêcheries participantes (PARPE) vise à permettre une évaluation rapide des pêcheries et également le but premier d'encourager la participation des pêcheurs locaux dans la prise de décision et la gestion de la ressource. PARPE est conçu pour être un outil de gestion adaptable et fiable qui peut fournir aux directeurs de ressource l'occasion de déterminer le statut probable du stock tout en développant des programmes alternatifs de collecte de données nécessaires pour aider à réduire le niveau d'incertitude dans les résultats. La fonction de PARPE peut être résumée en six étapes principales : comprendre le contexte de la pêcherie ; identifier les dépositaires principaux et convenir des objectifs de la gestion ; entreprendre une évaluation des stocks en utilisant les modèles d'évaluation existants; fournir en retour une planification de gestion ; aider à la planification de gestion ; et, évaluer l'outil PARPE. Ce document présente la méthodologie de PARPE et décrit des exemples réels, pris à partir d'études pilotes, pour illustrer chaque étape dans le processus.

MOTS CLÉS: ParFish, évaluation rapide

INTRODUCTION

To implement effective fisheries management, information necessary to establish the status of the resource is paramount. Without information on stock status, the risk of over-exploitation significantly increases. As a direct result of poor management, many global fisheries are currently in decline (FAO 2007).

Small-scale fisheries in particular often lack key information, institutional capacity and human resources to undertake basic fisheries management (Berkes *et al*. 2001, FAO 2004). This may lead to inaction by government

agencies to implement any appropriate management measures, thus putting the resource at greater risk. Without effective control, many small-scale fisheries are managed using precautionary input controls, such as minimum size at first capture and closed areas/ seasons (FAO 1996). However, it remains unclear how effective these measures are without sufficient monitoring and surveillance.

The importance of engaging stakeholders in the management process and the potential benefits of fisher participation or co-management initiatives are well documented (Wilson *et al.* 2004). Participatory Fisheries Stock Assessment (ParFish) has been developed to provide a rapid and participatory approach to stock assessment that utilizes local knowledge from fishers and other stakeholders (Medley 2006). This rapid assessment is particularly useful where information on the resource is lacking and provides a framework to develop co-management initiatives. This paper describes the ParFish methodology and how stakeholder participation can benefit the stock assessment and management of the resource giving examples from case studies from around the world.

METHODS AND RESULTS

The ParFish methodology was originally developed under the Fisheries Management Science Programme (www.fmsp.org.uk) funded by the United Kingdom Department for International Development (DFID). The general concept of the ParFish process is based on a cycle of adaptive learning, evaluation and management planning, and implementation (Garaway and Arthur 2005). Stakeholder participation plays a key role in the overall approach. A toolkit is available that provides guidance on the process and the ParFish software that enables the analysis of the data, based on Bayesian statistics and decision theory (Walmsley 2005).

A series of pilot studies have been used to test the ParFish methodology. The results have shown that the approach can be used successfully to collect key information about small-scale fisheries and provides an important starting point to help develop and implement management plans, particularly in data limited situations (Wakeford *et al.* 2008). The following sections provide a brief overview of the ParFish process and illustrate how and where stakeholder participation can be utilized to maximize the benefits of the approach.

The ParFish Process

The ParFish approach is designed to be an iterative cycle of participatory adaptive learning. One cycle has been simplified into six key stages:

i) To understand the context of the fishery,
ii) To agree objectives of the study with stakeholders,
iii) To undertake the ParFish stock assessment,
iv) To give feedback of the results and initiate management planning,
v) To assist with the implementation of the management plans, and
vi) To evaluate the ParFish process (Figure 1).

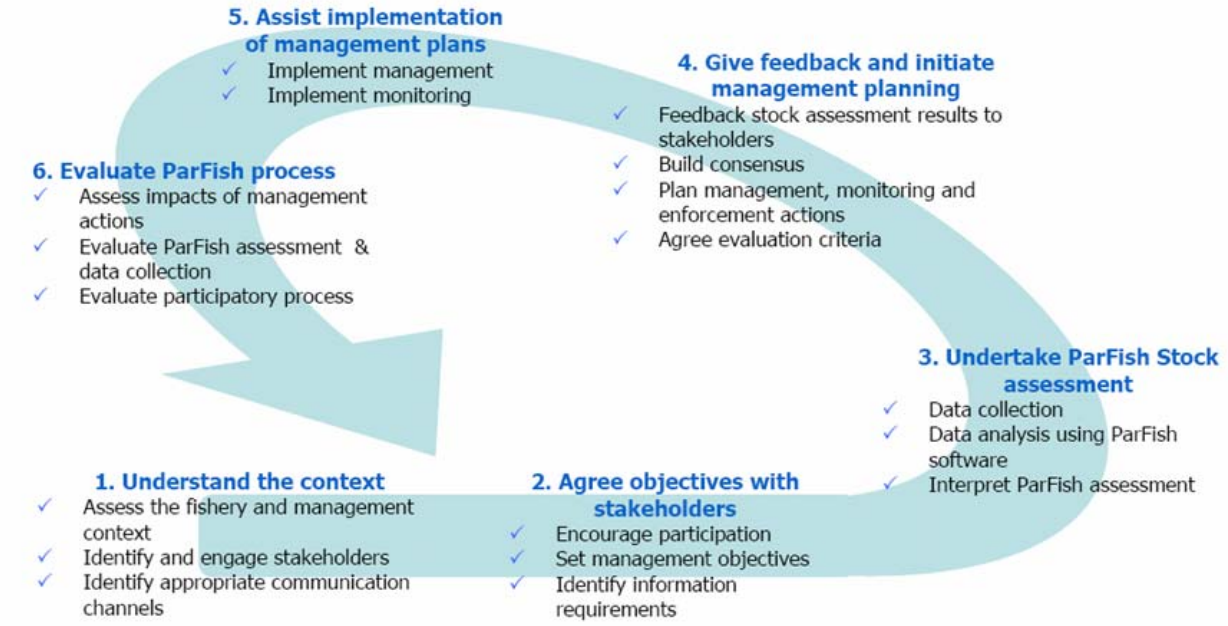

Figure 1. Stages involved in the ParFish approach (from Walmsley *et al.* 2005).

Several pilot studies have been undertaken to test and further develop the ParFish methodology (Table 1). The results generated from these studies are used in the following section to provide examples of how stakeholders have actively participated in the assessments and the broad lessons learned from the experiences.

Table 1. Pilot studies used to test and further develop the ParFish methodology. Interviews and data collection exercises undertaken in 2003; feedback meetings and workshops undertaken in 2005.

Location	Fishery	Date	Number of Fishers	Number of Interviews
Turks and Caicos Island	Conch	2003	c. 150	46
Zanzibar Island, Africa	Multi-species reef fishery	2003/05*	c. 350	92
India	Mud crab	2005	c. 5,000	110
Puerto Rico	Deep water snapper	2007	c. 40	31

STAKEHOLDER PARTICIPATION

The ParFish approach can be used as a tool to make a single rapid assessment of the status of the resource. However, considerable benefits, including more effective long-term management, may be obtained by involving stakeholders throughout the entire process and thus developing a mechanism for co-management. This section describes in more detail the benefits of stakeholder involvement in the ParFish process and potential obstacles identified from the pilot studies.

Initial Planning and Outreach

To ensure all stakeholders have the opportunity to become involved in the ParFish assessment, it is important to identify who are the individuals, groups and organizations that may be affected by, and that may influence, fisheries management. This can be achieved by undertaking initial planning and outreach meetings within the fishing community. This provides an opportunity for the assessment team to describe the ParFish process and identify all potential stakeholders. This is particularly important to help understand the full context of the fishery in order to frame the stock assessment and ensure all the relevant stakeholders are involved (stage 1).

The initial planning stages also enable the development of a stakeholder engagement plan to determine how different groups or individuals will be engaged in the ParFish process. Different stakeholders will be able to contribute different skills at different stages of the process. A communications plan can also be used to identify communication channels between stakeholders to determine how information will be shared. Different stakeholder groups with different backgrounds (e.g. fishers, government fisheries agency staff, environmental managers and NGOs) may need different materials and approaches to communicate ideas and information.

The pilot in Zanzibar was conducted with the main aim of developing and testing the data collection tools. Meetings were held with community leaders and local fishers to secure their participation, but the broader ParFish process including stakeholder identification and the planning processes of stages 1 and 2 did not take place, as they had not been developed at the time. This led to difficulties later, when the assessment results were presented and options for management measures discussed, during stages 4 and 5. Migrant fishers living outside the region and fishing in the area at certain times of the year had not been included in the process. Consequently, when stakeholders tried to agree and reach consensus on future management options, problems were encountered because it was felt any voluntary measures would not be adhered to by the migrant fishers. Similarly within Puerto Rico, the training workshop that was used to inform key stakeholders and interviewers about the project and develop data collection tools, failed to identify the importance of including stakeholders from all regions. This made subsequent data collection from all areas considerably more difficult and time consuming.

Inception Meetings and Training Workshops

To ensure the benefits of the ParFish approach are available to all stakeholders, it is important to agree a set of objectives and identify the range of potential problems and issues each group may have. These can be accomplished through a series of inception meetings to engage the stakeholders at the beginning of the process (stage 2).

Including stakeholders at the beginning of the process will also help them to better understand the results of the assessment (stage 3) and to take an active role in management planning (stages 4 and 5). Although fishers have a key role in the entire assessment, other stakeholders may need only to participate in specific stages of the ParFish process. The inception meetings can also be used to collect valuable information about the fishery such as the location of main fishing grounds as well as documenting fisher's concerns about the fishery. In Zanzibar, a series of meetings was held with various stakeholders to obtain background information on the fishery and explain basic concepts of the ParFish approach including fish stock dynamics, fisheries management and uncertainty (Figure 2).

In addition to the inception meetings that include a range of stakeholders, a training workshop can be used to introduce the data collection techniques and tailor the questionnaires to be used in stage 3. The workshop is designed to target a more limited group of stakeholders that will be responsible for helping to organize the data collection.

Figure 2. Generating management priorities from stakeholder meetings in Zanzibar.

In Puerto Rico, due to the small size of the fishery (approximately 40 full-time commercial fishers), the training workshop also served as an outreach meeting to inform key stakeholders from the fishing community and management agency staff about the ParFish assessment. Key stakeholders were then tasked to provide feedback from the meeting to all relevant fishers. It was found however, the fishery is conducted from two main areas of the island, and the fishers involved in the training workshop all came from the same area. As a result, fishers from the other area were not included in the training workshop and did not receive information about the assessment prior to interviews taking place. This caused significant delays in the data collection stage and reduced the likelihood of fishers participating.

Data Collection

Although general background information may be collected about the fishery, the ParFish assessment also requires specific information from individual fishers. This is used to estimate the status of the stock and develop management options.

During the training workshop two forms of questionnaire are developed to collect quantitative information from fishers: stock assessment and fisher preference. The former is designed to collect information to calculate statistical probability distributions (or priors) of parameters in the stock assessment model, using the ParFish software, to determine stock status. The preference interviews are used to score individual fishers' utility for alternative outcomes for the fishery based on changes in fishing effort (costs) and expected catch (benefits), which helps in developing management options for the fishery (Walmsley *et al*. 2005).

Participatory mapping is a process where fishers identify the areas where they fish, either individually or in groups (Figure 3). This helps with understanding the extent of the fishery and is particularly important if a fishing experiment is conducted, as it helps scale the fishing experiment up to the whole fishery. In Zanzibar, fishing areas had previously been identified by going out in a boat with an experienced fisher, who indicated where the fishing grounds were, and coordinates were recorded by GPS. When the participatory exercise was carried out, a number of extra fishing grounds were identified, the coordinates of which were then mapped with GPS. Figure 3 shows the difference in maps created without the participatory mapping, and with participatory mapping.

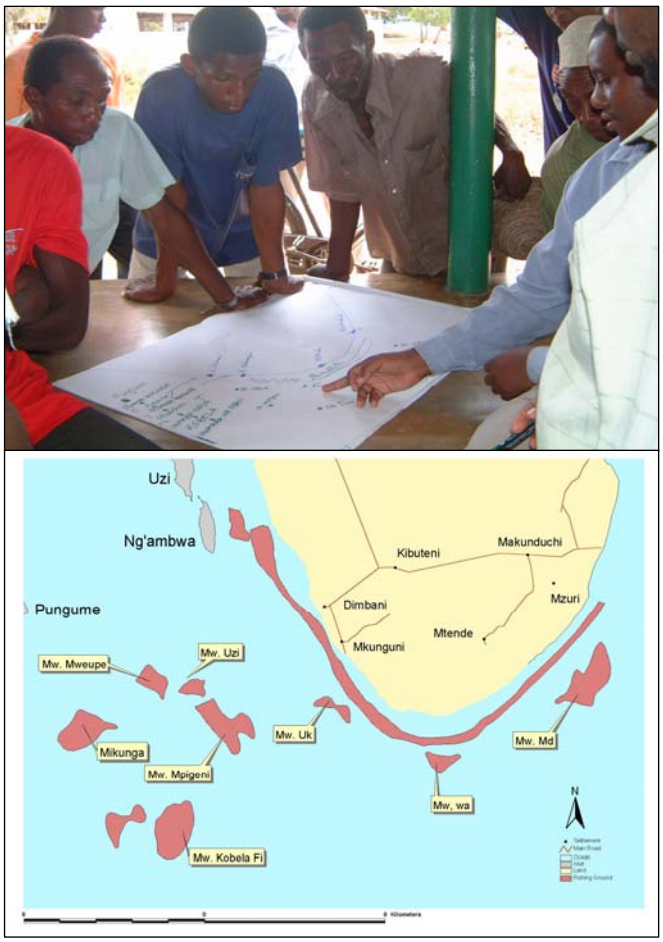

Figure 3. Participatory mapping exercises of fishing grounds within Kizimkazi region, Zanzibar.

In addition to fisher interview data, ParFish can utilize a range of scientific information such as catch and effort data, underwater visual census and fishing experiments. Fishing experiments focus fishers' activity on a specific area of the fishery, so that it is fished intensely over a period of 7 - 10 days. Catches and effort are recorded during the period, and catch per unit effort should decline over the course of the experiment as the stock is locally depleted. The area should be chosen so that immigration/ emigration of fish into and out of the experiment area is minimized over the course of the fishing experiment. This provides informative data on the catchability, of the stock, which is used in the stock assessment model. It may also provide information on the initial stock biomass. The

experiment can also be carried out in conjunction with an underwater visual census to provide a fisheries-independent index of stock size.

A fishing experiment was carried out in the Zanzibar pilot, and this was the aspect of ParFish that fishers remembered most clearly a year later. They recalled that over the course of the experiment, their catches declined, and recognized that they could themselves have an impact on the stock – something that they had not recognized previously. In Turks and Caicos Islands, auxiliary fisheries-dependent catch and effort data were available in addition to the results of a ParFish stock assessment (Medley and Ninnes 1999). The results were used to compare with the ParFish assessment and include them in the analysis to see if the combined data improved the overall results. The results of the ParFish assessment demonstrated that high levels of uncertainty can occur from a single ParFish assessment. To help reduce this level of uncertainty, multiple cycles of participatory adaptive learning can be used to test and refine the results of the ParFish approach.

Dissemination Workshops

The assessment team is responsible for running the stock assessment with the ParFish software to produce a range of outputs related to stock status and fishers' preferences for alternative management options. These preliminary results must be interpreted and presented back to fishers and government agency staff as part of a dissemination workshop (stage 4). This will identify whether the stock is overfished and whether overfishing is occurring. The workshop can also be used to help build consensus on the results obtained, such as the status of the resource, identify priority issues for management and determine solutions.

In Zanzibar, two meetings were held with fishers to provide feedback on the results of ParFish stock assessment and to discuss possible actions that the fishers could implement to start being actively involved in management. The assessment showed there was high uncertainty in the results, and the current state of the stock is unknown. However, there is about a 50% chance that it is overfished. The fishers in general agreed with this, and that fishing effort should be reduced. This led to discussion on a number of management options that included a reduction in fishing effort, closed areas and the collection of more information to improve the assessment. A reduction in fishing effort was considered difficult to implement without the involvement of other fishers such as migratory fishers from outside the region (Dar es Salaam, Tanzania). The fishers agreed that the next step would be to bring together all stakeholders from the region to discuss the problems and potential actions that can lead to improvements in the situation (stage 5). The whole process helped develop a dialogue and a more trusting working relationship among all parties involved. Previously, the fishers from the different villages would not meet to talk about the issues involved, and there was suspicion between the fishers and the government agencies. Jamhuri, a fisher from Zanzibar, said "I have been able to voice my concerns on the fisheries and to discuss with them how to make effective marine protection measures".

In the India mud crab fishery pilot study, a post-assessment dissemination workshop brought together fisher representatives from all the villages, managers, scientists, politicians and NGOs, brought other management issues to the surface. For example, an NGO had carried out mangrove rehabilitation which fishers believed had negatively affected the crab nursery grounds. Recognition of these issues is the first step towards their resolution and fishers welcomed the opportunity to have their voices heard by the government agencies involved in fisheries.

Management Planning and ParFish Evaluation

It is important that following the discussion of management options between stakeholders during the dissemination workshops (stage 4) that the process continues and develops new or modify existing management plans (stage 5). For this to be successful, it is necessary to build consensus amongst all stakeholders on the priority issues that need addressing and how they may be addressed. This may take several multi-stakeholder workshops to focus the range of topics and start developing an initial management plan. Following identification of priority issues, it is important to set roles and responsibilities, such as what needs to be implemented and by whom.

In Zanzibar, a series of multi-stakeholder workshops were held to raise issues of concern and build consensus on the range of possible solutions. A wide range of issues were highlighted, from education on sustainable use of marine resources to zoning of areas. For each priority issue, further details were identified on how the issue would be addressed, by which group of stakeholders and over what time scale. This process can take considerable time and effort by all stakeholders to achieve, and it requires long-term commitment that may require facilitation to complete (Figure 4).

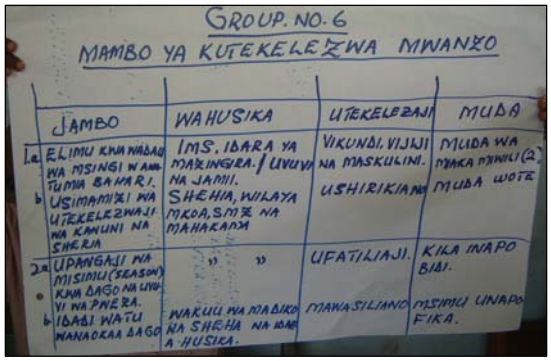

Figure 4. Examples of output generated from management planning workshop used to prioritize issues in multi-species reef fishery, Zanzibar.

The final stage is to evaluate the ParFish process. This allows a broad assessment to be made on what has been learned from the experience in terms of the process and outcomes. This includes the context of the approach and whether it was well understood, level of participation by stakeholders, the objectives achieved, success of data collection and assessment, methods used for communication, and management planning. ParFish is designed as an adaptive learning tool and the lessons learned from the evaluation should be used to formulate a new baseline for future work. In this way, additional cycles of the ParFish process can be viewed as an iterative process that aim towards achieving higher long-term sustainable benefits from the resource.

DISCUSSION

ParFish can be viewed simply as a tool to obtain a rapid assessment of stock status in data-deficient fisheries. However, the ParFish process has been designed to be a cycle of participatory adaptive learning, evaluation, and management planning and implementation.

The results of the pilot studies have shown that without the full support from stakeholders in a participatory manner, the results obtained from a single ParFish assessment may be limited in scope. For example, without auxiliary information from the fishery, such as historical catch and effort time series or fishing experiments, the Turks and Caicos pilot study showed the initial results of the assessment can be highly uncertain. Although efforts can be made to reduce the level of uncertainty through improved data collection techniques, this may not always be sufficient to develop sustainable catch controls. The ParFish process however, is designed as an adaptive learning and management tool and the cycle of events can be repeated numerous times in an iterative manner to help improve the results and reduce uncertainty. If the results indicate a reduction in fishing effort is required, without stakeholder 'buy-in' to the process, there is no guarantee that the advice will be considered appropriate or implemented. Furthermore, rapid assessments are unlikely to build rapport with the fishing community, who may be less inclined to co-operate in future management initiatives.

The results from the pilot studies have shown a range of potential benefits can be achieved by including full stakeholder participation in the ParFish process. For example, it can provide an opportunity for stakeholders to become more involved in the management process and decision-making and to become more responsible for the status of the resource. This in turn can lead to the development of new or support existing co-management initiatives. It is important however, to ensure that all stakeholders are identified early in the process and that a comprehensive outreach program is initiated. These activities help to increase the level of participation in the data collection stages in addition to reducing potential conflicts during management planning in the later stages of the ParFish process.

With the commitment of stakeholders to improve management through an iterative cycle of adaptive learning, an increase in benefits may be observed over time. During this period, auxiliary information can be collected and used in a revised ParFish assessment to further reduce the level of uncertainty in the results. Although obtaining information to determine the status of the stock can be rapid, it has been shown that developing consensus on priority issues and developing subsequent management plans can take considerably longer. The ParFish process requires multiple cycles to re-evaluate different outcomes. In this way, new priorities may be identified by stakeholders and changes made to the management plan that lead to increased benefits.

The ParFish process has been shown to be successful in helping improve management of small-scale fisheries where information is lacking. However, such fisheries are often associated with open-access, and caution should be given to trying to improve the status of the resource without effective means of controlling fishing effort. Under these circumstances, any benefits gained from the process can be quickly diluted as more fishing effort enters the fishery. These considerations have been raised during the management planning workshops. Further improvements to the ParFish assessment can be gained from developing new data collection programs and research to support the results generated. This may include fisheries dependent data (e.g. catch and effort) or fisheries independent data (e.g. fishing experiments, mark and recapture, and underwater visual census).

CONCLUSION

ParFish can be used simply as a rapid assessment tool to determine stock status. However, the participatory framework and involvement of stakeholders can provide a number of important additional benefits. These include an opportunity for stakeholders to become more involved in the management process and decision-making and to become more responsible for the status of the resource. Activities to help increase the level of participation in the data collection stages can help stimulate new research initiatives and develop more robust assessments on the status of the stock.

The ParFish approach can be used to kick-start management initiatives enabling a rapid start to the discussion and implementation of management measures even if the initial results remain uncertain, which can move management authorities from inaction to action. Increased stakeholder participation can also help reduce potential conflicts during management planning in the later stages of the ParFish process. This in turn can lead to the development of new or support existing co-management initiatives. It is important however, to ensure that all stakeholders are identified early in the process and that a comprehensive outreach program is initiated.

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LITERATURE CITED

Berkes F., R. Mahon, P. McConney, R. Pollnac, and R. Pomeroy. 2001. Managing Small-Scale Fisheries: Alternative Directions and Methods. International Development Research Centre, Canada. 308 pp.

FAO/RAP/FIPL. 2004**.** A research agenda for small-scale fisheries. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication No. 2004/21 and FIPL/C 10009. FAO, Rome, Italy. 42 pp.

FAO. 1996. Precautionary approach to capture fisheries and species introductions. Elaborated by the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6-13 June 1995. FAO Technical Guidelines for Responsible Fisheries. No. 2. FAO, Rome, Italy. 54 pp.
http://www.fao.org/DOCREP/003/W3592E/w3592e01.htm#bm01

FAO. 2007. State of World Fisheries and Aquaculture 2006. FAO Fisheries and Aquaculture Department. FAO, Rome Italy. http://www.fao.org/docrep/009/A0699e/A0699E00.htm

Garaway, C.J. and R.I. Arthur. 2005. Adaptive learning: A practical framework for the implementation of adaptive co-management. Lessons from selected experiences in South and Southeast Asia. MRAG Ltd., London, England. 44 pp.

Medley, P.A.H. and C.H. Ninnes. 1999. A stock assessment for the conch *Strombus gigas* fishery in the Turks and Caicos Islands. *Bulletin of Marine Science* **62**:153-160

Medley, P.A.H. 2006. ParFish – Participatory Fisheries Stock Assessment. Pages 149–162 in: D.D. Hoggarth, S. Abeyasekera, R.I. Arthur, *et al*. (Eds.) *Stock Assessment for Fishery Management – A framework Guide to the Stock Assessment Tools of the Fisheries Management Science Programme* (FMSP). FAO Fisheries Technical Paper No. 487. FAO, Rome, Italy. 2006. 261 pp.

Wakeford, R.C., S.F. Walmsley, R.J. Trumble, and P.A.H. Medley. 2008. Improving management of coral reefs fisheries in data limited situations: Experiences from the ParFish methodology. Proceedings of the 11th International Coral Reef Symposium, Ft. Lauderdale, Florida, 7-11 July 2008. 5 pp.

Walmsley, S.F., Howard C.A., and P.A.H. Medley. 2005. .Participatory Fisheries Stock Assessment (ParFish) Guidelines. MRAG Ltd., London, England.

Wilson, D.C., J.R. Nielson, and p. Degnbol. 2004. The Fisheries Co-management Experience. Accomplishments, Challenges and Prospects. Chapman and Hall, London, England.