



A Guide to Implementing an Ecosystem Approach to Fisheries Management (EAFM) within the Western and Central Pacific Region.

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Dr Rick Fletcher
FRDC ESD Subprogram
PO Box 20 North Beach
WA 6920
Australia

rick.fletcher@fish.wa.gov.au
www.eafm.com.au

AND

Pacific Islands Forum Fisheries Agency
Honiara
Solomon Islands
www.ffa.int

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This edition is unlikely to be the final version; changes are expected to be made at regular intervals when further information and experiences indicate that significant improvements can be made.

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Abstract

The Ecosystem Approach to Fisheries Management (EAFM) is just one of a large number of concepts that have been generated over the past decade to describe taking a more comprehensive approach to the management of natural resources. The key elements of all these types of approaches within a fisheries context, is that they require dealing with all the ecological consequences of fishing and also understanding the social and economic implications that this activity provides.

Developing this guide is part of an initiative of the Forum Fisheries Agency to introduce EAFM to the management of fisheries to the Pacific region, especially the tuna fisheries of the western and central Pacific region (WCPFC).

For the WCPFC, this initiative should be seen as providing the tools to help put into practice what has been outlined in Article 5 of the WCPO Convention. Thus, the guide covers issues related to target species, non target species, other dependent species within the ecosystem, minimising waste and pollution, endangered species, biodiversity, optimum utilisation, the welfare of the various states involved including the interests of artisanal and subsistence fishers.

Consequently, the implementation of EAFM by the WCPFC Commission should not be seen as a major change in direction that will require adding many extra elements. Instead, this guide outlines a framework that should help coordinate current activities, making them clearer by giving a 'home' to many of the strategies and monitoring programs already being undertaken.

The guide outlines the four steps required to fully apply EAFM:

- Step 1 – Determine the scope of the assessment – develop a clear description of what you are trying to manage/assess
- Step 2 - Identify issues across the full range of EAFM and helping to decide what you want to achieve for each issue given the requirements of any convention, country needs, local requirements and global attitudes. The outcomes wanted can be based on ecological concerns, economic realities or social attitudes. It is necessary to work out which of these are being used because they have different implications for what actions should be taken.
- Step 3 - The decision as to whether to address an issue should be based on risk analysis/assessment and the precautionary approach.
- Step 4 - To work effectively, there must be clear operational objectives and ways to assess if performance against these objectives is acceptable or not. Depending upon the issue, management actions may be implemented by the whole Commission; at a country level, or within some areas of a country. The management system must also include the monitoring and review of performance outcomes and what will happen if performance is not acceptable.

It is not necessary for all four steps to be completed for this system to be of value. It can be used at a number of levels depending upon the circumstances. Thus, only getting to the risk assessment component can be highly useful, the system can also be used to review existing management plans and even just using the general concepts outlined can help with the overall approach to management.

Section 1 Why are we Implementing EAFM?

1.1 Background

Why is EAFM being promoted by the FFA?

In the past ten years there has been a worldwide shift to incorporate more holistic forms of management for natural resources. This change has been particularly evident within marine systems, and has been most commonly focused on fisheries management where one of the numerous titles for such a concept is Ecosystem Approach to Fisheries Management (EAFM).

The major change required for these forms of management is that not only should there be management of the target stocks, but any impacts on the broader ecosystem arising from the fishing activity need to be considered, and importantly, the social and economic outcomes of this activity compared to other potential uses. This has resulted in assessments now being required of by-catch levels and a general drive to introduce more environmentally friendly fishing methods and techniques. The tuna fisheries of the western and central pacific region are one sector that has been actively addressing these issues.

Oceanic tuna fisheries are one of the major components of a complex marine ecosystem that exists in the western and central pacific region. Pacific island countries who are influenced by their obligations to various international and regional management regimes and treaties, have been involved in the development of viable management arrangements that will be effective in addressing issues such as resource sustainability, fishing capacity and effort control, maximizing benefits from resource utilization and mitigating impacts on the environment and non-target species. These issues are specifically covered by the objective of the Convention on the Conservation and management of highly migratory fish stock in the western and central Pacific Ocean (WCPO) which is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stock in the WCPO in accordance with the United Nations Convention on the Law of the Sea (1982), and also many of the articles within this convention.

This guide forms part of an initiative of the Forum Fisheries Agency to introduce EAFM as a more sophisticated approach to fisheries management in the western and central Pacific region. It is designed, therefore, to be of assistance in efficiently implementing the objectives and articles that are outlined in the WCPO Convention.

It is recognised that our general knowledge of the complex marine ecosystem in this region is limited, and many of the possible affects of tuna fisheries are poorly understood. Consequently, EAFM is a long-term undertaking for FFA member countries in an effort to reduce uncertainty in the decision making process particularly for the sustainable development of the region's tuna resources. It is expected that this

initiative should increase the long-term benefits for the communities in this region from the optimal utilisation of these resources.

1.2 Introduction

This section provides a general introduction to explain the concept of EAFM and how it relates to other current fisheries management arrangements and ecosystem related initiatives.

There are a large number of terms and concepts being used to describe how to manage natural resources in a more holistic manner, many of these relate to the management of fisheries resources. Some are relatively new, including Ecosystem Based Management (EBM; e.g. Ward et al., 2002), Ecosystem Based Fishery Management (EBFM; e.g. Brodziak & Link, 2002), Ecosystem Approaches to Fisheries Management (EAFM; e.g. Garcia et al., 2003) and Integrated Oceans Management (IOM; e.g. NOO, 2004). Others have been around for over 10 years, such as Sustainable Development (SD; WSED, 1987) and Ecologically Sustainable Development (ESD; CoA, 1992).

Such a large number of terms can be somewhat confusing but it is important to recognise that they are all just variations on a theme (Fletcher, 2006). Thus, sustainable development, (or ESD as it is known in Australia) should be the overall goal for governments and each of the other terms describe strategies that are being used by various sectors/agencies to work towards this overall goal (Fletcher, 2006). EAFM is, therefore, just one of a growing number of strategies that describes the taking of a more comprehensive approach to the management of natural resources (this term covers fisheries resources). All of these terms recognise that management must deal with the full set of ecological consequences of an activity and also understand the social and economic implications that the activity provides.

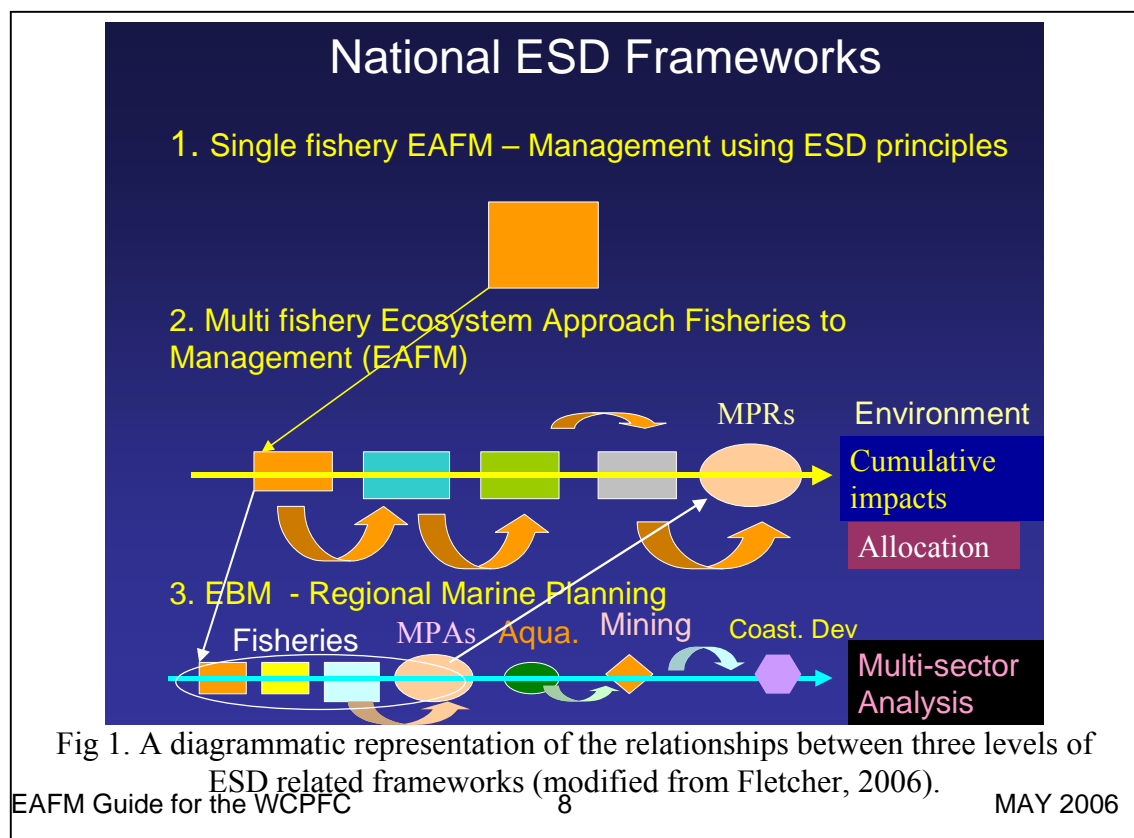
The key difference amongst these various strategies is the scope of the issues that they are attempting to deal with. This can range from a single activity operating in a small locality, up to all the activities that may be occurring in an entire region of an ocean. The defining element for EAFM (and for EBFM), is that the scope of issues covered is restricted to those that can be managed, or at least directly influenced by, the relevant fisheries management agency (hence the “F”). EAFM can, therefore, cover part of a fishery, all the issues affected by an entire fishery, up to managing the full collection of fisheries operating in a region (which should also deal with their cumulative impacts and the allocation of access amongst the individual sectors). The level chosen will depend upon the scope of the assessment required and the jurisdiction of the agencies involved. To implement higher levels such as Ecosystem Based Management (EBM) would, however, not only require the management of all

fishing related activities, but all other activities operating within the region¹ (See Fig. 1 for details).

The issues outlined in the WCPO Convention are fully consistent with implementing EAFM. Article 5 of the convention outlined what is expected for “*target species, non target species, other dependent species within the ecosystem, minimising waste and pollution, endangered species, biodiversity, optimum utilisation, the welfare of the various states involved including the interests of artisanal and subsistence fishers*”. Thus, the implementation of EAFM should not be seen as either a major change in direction for the WCPO Commission nor will it require adding EXTRA elements. Rather, it is largely a framework that should help coordinate current activities, making them clearer by giving a ‘home’ to many of the strategies and monitoring programs already being undertaken.

The implementation of EAFM should not be seen as either a major change in direction for the WCPO Commission nor will it require adding EXTRA elements.

Implementing these concepts has often proven difficult (e.g. Staples, 1997; Chesson et al., 2000). Since early 2000, Australia has been one of the regions where there has been substantial progress. A major reason for these advances has been connected to the requirement for any export-based state fishery and all commonwealth managed fisheries to complete applications to the federal environment agency against a set of guidelines for sustainable fisheries (CoA, 2001). If the application was not accepted, the fishery was at risk of being unable to continue exporting their catch. This was a powerful incentive to implement systems capable of providing the information needed across all the ecological elements of ESD.



Such incentives are becoming more wide spread around the world. This is occurring at both the government level (US ban on prawn/shrimp imports without turtle excluder devices); or at the market/wholesale level (e.g. Sainsburys, Unilever) leading to third party auditing schemes such as the Marine Stewardship Council system of certification. This situation is likely to get more common in the future.

Whilst external pressures will increase the need to implement EAFM style management, the real benefits to a fishery from doing this should also come from the increased efficiency and better management outcomes that could also result from implementing these systems. For the majority of fisheries around the world, if the management systems imposed do not improve the situation at the local level, they are highly unlikely to persist in the longer term. Consequently, the challenge is to make a system that not only produces outcomes that external parties may consider more appropriate, but preferably a system that assists the management outcomes for all the local stakeholders in the fishery – including the fishers, managers and local communities. Thus, the drive for EAFM must come from within the country/community/industry or it is unlikely to succeed.

To assist with meeting the increased assessment needs in Australia in an efficient manner, a framework for the reporting and assessment of wild capture fisheries against the principles of Ecologically Sustainable Development (ESD) was developed. This framework (which was based upon an initial system developed by Chesson et al., 2000) outlines a four step, risk based process to generate reports on all relevant ESD issues for a fishery; including impacts on target species and the broader ecosystem, and the potential social and economic outcomes and the current governance systems (Fletcher et al., 2002, 2005; see Fig 2 for outline of key components).

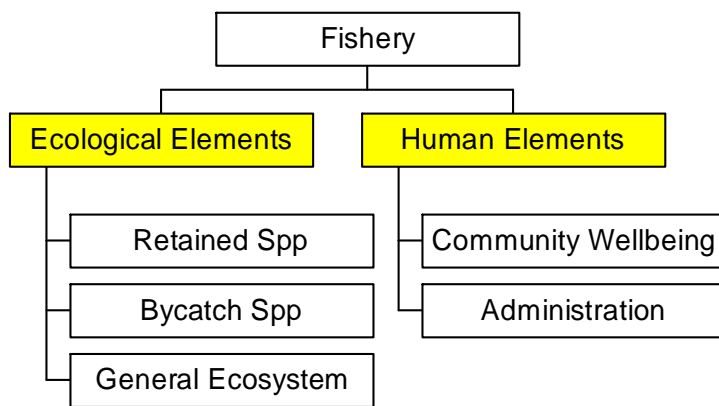


Fig. 2 The five key components of EAFM.

Given the success of this system in meeting these needs, this approach has been chosen as the basis for the development of a system specifically designed for use in the tuna fisheries of the Pacific region. Whilst a number of changes have been made to the framework which relate both to the specific circumstances of fisheries management in the Pacific but also from further experiences using the system, it is essentially the same process but the pathways and the levels used have been suitably adjusted.

One of the key issues that will need to be covered is that the scope of some issues may be difficult to define given that some fisheries that deal with transboundary and highly migratory species such as the tuna fisheries operate at island, country and region levels. There will also be a need to increase the emphasis on the social and economic analyses in the system as this is crucial in the decision making process especially in co-management regimes that are currently practised in most fisheries of the Pacific countries. There is likely to be different concepts of acceptability for some elements, particular interactions with species of customary importance both among countries and regions.

When fully implemented, these types of systems should greatly assist decision-making because they provide a framework for understanding the full implications of any management decision. Initially, however, their main value will be in identifying and assessing all relevant issues and the setting up of processes to enable their management to be undertaken effectively and efficiently. Therefore the key benefit from using this EAFM process should be to help all stakeholders recognise the impacts along with any overlaps between regions and between fisheries and any conflicts with outside country interests/benefits.

A key point to remember though, is that the system by itself, does not provide the 'answers' – it merely assists you in the process of trying to find these. The issues that need to be addressed and how you address these must come from the people involved in the management of the fishery. These may vary among countries and parties who participate in the management of a shared resource.

The system by itself, does not provide the 'answers' – it merely assists you in the process of trying to find these

1.3 Overview

This section provides an overview of the methods – it explains the system to a level sufficient for those who will not be directly undertaking the assessment but want to understand what it is and how it works.

To apply EAFM to a fishery is basically similar to completing the processes that are commonly used in all risk management systems (Standards Australia, 2004). In reality, managing fisheries is just managing risks. Therefore you need to identify all the good and bad things associated with an activity (in this case fishing) and then develop management plans for those things that need controls to maintain or improve performance at adequate levels.

The four main steps involved in this process are outlined above in Fig. 3. They involve:

- (1) determining the scope of the assessment – develop a clear description of what you are trying to manage/assess;
- (2) given the scope, identify all the issues that need to be assessed; preferably across the five key areas of EAFM (retained; non-retained; ecosystem, community; administration) and agree on the values wanted to be achieved for each of these ;
- (3) determine, using risk analysis, which of these issues really needs to be managed directly; and
- (4) for those issues requiring management, establish the levels of performance that are acceptable, the management arrangements that will be used to achieve these levels, and the review processes needed to assess performance.

Step 1. Defining the Scope

This is the most important step because it affects how the rest of the process will operate. The scope of the assessment should be defined by the responsible management agency (in most cases for Pacific countries, this is the Fisheries Management authority) - how do they want to manage the activities? The system can operate at any one of these levels –

- A subset of a fishery (either geographically separated or jurisdictionally separated)
- An entire fishery, even if this covers multiple areas/species/fishing methods
- A collection of fisheries

Where it is clear what is being assessed, the system works much more effectively. Although it must be acknowledged that the simplest assessment are of easily identifiable fisheries.

The other key factor is that it can really only work when the scope aligns fairly closely with powers of the management jurisdiction. If you do not have the power to regulate or manage the activity – then you really cannot establish objectives or set

performance levels nor introduce the management arrangements to achieve these². So there needs to be some reality in how large the scope of the assessment can be. To assist in defining the scope it may be useful to answer the following questions:

- What fishing methods are included (e.g. long line, purse seine, other)?
- Which groups of fishers are included (e.g. all commercial, foreign, local; artisanal, sport)?
- What species are covered (just the target species or non target species)?
- What spatial area does it cover/not cover (entire EEZ; territorial waters, a depth strata, a distance from land; waters in between islands)?
- What management agencies are involved (fisheries; enforcement; customs; immigration, the Commission, environment etc)?

For the purposes of this guide any entity that is to be assessed will be called ‘a fishery’ whether it covers a part, a whole or a collection of activities.

Effectively, for this region the two main levels will be:

- Regional (e.g. at the WCPO Commission level)
- Country /Local (e.g. within country)

Step 2 How are the Issues Identified?

Having identified the scope, the next step in the EAFM process is to identify all the relevant issues (given the scope) across the five components of EAFM (retained species, non-retained species, ecosystem; community and administration) for the ‘fishery’ being examined.

The process is assisted by using, and modifying, a set of “*generic component trees*”. There is one *generic component tree* for each of the five components of EAFM. Each generic tree has most of the types of issues that are likely to be relevant to fisheries across each of these categories – irrespective of which level of fishery is being examined. This maximises consistency and minimising the chances of missing issues.

These are, however, only the starting point, each fishery needs to tailor the trees to suit their individual circumstances. This can include splitting some of the issues to have greater detail, adding issues that were not there, or removing those that aren’t relevant. The need to add, remove or alter the trees will depend upon the fishing methods that are used, the areas of operations, the species involved and the types of communities where the fishery operates.

These trees can be altered using the organisational chart software³ available in MS Office, using another package or just drawing on paper.

² . The system does, however, provide a way to efficiently identify these issues to assist with opening dialogue with other relevant parties

³ The trees in this guide have been generated using ms organisation chart Version 2, which was standard in Windows 95 to Windows 2000. The version in XP and 2003 is less flexible but these versions are located in Appendix 4. Version 2 can still be downloaded from Microsoft [see <http://www.microsoft.com/office/orkarchive/2003ddl.htm>]

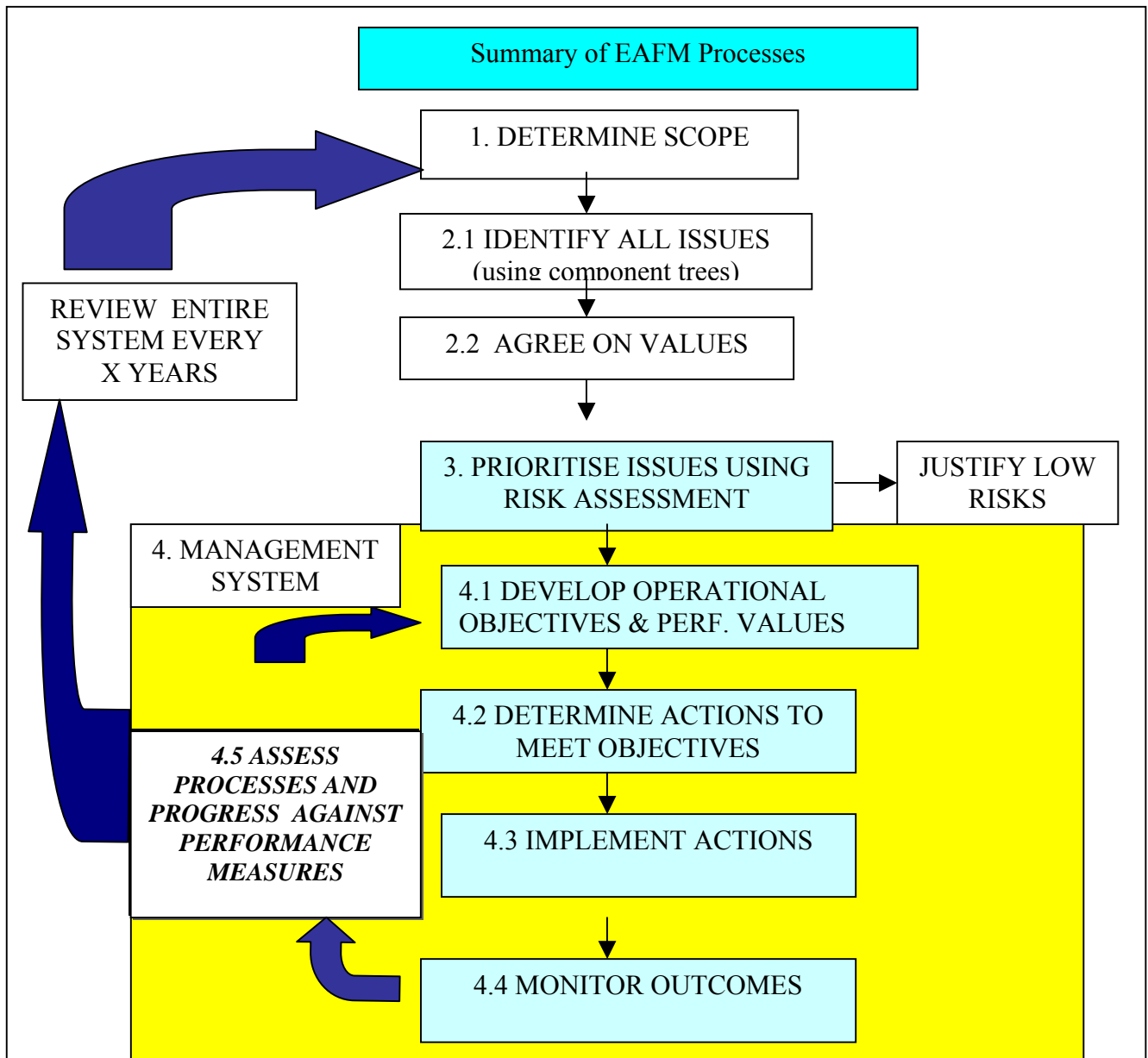


Figure 3. Outline of the EAFM process

Having identified the issues, it is important that the values that the management agency./community wants to achieve for each of these is agreed/determined. It will be seen later that different values (i.e. is a sustainability outcome wanted or is a social value outcome more important) can result in very different management outcome being generated and it is vital that these are agreed up front.

Step 3. How are the Issues Prioritised - Risk Analysis/Assessment

A large number of issues can be identified for a fishery but their importance varies greatly. Consequently, it is necessary to have some way of prioritising amongst the issues so that only those issues that require management receive what are usually rather scarce resources.

To determine the priority of issues and therefore the appropriate level of management response, the process uses risk analysis methods. The risk analysis tool (which is

based upon the AS/NZ Standard, SSA 2004) assesses the ‘risk’ of not meeting your objectives (which are affected by the values/outcomes wanted – see above). It works by assigning a level of consequence (impact) (from low to severe) and the likelihood (probability) of this consequence actually occurring (from remote to likely) to generate an estimate of the risk (from low to high) for each issue. Only medium and high risk issues require direct management with high risk issues probably requiring additional management.

This assessment must also include appropriately detailed justifications for why the levels of consequence and likelihood were chosen. This allows other parties who were not part of the process to be able to see the logic and assumptions behind the decisions that were made. It also helps when reviewing the issue some time in the future – unless you know why you choose the levels, it will be hard to know if anything has changed that may require a shift in the risk levels and therefore management actions. This also assists in understanding the knowledge “gap” analyses/uncertainties.

Most importantly, this is a tool to help you decide what you should and should not be spending your resources on.

Thus, for issues you are **not** currently addressing directly:

1. should I continue to do nothing or,
2. do I really need to be doing something?

For issues that **are** currently being managed or investigated:

3. are you doing an appropriate amount;
4. not doing enough
5. or doing too much?

Step 4 Developing the Management Systems

The final step in the process is to develop the management system for each of the issues that require direct controls and/or investigation. The EAFM process outlines a set of elements that each need to be completed to ensure that the management system is comprehensive and effective. These elements are outlined in Table 1.

The three most critical elements in this system are the operational objective – what specifically for this issue and this fishery do you want to achieve; the performance measure (what levels define acceptable performance); and the indicator (how will you actually measure performance). These three are a package; one is no value without the others.

The management responses developed should be directly related to trying to achieve each of the objectives and there should be regular reviews of progress and alterations to management where performance is not considered good enough.

Conclusion

All of these steps outlined above are consistent with elements of the WCPO Convention. It must also be pointed out that it is not necessary for all four steps to be completed for this

system to be of value. It can be used at a number of levels depending upon the circumstances.

For example, it is possible to just use the risk assessment components. Similarly, the system can also be used to review existing management plans and even just using the general concepts outlined can help with the overall approach to management.

Table 1 Summary of Headings used for developing a management system for issues (modified from Fletcher et al., 2002, 2005).

Performance Report Heading	Description
1. Reason for inclusion	<i>Summary outcome of Risk Assessment why is it important and high risk, how do you know/ how certain are you? State knowledge base</i>
2. Operational Objective (plus justification)	<i>What are you trying to achieve and why?</i>
3. Indicator	<i>How are you going to use to measure performance?</i>
4. Performance Measure/Limit plus (justification)	<i>What defines acceptable and unacceptable performance and why?</i>
5. Evaluation	<i>Monitoring programs needed and their results</i>
6. Robustness	<i>How robust are the indicators and performance measures?</i>
7. Fisheries Management Response	
- Current	<i>What management actions are currently used to achieve acceptable performance?</i>
- Future	<i>Does any extra management need to be introduced?</i>
- Actions if Performance Limit is exceeded	<i>What will happen if performance is not acceptable?</i>
- Review Cycle	<i>What is the time frame for reviewing performance? And why (the basis of) this time frame?</i>
8. Other Issues	<i>What, outside of the fisheries control, could affect performance against the objective?</i>

Section 2 Details for Implementing EAFM

2.1 Step 1 – Identify the Scope of the Assessment/ Management System

This section describes in detail how to determine the scope/scale of the fishery that is to be assessed

The first step in developing any management system is to determine the scope of what is to be managed. This may seem a trivial task “*of course I know what we are trying to manage*” - has often been the response. Yet, when questioned further this has frequently revealed large differences of opinion amongst the individuals involved in the management process about exactly what they are managing, and what are the overall goals for management. It has, in some cases, taken half a day at workshops to resolve even for simple fisheries.

Spending time to clarify this scope is not a waste of time because if there is not a clear understanding at the beginning of the assessment, there is a high probability that confusion will continue to spread through the rest of the process and it is very unlikely that a sensible outcome will be generated. In some cases the entire process will fail completely.

So how do you work out what is the appropriate scope?

The EAFM framework we are using examines all the elements that are relevant to an activity – in this case a fishery, however this is defined. Thus, it examines all the outcomes from this activity and the issues that may be affecting this activity irrespective of where these may be operating. There is no absolute formula for defining what should be a ‘fishery’ - it is a term of convenience to describe the activities that you are trying to manage in a collective manner. Consequently, the fishery can be one that is based on the type of gear – eg long line, purse seine, trolling, pole and line – or it could be on a species/group of species (eg skipjack, yellowfin, bigeye and albacore tuna) as taken by all methods. Whether it covers part of a country, one entire country, or it covers multiple countries depends upon who is involved, and part of the process, along with who has management responsibility and authority.

General

The easiest situation is where the fishery to be examined has already been defined clearly in some form of instruments including legislations as in the case of most pacific island fisheries or a convention as in the UNCLOS, UN Fish Stock Agreement and the WCPFC Convention. Where this hasn’t been done formally, the scope can be generated by answering the following questions.

1. What the groups or type of fishers involved (e.g. all commercial, distant water fishing nations (DWFNs), local; artisanal, sport, charter)?
2. What fishing methods involved – just one (e.g. purse seine) or all relevant methods (long line purse seine pole & line etc.)
3. What is the geographic area it will cover (the EEZ, just national waters, the WCPO region, specific depth strata, specific distance from land - waters in between islands; archipelagic waters, etc.)?
4. The species caught (tuna; billfish)
5. The agencies involved in the management of the resource (e.g. the national fisheries agency, other national agencies – customs, police; a Regional Commission – e.g. WCPFC).
6. What authority do they have to control what happens, over what area, species, activities, do they have control? (e.g. what controls does the Convention require, what controls do individual agencies have?)

It is not possible to effectively manage something or be held responsible for the outcomes if you do not have any authority or real control. This doesn't mean that these elements are ignored in the process, it just means that they must be taken into consideration for the planning of what you do have control.

If a regional fishery is to be assessed, there should be some formal or informal arrangements in place to collectively manage this (e.g. the WCPO Convention). If there are currently no arrangements, there should at least be agreement from all parties to cooperate in the process, from which such arrangements may be one of the outcomes.

Within the Pacific region, the problems of regional fisheries are a common issue because many of the larger fisheries (e.g. tuna) operate across a large part of the Pacific Ocean. This has been the reason that a number of regional agencies, multi-lateral and bilateral fishing agreements and Conventions have been generated (e.g. FFA, WCPFC, US Multi-lateral fishing agreements, and bilateral fishing access agreements).

If the scope of the assessment can only deal with part of a more widespread fishery, the assessment should still identify and include any relevant potential impacts and issues outside the scope of what is being examined – this could include other fisheries that may also be affecting the stocks, other activities that may be affecting the environment that the fishing activity operates within or other activities that may be competing for alternative uses of the space or resources. The explicit identification of what can be controlled and what influences performance is one of the more useful outcomes from this system.

For simplicity all subsequent references to this 'entity' in this EAFM guide will be called a 'fishery' even if it is only part of a large entity or if it is a collection of what otherwise would each be called fisheries. Given the focus on Tuna in this guide, a common distinction that will be made will be for those assessments and arrangements that relate to the:

- Regional level (e.g. WCPFC)
- Individual country level and;
- within country (artisanal) level

2.2 Step 2 - Identifying Issues and Values

This step provides details of how to identify issues relevant to the fishery being assessed. This includes both the environmental issues and the relevant social and economic elements. It also determines what are the values wanted for each of these.

The scope of the assessment that is being done will affect what issues need to be examined, most fisheries will have their own unique set of issues. To help determine these issues we use a set of component trees that cover each of the five key areas of EAFM (as outlined in Figure 2 and described in detail below). This process is a tool to help identify issues in a structured manner and to help lower the chances of missing important issues. It also helps by structuring the issues into related groups, which helps both in determining their priority and also developing management objectives and strategies.

Each of the five key areas has a detailed generic component tree for which potential issues have been included because they may be relevant for fisheries operating within the Pacific region. Just because an issue is present on the generic tree does not mean that it will always be relevant to a fishery, nor does it mean that all relevant issues will be present. These generic trees just make a good starting point to help the process of identifying what issues are relevant to the fishery being assessed.

The process works by modifying each of the trees by adding issues not included already and deleting issues that are not relevant. If any of the generic issues are removed, written justification should be provided on why it wasn't applicable (e.g. bait collection for a haul net fishery). Merely because you do not have data or direct information is insufficient reason to ignore a potential issue. Remember, at this stage of the process, it is about issue identification, not prioritisation so there should be virtually no discussion of the importance of an issue. Even when one group raises an issue that is known to be wrong, this may be useful to document because in many situations describing what is NOT important is more valuable than what is. So, if one of the groups thinks it is an issue, deal with it.

Identifying the issues is best done during a workshop where all relevant stakeholders are present. This could include representatives of the fishers, managers, scientists, community groups, and environmental groups etc. Such workshops provide each of these groups with the opportunity to have input to the process (Section 3 outlines in detail possible ways of running such meetings).

If a large workshop is not possible to organise/hold, the issues can still be identified by a smaller group or even just the one person (scientist/manager) using the component trees. The fewer people involved in this stage just increases the chances of some issues being missed and it also reduces the 'ownership' of the process by groups that were not present. The impacts of this can be minimised by sending the modified trees to these groups for their input.

Each one of the component trees has its own set of peculiarities; the following is a set of hints to help with the identification of issues within each of the five key areas.

2.2.1 RETAINED SPECIES

(those species that the fishery wants to capture and use)

General

These are ‘species’ based assessments. Once a species/group has been included on any one tree, all elements are covered; including issues concerning their abundance, distribution, genetic changes, along with any impacts of discarding by this fishery for being undersize, over quota, or any other impact on it by other sectors (e.g. capture by other fisheries, illegal fishing).

This approach is taken because it is more efficient (and appropriate) to deal with the issues collectively and it becomes confusing if the same species is dealt with in multiple places when ultimately this system is designed to understand the risk to the stock as a whole and, where necessary, manage it appropriately – so this should be done in a comprehensive manner.

To assist in classifying issues, the tree can be divided into three branches:

- Target species – the key species that fishers specifically try and catch. These are usually assessed at a species or ‘stock’ level.
- Non-target (byproduct) species/groups – those which are those caught and kept whilst out trying to catch the target species. Normally they would only make up a small part of the catch and can often be assessed at the group level (e.g. billfish) rather than at the species level (e.g. blue marlin), unless they are especially at risk/vulnerable.
- Bait collection – this covers those fisheries that capture their own bait.

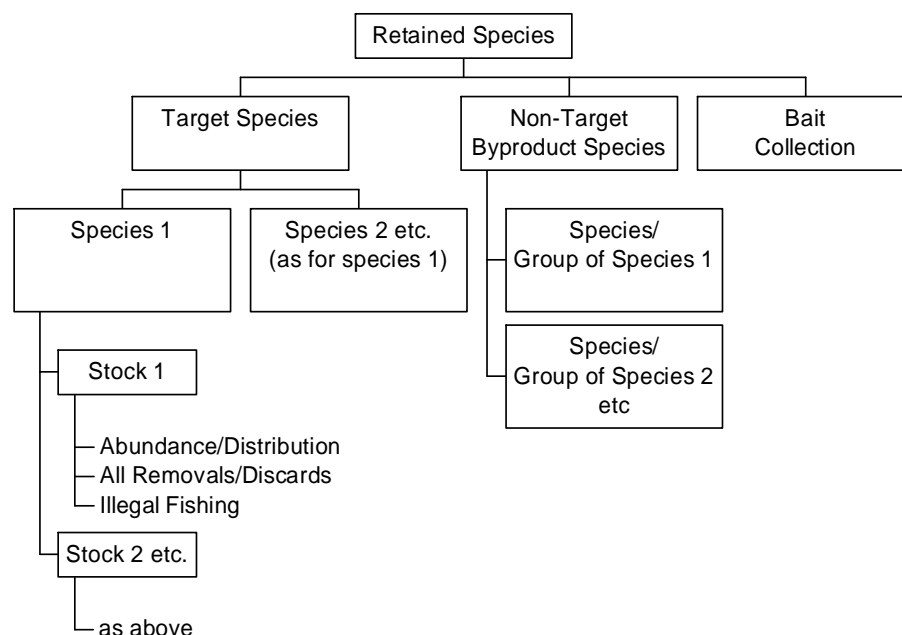


Fig 4. The generic component tree for the retained species (modified from Fletcher et al., 2002).

Target Species

These are the species that are the main focus of the fishery. Whether you need to divide the issue into more than one stock or just leave it at the species level depends on what is the appropriate level needed for management given the stock structure of the species and how fishing effort/catch is managed. It covers all aspects of the management of the species/stock including all landed catch by all fisheries, any discards and illegal fishing on the stock.

The process of determining the right level of division can be used to check if the current management arrangements are appropriate. A useful question is: does the scale of management match (as much as possible) the biology/dynamics of the stock?

In the example for the WCPFC (Fig. 5), the target species include Albacore, Skipjack, Bigeye and Yellowfin. If, however, the retained species tree was generated for any one member country of the Commission, the list may differ because not all these species are a target everywhere.

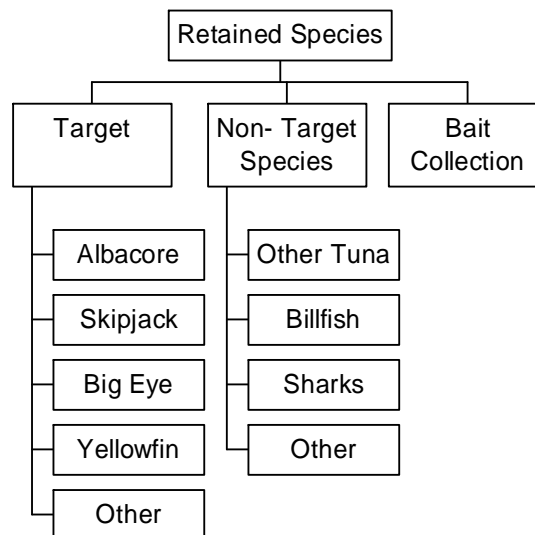


Fig. 5a A draft component tree for retained species in the whole WCPFC.

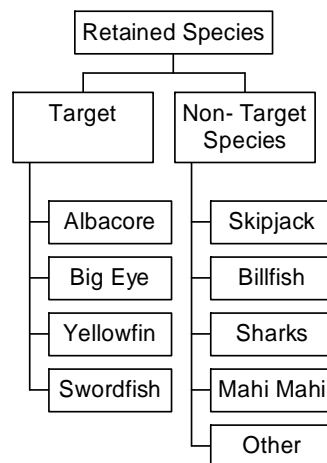


Fig 5b An example of a draft component tree for retained species for one of the countries in the WCPFC.

Non- target (By-Product) Species/Groups

Within this branch, the decision to group species or assess them separately depends on the level of catch and the biology of the species involved. In the WCPFC example, a mixture of individual species and groups was identified. Where groupings are made, they should be sensible from a monitoring and management basis - e.g. similar quantities taken, similar life histories/vulnerability to capture etc. Many assessments also use an 'Other' category - which covers a wide variety of species each of which are only captured rarely. These byproduct species may include the target species of other fisheries. In WCPFC (Fig. 5) sharks are a good example because they are often the target species of other fisheries in the region.

Bait Collection

For fisheries that capture their own bait – eg many pole and line fisheries, an assessment of the impacts on these stocks is also required. The decision to assess these at a species level or at the group level will again depend upon the catch levels, and information available.

2.2.2 NON-RETAINED SPECIES

(those species caught or directly impacted by the fishery but not used – can also be called 'trash' species)

The issues that are covered in this tree relate to those species that no one in the fishery wants to keep at any time, irrespective of their size or life history stage. These species are likely, therefore, to have different types of objectives than target species - in most cases this would be to avoid or minimise their capture. This tree can also cover those situations where some species may not be caught but still affected by fishing activities (i.e. accidental collisions between fishing boats and dugongs). But remember if such a species is also caught by the fishery, just deal with it once.

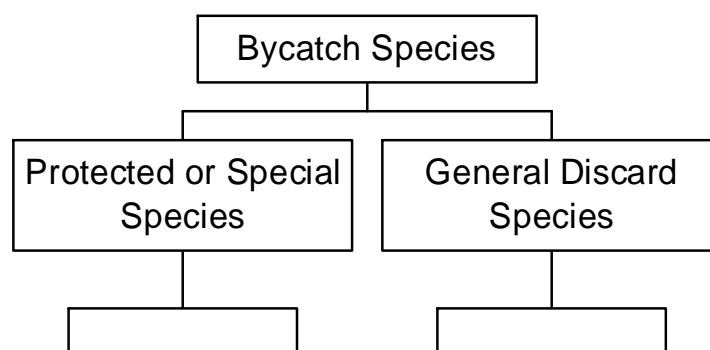


Fig. 6 Generic component tree for non-retained species (modified from Fletcher et al., 2002)

The two classes of bycatch species are 'General Discards' (often termed trash fish) and "Protected" or "Special" species (listed in IUCN or they have some special cultural significance which prohibits them being kept). The number of species within this second category will vary greatly amongst countries. In the Pacific there are a

large number of species in the protected or special category and some fisheries capture a variety of these species (Fig. 7a). At the WCPFC level, it was recognised that the impacts on species may vary across fishing methods and that what was recognised as protected may vary amongst countries (Fig. 7b).

Again, the decision to examine the issue at a species level, group level or higher level depends upon what is considered appropriate. Often a large number of species can be identified separately during this phase, but the risk analysis phase often results in them being lumped because they have relatively similar risk profiles.

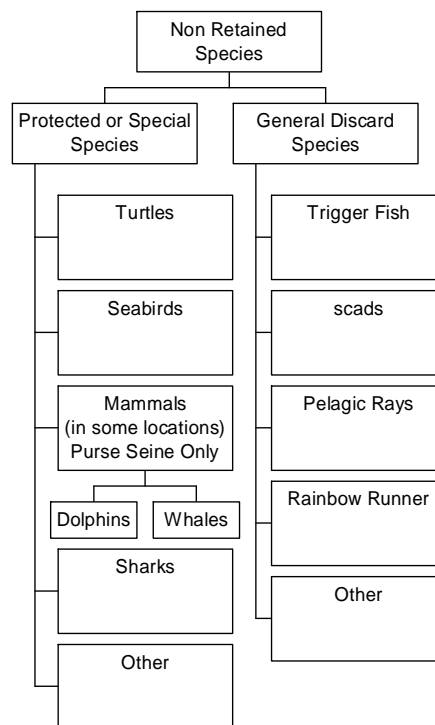


Fig 7a A draft by-catch (non-retained) species component tree for the whole WCPFC.

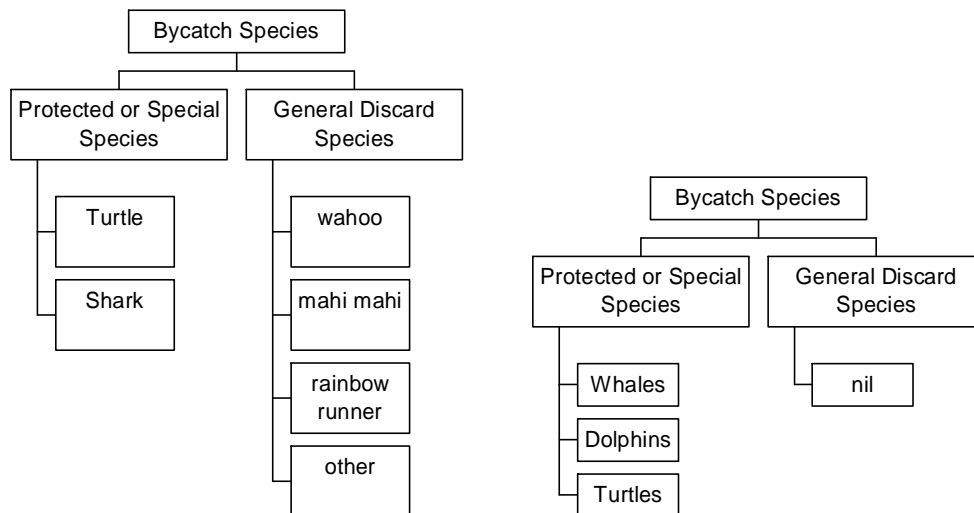


Fig 7b Examples of draft by-catch (non-retained) species component trees for two of the countries in the WCPFC.

2.2.3 ECOSYSTEM EFFECTS

(this covers the potential indirect and more general environmental impacts the fishery may have).

The issues in the ‘Ecosystem Effects’ component tree cover the indirect and more diffuse interactions of the fishery with the broader ecosystem and environment. This includes the types of issues that have only recently begun to be dealt with by fisheries agencies and the industry. Consequently, there will generally be a greater degree of uncertainty about what is, or is not, likely to be an issue.

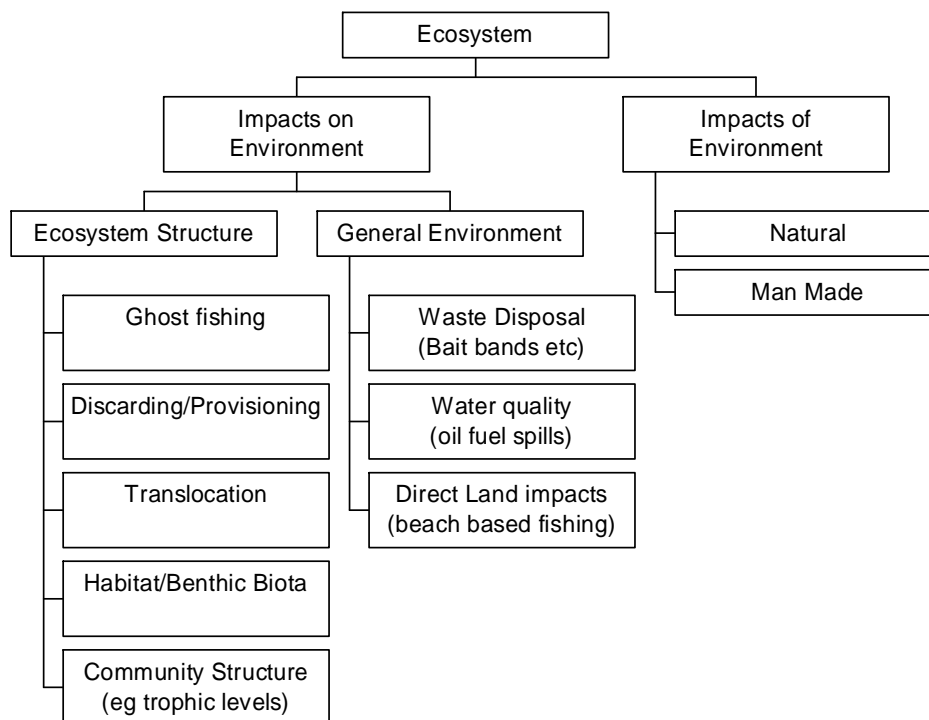


Fig 8. Generic tree for the ecosystem Issues (Modified from Fletcher et al., 2002)

The tree is split into three branches that cover:

- Impacts from the damage, removal or additions caused by the fishery to the rest of the ecosystem structure.
- The more general issues associated with fishing activities that could impact on the broader environment.
- The influence of the environment on the fishery.

Ecosystem Structure

The direct and indirect effects on the general ecosystem caused by damage to - or removal of - material due to the fishing operations are one of the highest priority issues for groups wanting fisheries agencies and the industry to take an 'ecosystem approach to management'. There are a number of possible elements within this branch that may need to be assessed.

Ghost Fishing

For many fisheries, the possible impacts of 'ghost fishing' need to be considered. This refers to fishing methods that use gear that continues to 'fish' even after it has been lost. One of the most well-known methods in this category is monofilament drift nets that have been lost. However, many other gear types, if poorly designed, can continue to capture fish when lost - this includes traps, pots, etc. In the example completed for the WCPFC (Fig. 9), this was considered not to be an issue because the longline and purse seine methods used do not 'capture' fish when they are lost.

Discarding/Provisioning

The possibility that there could be impacts from the discarding of unwanted catch and the 'provisioning' that occurs from the addition of bait may need to be considered. These will only be relevant to fisheries where there is a significant level of unwanted catch (or old bait) discarded, particular if it is dead/or available for easy capture.

This process may be providing a source of food to other species that would not normally have access to it (e.g. birds), or at least not as readily. It also covers situations associated with loss of bait – especially when live bait is used.

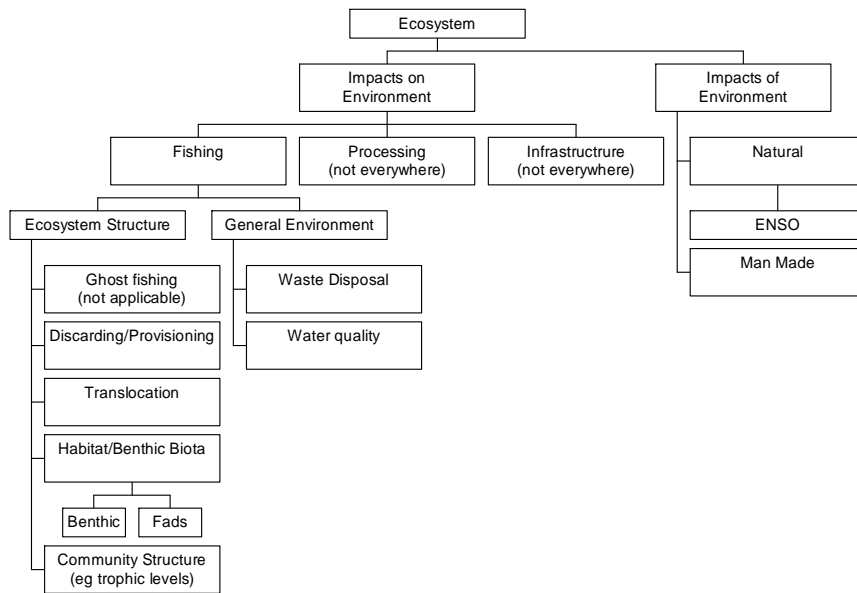


Fig 9. The draft general ecosystem tree generated for the WCPFC.

Translocation

This category covers the translocation of material by the fishery. This can cover both the movement of the target species outside of their normal distribution, or even the potential for the boats operating in the fishery to translocate fouling organisms from one region to another. There is also the possibility for the introduction of diseases through the use of imported baits.

Habitat impacts

One of the major categories in this branch covers the possible impacts of the fishing methods on benthos and benthic communities. This is likely to be relatively significant issue for a trawl fishery, and could required splitting this issue into a number of sub-categories, depending upon the number of habitat types affected. However, it is unlikely to be an issue for hand-gathering types of fisheries, such those for trochus. In the WCPFC example, it was recognised that the impact of fishing needed to be examined along with the impacts of FADs by creating ‘habitat’.

Community Structure

The potential for disruptions to trophic interactions causing changes to the community structure of ecosystems that may arise from the removal of too many individuals of the target or bycatch species (such as taking too many predators or too many of their prey), changing the habitat or from provisioning; and it is an issue that needs to be considered in every fishery. In many respects this summarises and integrates all of the other elements in this branch along with all the removals outlined in the previous two trees – i.e. what is the cumulative impact of the fishery.

The level of potential interactions and changes to community structure will obviously vary, depending upon the species being harvested (some species are more likely than others to have an impact if removed – i.e. keystone species) and how much is taken

(the more you take or affect, the more likely for flow-on effects to occur) and the methods of capture involved (some fishing methods are more likely than others to have an effect). Determining what may be an appropriate/acceptable level of impact is discussed in the next chapter.

General Environment

This branch covers the more general environmental impacts that could occur from the fishing operations. Many of these impacts may not appear particularly critical at this point, but as the debates over greenhouse gas emissions continue, the need for a fishery to have systems in place to report on this kind of environmental performance may become more necessary. Whether there is also a need to assess the associated port facilities, processing plants for a fishery will depend on whether they are specific to the fishery and where they are operating. These potential issues were identified in the example for the WCPFC (Fig. 9).

Waste Disposal

This covers the potential environmental impacts of debris from fishing operations, such as loss of bait boxes, bands, general rubbish, etc, dumped into the water.

Water Quality

This includes the impacts on water quality that could come from the possible accidental release of fuels, oils, etc, if appropriate codes of conduct/protocols are not in place. Transshipping risks in lagoons

Direct Land Impacts

Possible impacts on the foreshore can also be included, particularly where fishing requires the fishers to drive along the beach in a 4WD to reach their fishing locations and launch their boats. Port and processing facilities may be relevant here too.

Impacts of the Environment

The Impacts of the Environment on the Fishery tree has been designed to capture the major issues that are/or may at some time impact upon the performance of the fishery, but which are beyond the scope of the relevant legislation of the fisheries management agency. Even though they are not controllable directly by the management agency, these issues still need to be taken into consideration when developing management arrangements because they are likely to affect what is possible, which directly affects how strong or cautious management should be.

Natural

There are two major types of issues in this tree. The first are impacts that arise from natural changes to the environment, a good example of which is the strong link between the variations in the strength of the ENSO, La Niña and El Niño events which affects many fisheries throughout many oceans.

These impacts are much more likely to be noticeable at a country level rather than regional and will probably vary on an annual basis. Thus some shifts in oceanography may benefit some countries but result in negative impacts elsewhere by affecting the distribution of fish.

Man Made

The other branch covers the anthropogenic impacts from non-fishing activities on the performance of a fishery. These can include impacts on water quality such as those occurring from increased sediment loads or water pollution from land-based activities.

Other types of impacts come from the removal of nursery areas for coastal developments and the introduction of exotic species that may swamp or eat native species. In freshwater areas, the use and removal of water from the streams by agricultural activities is seen as probably the major potential issue for many of the native species living in these environments.

Not many examples have been identified for tuna fisheries in the open ocean. Impacts of mining in coastal waters has been identified.

2.2.4 COMMUNITY WELLBEING

(The local or regional communities and their dependence on the operation of the fishery)

The 'Community Wellbeing' tree covers the potential social and economic impacts of the fishery on the wellbeing of the local or regional communities associated with that fishery. This includes the fishing industry itself, the small villages or local towns that may be directly and highly dependent upon the fishery for their existence, and the communities that are only indirectly affected by the fishery. The community wellbeing component tree is broken into two main branches, one dealing with the industry community (those directly employed in the industry and their families) the other dealing with the local communities directly or indirectly affected by the industry.

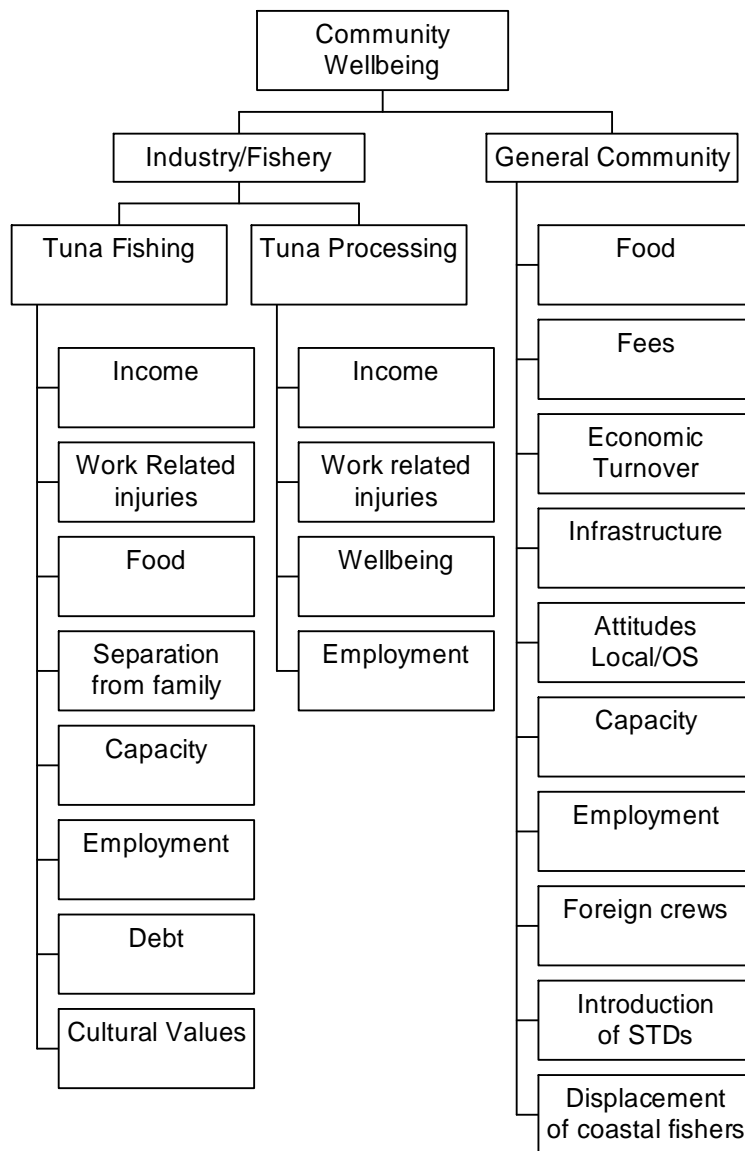


Fig. 10 The generic component tree for socio-economic wellbeing of affected communities (modified from Fletcher et al., 2002).

Industry

The ‘Industry Community’ branch can include contributions to wellbeing of the fishers and their families through a range of factors directly associated with the industry. The components often identified include income, contribution to the lifestyle along with their general wellbeing and occupational health and safety.

Income

A clear issue is the level of income that is generated by the fishing activity for the individuals involved. This can be assessed as a dollar amount but also in terms of the proportion of the average wages for the region.

Work related injuries

Fishing can be a dangerous occupation. There may be a need to monitor the level of such injuries and to ensure that there are policies used in the fishery to minimise these. There may also be concerns with regard to other more indirect impacts, including the movement of communicable diseases of those who work on foreign boats travel to other regions.

Food

The fishery may not only or always generate income. In some regions the main benefit from the fishery may be the provision of food for the participants (and the community). This can include some of the non-targeted but retained catch.

Wellbeing

This issue covers both spiritual and physical elements. Fishing may instil a sense of pride or status within the community, or it may be considered a lower form of employment. It can also provide a good environment or in some cases it can be associated with high levels of injury and in some cases even death. This can also be a result of interactions with species that may have a high social value (e.g. whales, turtles).

Separation from family

Work on tuna boats can regularly involve the separation of fishers from their families for extended periods. This can result in significant social problems associated with loss of contact with children, infidelity etc. which may cause the ultimate breakdown of the relationship.

Debt

The purchase of the vessels and gear may require a large level of debt to be generated. This can put a level of stress into a village or region and result in severe problems particularly if the enterprise is not successful.

Cultural Values

By undertaking tuna fishing activities this may or may not assist in maintaining cultural values of the community.

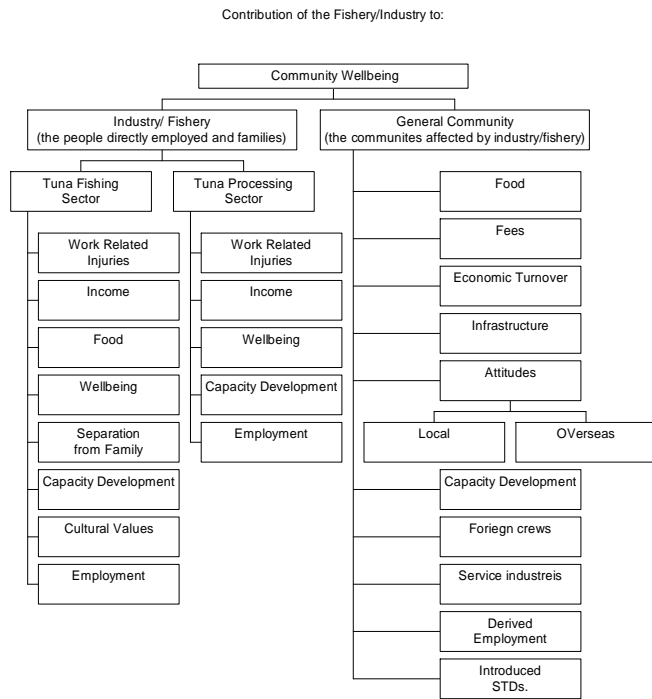


Fig 11 A draft community wellbeing component tree for the WCPFC.

Community

The community wellbeing branch covers both the financial benefits/costs to local and regional communities of having the fishery continue to operate in the area, along with the social impacts of the industry, including the general attitudes of the community towards the industry.

While the importance of local industries to income and employment opportunities is obvious, other impacts could include attracting or maintaining services and contributions to the general infrastructure of the region.

It may also be somewhat difficult in some circumstances to identify and isolate for this component tree the issues associated with a single fishery from those issues associated with other fisheries that operate in the area.

Employment

Direct and indirect employment that result from activities such as fishing are easily understood as issues that can contribute to the well being of communities. The key element is what proportion of employment does this industry contribute; a relatively small amount or a relatively large amount. This will affect how dependent the community is on this industry (see above). Whilst the fishing may not occur directly in the area, the income that is sent “home” by boat crews can be a major source of income in some countries.

Clearly one of the key drivers for understanding these linkages is that communities that are highly dependent on fishing will be vulnerable to the effects of any changes in the fishery. Of course, this does not mean that fisheries management decisions can be made in a way that prevents any community impacts. The value of understanding the community impacts of fisheries management actions is that:

- where a management decision is likely to have a severe negative social impact, the relevant government agencies can be informed so that they can target employment, business development etc assistance to the area;
- where there are two or more management options which are equally beneficial in ecological and economic terms, understanding the social impacts would allow managers to choose the option which causes the least community impact.

Food

In many locations the fishery is one of the main suppliers of protein to the local communities. In these situations, it will probably not be possible to implement major management changes that interrupt this without having some alternative source of food in place beforehand

Fees

In some cases the fishery may generate access fees from participants. This is often the case when they are operated by foreign owned fishing vessels. These fees may be a source of considerable foreign capital to a region.

Economic Turnover

The fishery resource may also contribute jobs related to fish processing, retailing, provision of boat fuel and parts, accountancy, groceries for fishers and their families, school teaching for the children of fishers, and so on. These are the multiplier effects of the fishery. Each dollar earned fishing that is spent in the community generates employment and income for other community members.

Infrastructure & Services

Fishery-related infrastructure can be identified as a component of the contribution of a fishery to community wellbeing. For example, a harbour and associated infrastructure that exists primarily to service commercial fishing provides benefits to other users.

Alternatively, if a fishery requires the construction of a significant level of infrastructure in order to develop (e.g. roads, wharves, freezers etc), then government may have to decide if the investment needed to complete this infrastructure is worth the value that is generated by the fishery.

As well as the direct and indirect employment/income/expenditure links between a fishery and local communities, access to services for a community may also depend to some degree on a fishery.

Attitudes

The perceptions of the local community about the fishery and its impact on that community are also seen as important. This could be especially the case where the fishery is not undertaken by local fishers.

Foreign Crews

For fisheries where a large number of foreign crews are housed in a region this can have a significant impact on the local community. Tensions can sometimes occur between locals and foreigners.

Displacement of coastal fishers

The commercial tuna fishery may affect small scale fisheries either by affecting their markets through the supply of high levels of cheaper fish, and/or through their fishing activities reducing local densities of fish and therefore affecting the catch rates of coastal fishers.

2.2.5 ADMINISTRATION

(The management processes and arrangements needed to assist achieve an adequate level of performance)

The administration tree covers all the legislative, administrative and bureaucratic processes that need to be completed to enable the issues in the previous four trees to be dealt with effectively. These issues may cover a number of levels of government and the industry. For the WCPFC, most of these elements are outlined in Article 10 of the Convention, under the function of the Commission.

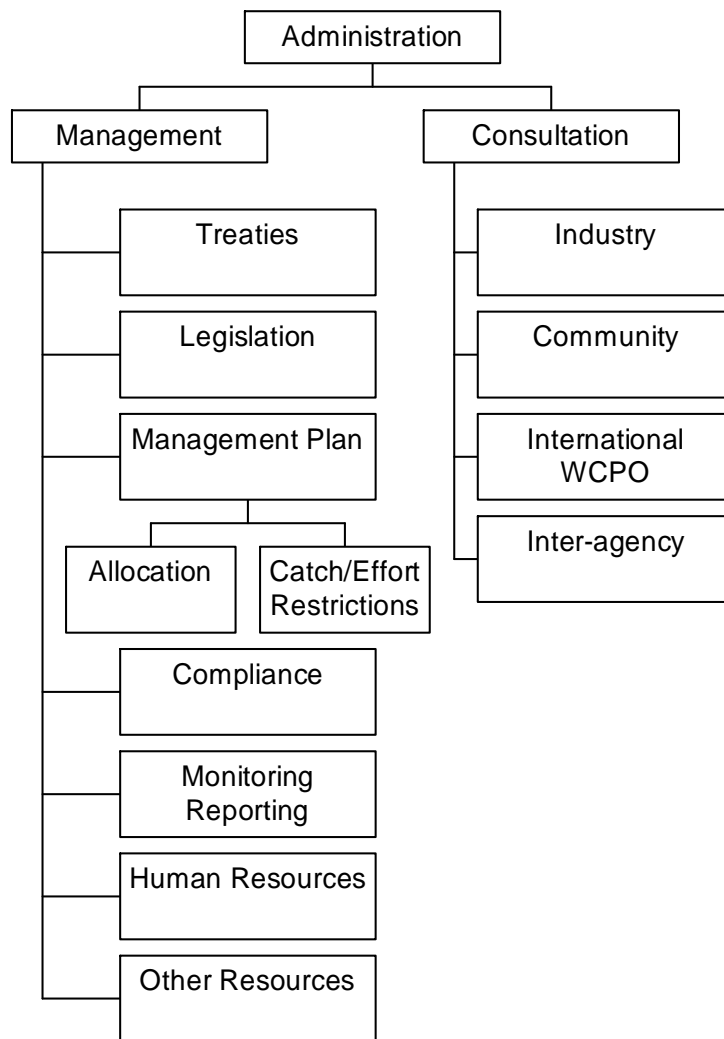


Fig 12 The Generic Component tree for Administration
Management

The management branch of this tree covers the issues which are relevant to the management agency.

Legislation

Is there adequate legislation that will enable all management plans, regulations etc that may be needed to manage the fishery in place and valid? For the WCPFC, the key legislation is the Convention.

Treaties

What treaties have been signed that relate to the operation of this fishery? What conditions are required to uphold this treaty and are they being met?

Management Plan

Is there a plan that outlines what is being managed and how it will be done (in many respects this is the plan that will be described in the following section)? If completed fully the EAFM outlines how this can be done.

For the WCPFC, the key elements of this are that it must operate at two levels- there must be a plan for the Commission that specifies allocation amongst the countries – this is spelt out in Article 8 (2) when in establishing compatible conservation and management measures the commission shall take into account biology, geography and “*the extent to which stocks occur and are fishing in areas under national jurisdiction*”. Moreover, Article 10 (g) states that the commission “*must develop, where necessary, criteria for the allocation of the TAC or TAE for the fish stocks in the Convention Area.*”

Similarly, at the country level Article 7 (1) states that principles and measures for conservation and management in the convention area shall be applied by coastal States. Moreover, Article 8 (3) states that *each coastal State shall ensure that the measures adopted and applied within its jurisdiction do not undermine the effectiveness of measures adopted by the commission*”.

Compliance

Is there adequate observance of any regulations rules by the individuals in the fishery, is there any checking by officers of the relevant department? For the Commission this would entail the checking of catches and monitoring of vessels through VMS. These activities are managed by the Technical and Compliance committee (Article 14).

Monitoring and Reporting

Is the performance of the fishery against each of the objectives monitored on a regular basis and are these results reported in a manner that allows the general public or interested parties to be aware of these assessments? Are there peer/independent reviews of the fishery and the assessments?

For the WCPFC, much of this information comes from the Scientific Committee and Scientific services (Article 12 and 13).

Human Resources

To ensure that the administration operates effectively, there is a need to have adequate numbers of skilled people. The greater the complexity of management, the more people required.

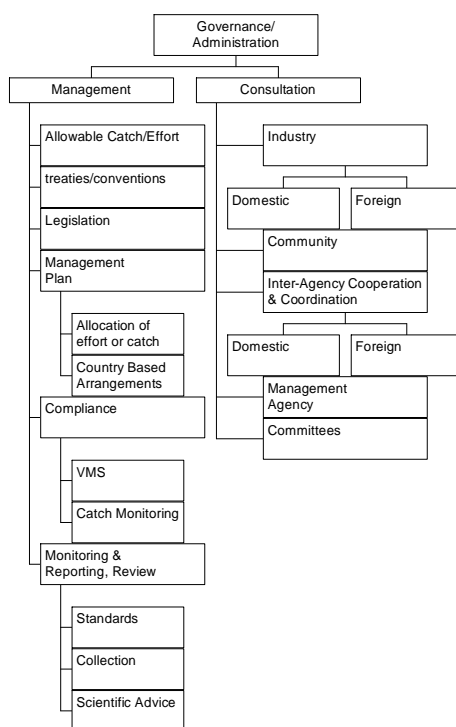


Fig 13 A draft governance/administration tree for the WCPFC.

Consultation

This branch covers the consultation issues that require the management agency. For the WCPFC this is the commission and/or FFA with the requirements outlined under Article 15 of the Convention.

Industry

Are processes in place for communication with the fishing industry?

Community

Is the community, at what ever levels is necessary, informed and are they able to input to the processes

Interagency

Are there appropriate linkages with other agencies within the country, with other countries or with regional organisations?

2.2.6 DETERMINING VALUES

During the various workshops associated with the development of this guide, it was identified that there are four types of values that could be applied by countries. These could be used as the starting points to assess the risk associated with any specific issues:

1. Sustainability – keeping biomass levels above B_{msy}
2. Viability – avoiding extinction for a species (i.e. $B_{current}$ can be $< B_{msy}$ but $> B_{extinct}$)
3. Economic – optimise/maximise economic benefits
4. Social - optimise social acceptability

Depending upon which of these types of objectives are used, the outcomes of any risk assessment (outlined in the next section) may differ greatly. Similarly, the types of performance measures and indicators to monitor performance would also likely to differ.

2.3 Step 3 - Using Risk Analysis to Prioritise Issues

This section outlines a simple risk analysis process to help determine the priority of issues and which ones need direct management

2.3.1 BACKGROUND

Using risk assessment approaches to assist with fisheries management is not new (e.g. Lackey, 1994, Francis & Shotten, 1997; Lane and Stephenson, 1998). Complex quantitative risk assessments are often employed in stock assessment analyses to calculate the probability that stock abundance will meet some agreed level of performance (e.g. Francis, 1992). These types of analyses, however, require significant levels of information and can only be applied in a small number of situations (usually stock assessments of key target species in large fisheries). Given the large number of issues usually identified as part of the EAFM process, many of which have minimal data, an alternative method of assessing priorities is used.

The qualitative ecological risk assessment methods developed for the EAFM system, were originally adapted for use within a fishery context to form a module of the Australian ESD framework (see Fletcher *et al.*, 2002; Fletcher 2005 for details). This approach provides a consistent method for the calculation of the relative level of ‘risk’ from each ecological issue, which can be used to prioritise issues and help determine which ones require direct management and monitoring (and importantly, which ones don’t!).

The risk analysis methods are based on the Australian & New Zealand Standard Risk Analysis (Standards Australia, 2000, 2004) and involve issue identification (which was covered in the previous section), the potential impacts (consequences) that may result from these issues and the likelihood (probability) that a particular level of impact will actually occur – which when combined together calculates the risk level.

The key element for these types of analyses is having good descriptions for each level of impact and likelihood. The more precise these are, the easier it is to assign the ‘right’ levels to each issue. Five comparable sets of impacts were developed that cover most of the ecological issues being assessed (Table 6). Thus, assessments of target species issues use Set A - where these were of highly targeted/vulnerable species; Set B is used for ‘byproduct and most ‘discarded’ species, with the main exception being for the assessment of ‘Protected Species’ (for either cultural or conservation reasons) – these are completed using Set C. General ecosystem issues are either assessed using Set D for ‘ecosystem (food chain)’ issues or Set E for ‘habitat’ related issues.

Each of the sets has four levels of impact ranging from minor (no or little impact with a score of 1) to extreme (possibly irreversible with a score of 4), with the moderate level (with a score of 2) being defined as the highest acceptable level of consequence. The qualitative likelihood table (Table 7) also has four ordinal levels ranging from remote (never heard of, but not impossible; with a score of 1); to likely (expected to occur; with a score of 4).

2.3.2 CALCULATING RISK RATINGS

For the purposes of this prioritisation process, a relatively high level approach is taken by asking

‘what is the risk (for each issue) from having the fishery?’

Moreover, because “*risk is the chance of something happening that will have an impact on objectives*” (Standards Australia, 2000, 2004a), you need to be clear about “whose” objectives were being assessed. Different outputs may be achieved depending upon whose perspective is chosen (generic objectives have been included for use where no specific ones are available, where relevant WCPFC objectives have been listed). Similarly, the impact and likelihood levels are determined given the management controls already in place. Again, the outcomes of a risk analysis should be different depending upon whether the current management arrangements are, or are not, included in the assessment.

The risk for each issue is calculated as the product of multiplying the two scores for impact and likelihood levels chosen as being appropriate for the issue. This can produce possible values between 1 – 16 (Table 4). Each issue is placed into the appropriate combination of impact and likelihood levels based upon the collective wisdom of the people involved in the process. The decision about what levels should be chosen include an understanding of the scale of impact required. If more than one combination is considered appropriate, the combination with the highest risk score should be chosen. (i.e. this takes a precautionary approach).

Table 4 - Risk Matrix – numbers in cells indicate risk value, the colours/shades indicate risk rankings (see Table 7 for details)

		Consequence Level			
		Minor	Moderate	Major	Extreme
Likelihood		1	2	3	4
Remote	1	1	2	3	4
Unlikely	2	2	4	6	8
Possible	3	3	6	9	12
Likely	4	4	8	12	16

Whichever combination is chosen, it is very important that the justifications for choosing these levels are recorded. The key element is that other parties who were not part of the process to generate the report need to be able to see the logic and assumptions behind the decisions that were made. It will also greatly assist the review of the risk at some time in the future if you know why the levels were chosen the first time.

Output from the Risk Assessment

The actual risk assessment is not just the scores generated during the assessment process but needs to include the appropriate level of documentation/justification for the categories selected.

To correctly assign these levels, it is important to recognise that when assessing the likelihood of a consequence occurring, this is a conditional probability. It is the likelihood that, given a particular fishing management strategy (e.g., the current allowable catch levels for a tuna fishery), a particular level of impact (e.g., a reduction in spawning biomass to x% of unfished levels) may ultimately be the result (either from a cumulation of small events over time, or from a single large event). It is NOT, as is commonly done when beginning this process, mistakenly assessing the likelihood that the particular fishing activity (i.e., catching the species) will occur. This type of error must be avoided.

2.3.3 LEVELS OF DATA, UNCERTAINTY AND RISK SCORES

Many of risk assessments are completed with relatively little quantitative data. This is not uncommon. Even fisheries that have significant levels of data for their target species generally have limited information for many of their by-products; by-catches or ecosystem issues (Whitworth *et al.*, 2003). In such circumstances scientific inference from the literature, and management experiences associated with similar

issues and impacts elsewhere, can be used effectively. There are very few issues for which no information is available to make an informed assessment. The key point of the process is to try and ensure that the level of resources applied to the future management and/or monitoring of an issue should be matched with the level of risk (this may include the need to collect more data to reduce the uncertainty – see below).

The level of uncertainty can be factored into the score combination that is chosen to best reflect this understanding. For example, if there is some uncertainty about the effectiveness of management for a target stock, it is probably more appropriate to score the fishery as possibly having a severe impact rather than expressing it as likely to have only a moderate impact. Whilst the risk scores may be similar the former combination more appropriately reflects the current knowledge of its status. In some cases the risk score may be higher because of this uncertainty and the management response may be to reduce this uncertainty to a level that is acceptable.

It is also important to recognise that these techniques may be just the first step in the process. Once an issue is rated as medium or higher risk, then it requires a more detailed assessment to determine what management, research and monitoring are necessary. Where the process initiates the collection of more information (e.g. because of uncertainty), more precise, quantitative assessments of risk may be possible. In such cases these reviews could either confirm the need for direct management, identify that an even greater level of control is needed, or suggest that the initial risk rating was too high and that direct management may not be required. Where greater management controls are needed, this system should help the focus of additional measures to either reduce the potential consequence level resulting from the activity, or the likelihood of the unacceptable consequence occurring, or both.

2.3.4 MANAGEMENT OUTCOMES

The possible risk values are separated into three Risk Categories ranging from minor to high risk (Table 5). These categories identify the level of reporting needed and, more importantly, whether direct management of the issue (e.g., imposing increased levels of restrictions, collecting more data) would be required to reduce or maintain the current level of risk.

The outcomes from the risk assessment should be used a tool to help you decide what you should, and should not, be spending your resources (both people and operating) on.

(1) For issues you are not currently addressing directly this should help identify if:

- you should continue to do nothing directly (Low Risk) or,
- you really need to be doing something (Moderate or High levels of risk - e.g. imposing direct management, starting a research program)?

(2) For issues that are already being managed or investigated the scores should help decide if:

- you are doing an appropriate amount (moderate risk levels);
- not doing enough (high risk levels)
- or doing too much (low risk levels).

Table 5 Risk Categories and Outcomes

Risk Category	Risk Values	Likely Management Response	Likely Reporting Requirements
Low	1-4	None Specific	Full Justification needed
Medium	6-8	Specific Management/Monitoring Needed	Full Performance Report
High	9-16	Increases to management activities needed	Full Performance Report

2.3.3 TARGET SPECIES

The default objective that can be used to assess the risk to each of the target species (if one is not already developed) is:

“maintaining spawning biomass at least above the level where it is likely that to result in recruitment overfishing”

The WCPFC has the objective for target species to *‘maintain or restore stocks at level capable of producing maximum sustainable yield as qualified by relevant environmental and economic factors...’ (Part II Article 5 (b))*

To assess the risk of the fishery on each of the target species against this (or any other objective), the risk assessment should integrate/incorporate the following:

- *The removals, by all sectors (i.e. commercial fishing, recreational fishing, indigenous, illegal and discards).*- How many fisheries capture this species? Do you know what these amounts are? The greater the relative amounts of catch being removed and the larger the number of other sectors catching the species, the higher the possible consequence is likely to be.
- *Species biological characteristics/dynamics* Does the biology of the species make it more likely to be susceptible to over fishing? For example, is it long-lived and low fecundity, short lived and high fecundity, widely dispersed, local populations only, etc.
- *The current knowledge and understanding available on these issues (including distribution versus area fished)* Is there a large amount of data on the species and the sources of mortality? The less data available, the higher the risk is likely to be.
- *Current management arrangements - their effectiveness and problems.* Are the current management arrangements, including compliance with rules and effort limitation methods, working?

Obviously each of these elements interacts with each other. For example, you may be able to have a relatively large catch on a “susceptible” species if appropriate management arrangements are imposed combined with effective monitoring that

demonstrates that these arrangements are working successfully. The consequence categories for this type of species are outlined in Set A in Table 6. Although, Set B may be an alternative depending upon the objective (see later).

The scope of the assessment of target species, particularly those within the WCPFC can be done at the commission level, and at the country level. Thus whilst the overall risk to the sustainability of stock within the WCPO region maybe high (eg Yellowfin), the risk generated by different countries may vary – those that take 1% of the catch would have a low risk of impact, whereas those countries that take 10% or more should generate a moderate to high risk.

2.3.4 NON-TARGET (BYPRODUCT) SPECIES

Default objective – (may be the same as target species – but the Convention has alternative objective to maintain viability of non-target species – see also section 2.4.2.)

Assessing the risk of having this fishery for each of the byproduct issues should integrate/incorporate

- The relative impact of this fishery compared to the distribution of the species and other impacts on the stocks
- The biological characteristics and dynamics of the species/group
- The current knowledge and understanding available on these issues and current management arrangements.

To assess these issues, Set A, B or C may be appropriate depending upon the level of capture and the objective used.

2.3.5 BYCATCH SPECIES

Default objective (Discards) - *To maintain appropriate levels of biomass of bycatch species to minimize any significant impact on their dynamics and the broader ecosystem* Or- use the target species objective

(Protected) – *“To keep the level of capture of this species at acceptable levels”*

For the WCPFC, they must adopt measures for non-target species and dependent species with a view to maintaining or restoring their populations above levels at which their reproduction will not be seriously threatened (Article 10 c). This may be substantially lower level than the objective outlined above. This has implications for determining risk values, depending which objective is appropriate and used, different outcomes may be generated.

The questions covered (and the types of data used) for the assessment of bycatch - discard issues are generally the same as for target and byproduct species. The analysis can be complicated when assessing ‘special icon’ species, such as cetaceans and pinnipeds, which not only have different dynamics to finfish but for which different levels of impact may be accepted by the public. In such circumstances the second objective and Set D is used to assess the risk.

In some cases it has been recognized that separate assessment of the cumulative risk to some bycatch species from all fisheries/activities in the region (not just the fishery being examined) may need to be done where a full understanding of all impacts was not possible at the workshop. When this happens you need to clearly state in the report that it only relates to the one fishery – not all impacts.

2.3.6 ECOSYSTEM

Ecosystem Structure

Default objective *‘To maintain any impact on the wider ecosystem within acceptable levels.*

The assessment of potential overall consequences on ecosystem structure from the removal of biomass and other changes resulting from the fishery should also be done at the level of the entire ecosystem (Set E). This can often be assisted by separately assessing the potential impacts on any prey and predator species and by determining whether any potential “keystone species” (*sensu* Paine, 1966; which is not equivalent to just being a higher order predator) are being affected. It is largely a result of the level of redundancy of function. If there are a large number of species that occupy this trophic level or undertake some function, there is minimal chance of being a keystone species. If they are the only species that occupies a trophic level or form a clear majority, then this increases the chances of them playing a keystone role.

Habitat

Default objective *‘To maintain the spatial extent of habitat impacts from the fishing activity to a comparatively small percentage of the habitat/community’*

Assessing the habitat impacts that may result from each fishery should be done at a regional level, with impacts judged against the best estimate of the original extent of each of the habitats, not their current distribution (Set F). The assessment criteria have divided habitat into 3 categories which recognise that not all habitats are equal – some are more fragile than others - often due to slow recovery rates. Also some are more critical to the functioning of the ecosystem than others – providing substantially greater levels of fish recruitment or nursery habitat. This is why different levels of impact generate different levels of risk.

2.3.8 INFLUENCE OF OBJECTIVES ON RISK OUTCOMES

As outlined above in section 2.2.6, there are a number of possible values and objectives that can be associated with an issue. The outcome of a risk assessment process may be affected greatly depending upon which objective is used. This will be illustrated by using examples of the assessment of two target species within the WCPO which have been identified during the workshops held to develop this guide.

Given the estimate biomass trajectories of the stock of Albacore within the WCPO region, from a sustainability perspective it is unlikely (2) that it will get to fully a moderate level of depletion (2) which is a Low Risk (See Fig. 14). However, from an economic perspective, the fishery needs to have the current catch rates levels maintained, hence any significant reduction in biomass will reduce the catch rates and generate unacceptable economic outcomes. Therefore, from an economic risk analysis, because it is possible to unlikely (L 2-3) that it will decline below current economic levels (C 3) – with a risk score of 6-9, this represents a moderate to high risk.

By contrast, for “Yellowfin” Tuna, the current biomass trajectory suggests that this will pass below the B_{msy} line within the next five years (Fig. 14). Against the sustainability objective this represents a High Risk (C3 L4 = 12).

If however, this trajectory is assessed against a viability objective, the risk score is reduced because this it is only possible that the biomass will decline to the B_{rec} level in the next five years which is a L3 C2 = 6 which represents only a moderate Risk.

These shifts in risk score with objectives demonstrate that absolute need to get clarity about what is trying to be achieved. It is recommended that if there are multiple possible objectives that the risk scores for each are developed separately. This will. Nonetheless, require a process to determine which objective has primacy.

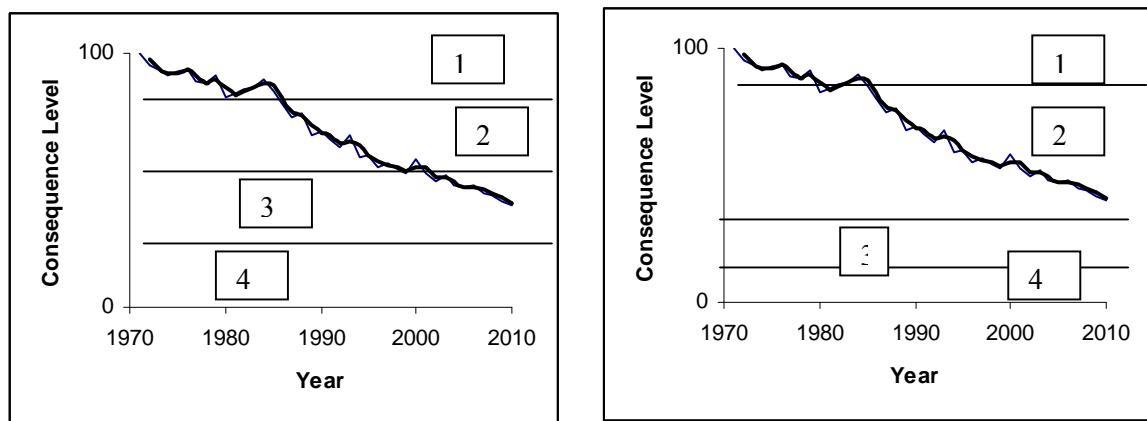


Figure 14 - Different risk levels using different objectives for “Yellowfin Tuna” using sustainability and viability levels as objectives. Note these are not real trajectories but only for illustrative purposes.

Table 6 Summary descriptions of the six sets of consequence levels covering the three environmental categories (modified from Fletcher et al., 2002). Full descriptions plus economic and social levels are presented in Appendix 1. *3 categories of habitat – normal, fragile, critical.

Consequence Level	A Target/Vulnerable (Sustainability)	B. Target/Vulnerable (Viability)	C Discards/Byproduct	D. Protected Species	E Ecosystem Structure	F Habitat*
1- Minor <i>Rapid recovery would occur if stopped - measured in days to months</i>	Possibly detectable but little impact on population size and none on their dynamics. Spawning Biomass 100 -70% unfished levels	Possibly detectable but little impact on population size and none on their dynamics. SPB > 70%	This fishery takes a small % compared to total take by all fisheries (covered explicitly elsewhere). Take and area of capture by this fishery is small compared to known area of distribution (< 30%).	Some are impacted but there is no impact on stock, and this is well below society's acceptable levels	No, or only minor, detectable changes in relative abundance of other constituents of region. None of the species removed play a 'keystone role'	Measurable but localised affects < 1-5% of total habitat area
2 –Moderate <i>Recovery probably measured in months – years if activity stopped</i>	Full exploitation rate where long term recruitment/dynamics not adversely impacted. SB < 70% > B _{msy}	Biomass above point where recruitment has been affected significantly SB < 70% > B _{rec}	Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits	Level of interaction/ impact at the maximum acceptable level	Measurable changes to the ecosystem components (e.g. catch levels of some have altered) without there being a major change in function. (i.e., no loss/addition of components)	Impacts more widespread but still acceptable 5-50 % of habitat area is affected
3 – Major <i>Recovery measured in years – decade if stopped</i>	Affecting recruitment levels of stocks/ or their capacity to increase. SB < B _{msy} - 5%	Recruitment affected but not stock will be sustained in longer term SB < B _{rec} > 3%	No information available on vulnerability to capture or life history traits of species; or relative levels of susceptibility known to be > 50% - should be examined using criteria in Set A.	Level of impact at above maximum acceptable level. Refer to Set A criteria for any higher levels associated with threatened species.	Ecosystem function altered measurably and some non target components have declined or increased to levels outside of acceptable range &/or facilitated new species to appear. Different species now the targets of the fishery.	Impact larger than sensible 20- 60% of habitat is affected/removed
4 – Extreme <i>Recovery period measured in decades</i>	Likely to cause local extinctions if continues	Highly likely to cause local extinctions if left	N/a	N/a	A major change to ecosystem structure and function likely to lead to	Removal may result in major changes to

<i>if stopped.</i>	SB < 5%	SB < 3%			total collapse of the ecosystem if continues.	ecosystem if 60 - 100% affected
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Table 7 Likelihood Definitions – both text descriptions and approximate probabilities – these are usually defined for the likelihood occurring within whatever is the normal review period (5 years is common).

Level	Descriptor
Likely (4)	It is expected to occur (Probability of 40 - 100%)
Possible (3)	Evidence to suggest this is possible and will occur occasionally (Probability of 10 - 35%)
Unlikely (2)	Uncommon here, or has been known to occur elsewhere (Probability of 2 -10%)
Remote (1)	Never heard of, but not impossible (Probability < 2%)

2.4 Step 4 – Developing Management Systems

This section details what processes and report headings need to be completed to ensure that a complete system has been developed for each of the issues requiring management

2.4.1 BACKGROUND

The management system outlined below covers all the processes needed for a management agency to give a good reason for the current and proposed management actions (or inactions) for each of the issues, given the levels of risk and current knowledge available.

Management Reports

There are four levels of management reports that can be generated using this approach. The first two can be generated very quickly, in a matter of days to weeks, whereas the final two categories will take considerably longer. It is likely that the outputs from the more brief reports will be used as the basis for completing the more comprehensive reports.

a) a very brief outline – component trees and a brief risk tables,

These reports may only be a few pages long but they could include an outline of the scope of the fishery/activity/region that was being assessed; a set of component trees that has been modified to fit the situation and a summary outcomes table (see format below) that captures the critical elements of the risk assessment but also includes a summary of what management actions will now need to occur. This provides a very rapid way of an agency/group to understand what they need to do and why.

ISSUE	Objective	Conseq.	Likel.	Risk Score	Reasons	Management implications

b) Include brief management reports on key issues

This level of report is similar to (a) but also includes a summary of the systems that will be used in the future for issues that require management. This includes what indicators, performance measures and other management actions will be undertaken.

Issue	Objective	Risk level	Indicator	Performance Measure	Management Actions

c) *Comprehensive reports on risk and management*

This level requires more comprehensive performance reports that complete for each issue a full description of the risk assessment analysis including appropriately detailed justifications. It also requires for issues needing management the following performance reports with these headings to be completed.

The following set of headings relates to issues that the agency has full responsibility. Those issues for which the agency has an interest but not full responsibility (which includes many of the community wellbeing issues), all headings may not be required (see example for debt).

Performance Report Heading	Description
1. Reason for inclusion	<i>Summary outcome of Risk Assessment why is it important and high risk, how do you know/ how certain are you? State knowledge base</i>
2. Operational Objective (plus justification)	<i>What specifically are your trying to achieve and why?</i>
3. Indicator	<i>How are you going to use to measure performance?</i>
4. Performance Measure/Limit plus (justification)	<i>What defines acceptable and unacceptable performance and why?</i>
5. Evaluation	<i>Monitoring programs needed and their results</i>
6. Robustness	<i>How robust are the indicators and performance measures?</i>
7. Fisheries Management Response	
- Current	<i>What management actions are currently used to achieve acceptable performance?</i>
- Future	<i>Does any extra management need to be introduced?</i>
- Actions if Performance Limit is exceeded	<i>What will happen if performance is not acceptable?</i>
- Review Cycle	<i>What is the time frame for reviewing performance? And why (the basis of) this time frame?</i>
8. Other Issues	<i>What, outside of the fisheries control, could affect performance against the objective?</i>

The completion of these set of headings can be done at a number of levels. They can be filled in very quickly (a few hours) to get an overall understanding of how well the systems have been developed, or they can be done in a very formal manner requiring stakeholder input which may take some months to generate. It is suggested that the initial, rapid version is done prior to any public level scrutiny or consultation to identify where the likely gaps and issues will be. The two examples located at the back of this section (2.4.4) were both written within an hour. Whilst they are not very polished, they still provide a

very comprehensive understanding of what are the management systems for these two issues and what needs to be done.

2.4.2 DESCRIPTION OF HEADINGS

Reason for Inclusion and Identification of Management Scope

Providing the reasons why an issue needs to be addressed is useful for determining both the objective and the management responses. In most cases this will be the summary of the risk analysis process outlined above and should include the risk scores and their justification.

The section can also specify which management authorities are responsible for ensuring adequate performance for this issue. In cases where more than one agency is involved, this could record how the relationship amongst the relevant agencies will operate – particularly who is responsible for setting the objectives and monitoring performance.

Operational Objective

The operational objective to use for an issue needs to have a direct and practical interpretation for the management of the fishery and needs to be measurable and auditable. It therefore needs to be outcome-based and can best be described by answering the question

“What do you want the fishery to achieve for this issue and why?”

The objective should also be consistent with any relevant legislation, policy statements or management plans. One of the most common objectives for target species is “maintaining spawning biomass above the level where it is likely that there will be recruitment overfishing”. As stated above the relevant objective for target stocks in the WCPFC is to *‘maintain or restore stocks at level capable of producing maximum sustainable yield as qualified by relevant environmental and economic factors...’* (Part II Article 5 (b).) Whereas for non-target species it is - *they must adopt measures for non-target species and dependent species with a view to maintaining or restoring their populations above levels at which their reproduction will not be seriously threatened* (Article 10 c).

The objective should not be how you will achieve it, nor what you will need to achieve it, and, most importantly, you need to be able to measure how you are performing against this objective.

The reasons for choosing the objective should also be recorded. This may be important when reviews of the system are undertaken in the future – if you write down why you chose something, it is easier to see if the reasons are still valid.

Indicators

The indicator is used to measure performance – are you achieving the operational objective? An indicator can be a direct measurement of performance (e.g. the level of

spawning biomass as estimated from a stock assessment model) or a surrogate (e.g. catch rates as an indirect indicator for measuring the level of the spawning biomass).

In some cases a number of indicators can be used for the same objective to provide a greater degree of confidence in the result, particularly where none of these by themselves is considered particularly accurate. If more than one is used, however, it is better to determine before hand how they will be used together to track performance, particularly for situations where they may show different trends.

Performance Measures

The performance measures are used to describe what is, and what is not, acceptable performance. For example the Convention states that the members of the Commission *shall .. determine, on the basis of the best scientific information available, stock specific reference points and the actions to be taken if they are exceeded” (Article 6 (a)).*

A performance measure (reference point) can take a number of forms and there may be more than one for a single indicator.

Specific value measures

- Limit reference points – the values below which management is trying avoid reaching (either exceeding or falling below, depending upon the issue); and
- Target reference points – the values which management is trying to reach

A range of values

- A range of values within which performance is considered acceptable, outside of which performance would not be considered acceptable.

A trend in values

- A positive trend could be good, but a negative trend would be bad (or the reverse – depending upon the issue and indicator).

Justification for Performance Measure Chosen

Similar to the operational objective, it is important to provide the reasons for choosing each of the levels/limits/trends that will be used to assess performance. This is a key decision in managing an issue because it will greatly affect the outcomes. Each of the reasons should be recorded including any assumptions based on - historical trends, results from similar fisheries elsewhere, scientific references etc. Recording these will help provide the basis for any review at some later date.

The operational objective, indicator and performance measure are a package. All three are needed before any one of them is useful. Indicators by themselves are of little value because without an objective and performance limit, you cannot interpret performance (Chesson, et al., 2000)

Evaluation

If data are available, how well is the fishery performing against the objective? Graphs such as that shown in Figure 15 can be a useful way of showing both the indicator and how it relates to the various performance measures.

There should also be a written description of the information and a definite statement about whether the current performance is acceptable or not.

Robustness

The evaluation could also include some discussion about the robustness of the current indicator/performance limit/evaluation package. This could involve either a textual description or possibly choosing a summary level (High, Medium, Low).

Management responses

This section describes the management needed to achieve the operational objective. This includes the current management arrangements, what is already proposed in the future, and what is the plan if the performance levels are triggered. The types of management actions should take particular note of the level of information available and the reliability of the evaluation.

Current

This should outline the current management arrangements that are already in place to maintain or improve performance and help you achieve the objective. There should be an explanation as to how each of the arrangements will assist performance.

Future

This is where you can outline any extra or different management arrangements that have been identified as a result of completing the risk assessment. Thus, these are those that will be *in addition to, or instead of*, the current arrangements. It is not necessary to merely repeat the current arrangements here.

If the Performance Measure/Limit is “exceeded”?

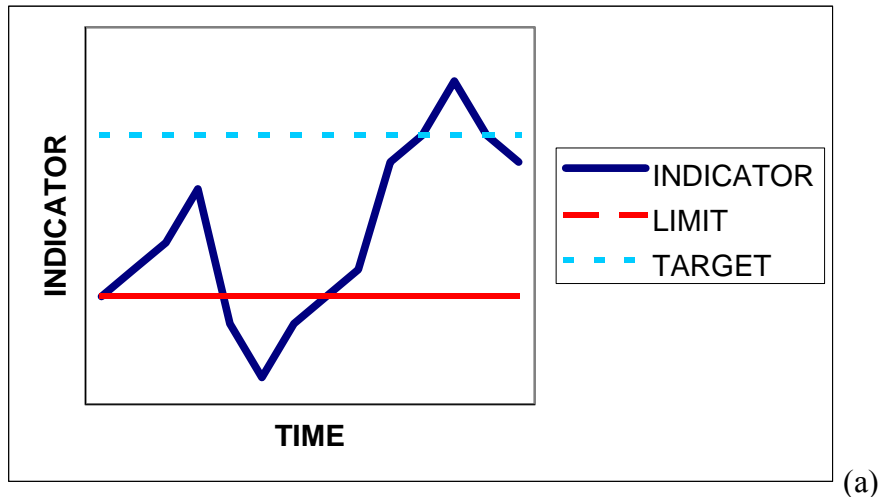
Finally it is important to outline the processes that will occur if an assessment shows that performance is not acceptable – i.e. one or more of the Performance Measures has been “exceeded”.

This is consistent with Article 6 part 3 of the Convention where it states that ... *in the event they (the reference points) are exceeded members of the Commission shall, without delay, take the action determined under part 1(a) to restore the stocks.*”

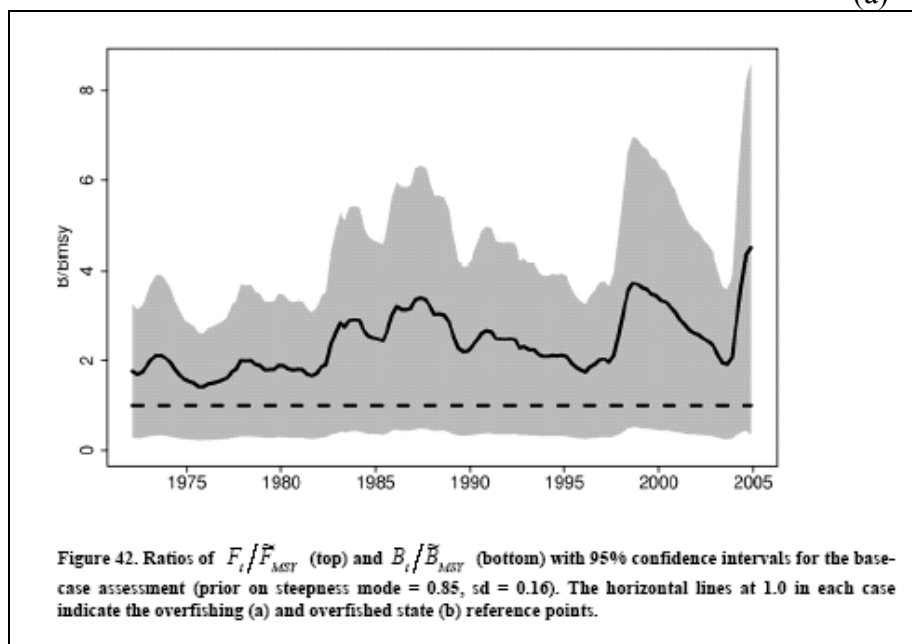
This process can range from initiating a review to determine the future actions that would occur, all the way through to having very clear, pre-defined management actions that will occur. In general, the less accurate the indicator, the less likely it is that having preset harvest strategies can be used.

Review Cycle

The period for reviewing performance should be outlined. In most cases this will be an annual process, but it could be either shorter or longer depending upon the issue.



(a)



(b)

Figure 15:

- (a) The general relationship between indicators, target and limit reference points (from Fletcher et al., 2002)
- (b) A real example for Skipjack Tuna in the WCPO fishery taken from Langley et al (2005) indicates the relationship between the indicator and a limit reference point (in this case when $B = B_{msy}$ i.e. = 1). If the solid line goes below 1 this would indicate overfishing had occurred.

Other Issues

This section is designed to enable any other factors, outside of the control of the fishery and the fishery management agency that could potentially affect this issue. These include natural environment effects but they can also include other human based effects such as the impact of urban runoff.

Thus Article 6 (6) of the Convention states that “*If a natural phenomenon has a significant adverse impact... members.. shall.... adopt management measures to ensure that fishing does not exacerbate such impacts.*”

2.4.3 EXAMPLE OF A QUICK TARGET SPECIES REPORT – TUNA SPECIES WCPO LEVEL

Performance Report Heading	<i>Tuna 4 Target Species (Skipjack, Yellowfin, Big eye, Albacore) WCPO Level</i>
1. Reason for inclusion	These are the management species in the WCPO Convention (Article 5). The specific risk assessments outcomes for these species can be based on Sustainability Viability or an Economic perspective. This alters the risks associated with these species dramatically.
2. Operational Objective (plus justification)	Sustainability of these species as qualified by environmental, economic and social factors
3. Indicators	S- Harvest levels in relation to Bmsy as measured using SPC based biomass stock assessments (multifan length based age structured model). E- Generation of fair and equitable economic benefits to all member countries.
4. Performance Measure/Limit plus (justification)	Harvest levels must be below that to achieve Bmsy (B/Bmsy > 1.0 for example, etc)
5. Evaluation	These are published regularly in the various SPC reports on each of the target species.
6. Robustness	Most precise estimates that can be achieved but there is a degree of uncertainty about the estimates.
7. Fisheries Management Response	
- Current	<i>Catch/Effort</i> There are currently a number of countries which have limits on total catch and or the level of effort (e.g. number of vessels) operating in region. <i>Allocation amongst countries.</i> Yet to be determined.

- Future	<p><i>Catch/Effort</i> Currently working on the decisions to determine the appropriate levels of catch and or effort for the region by species. “TACCC”</p> <p><i>Allocation</i> Determine the process for allocation of relative access levels among countries within the commission.</p>
- Actions if Performance Limit is exceeded	<p>The commission needs to determine what action will be taken. This will be activated by the triggering of one or more of the above performance measures. This is yet to be determined</p>
- Review Cycle	Annual assessments of YF and BE, and 2 years for SJ and Albacore
8. Other Issues	<p>Fishing nations not ‘member and cooperating nonmembers’.</p> <p>Climate and oceanography affect the fishery at the convention level but more so at the individual country level.</p> <p>Fishing from areas not controlled by the commission.</p> <p>Political instability</p> <p>Collaboration with other institutions (eg IATCC) – and non-fishing agencies/institutions.</p>

2.4.4 EXAMPLE OF QUICK BYPRODUCT REPORT –COUNTRY LEVEL (SHARKS)

Performance Report Heading	Shark
1. Reason for inclusion	<p>Shark species are vulnerable. Their management is required under the FAO code of conduct for Responsible Fishing (IPOA-Sharks).</p> <p>A number of species are commonly caught.</p>
2.Operational Objective (plus justification)	<p>Maintain the catch of key shark species at historical levels and catch rates.</p> <p>If this is occurring then shark stocks should still be at acceptable levels.</p>
3.Indicators	Monitor the CPUE and total catch by species
4. Performance Measure/Limit plus (justification)	<p>Catch of species to remain in acceptable range not to exceed x tonnes.</p> <p>No declining trend in CPUE</p>

5.Evaluation	Using observer based information to assess the catch and catch rates. This is assessed and reported to parliament and the WCPO commission at regular intervals.
6. Robustness	The CPUE trend for many species is acceptable, but discrepancy in data for lesser species due to identification problems.
7. Fisheries Management Response	
-Current	Catch/Effort limit: - Limited number of long line vessels are allowed to fish in this fishery and they are each only allowed to set a certain number of hooks per vessel per day -Fishing must remain outside of any Islands and reefs. -Tuna longline vessels are not allowed to use trace wire. -Catch must be landed in a home port before export
-Future	Given current evaluation, there will need to be a decrease in the number of vessels until sustainable TAC can be determined
-Actions if performance limit is exceeded	-Further reduce number of shark vessels potentially leading to a total ban on shark fining an even a total ban on shark fishing if things don't improve
-Review Cycle	After every two to three years-Need to get enough data.
8. Other Issues	Bycatch of shark in other fisheries, illegally targeted by other fisheries for shark fin. Environmental fluctuations.

2.4.5 EXAMPLE OF QUICK COMMUNITY WELLBEING REPORT (DEBT)

Performance Report Heading	Debt
1. Reason for inclusion	Boats and licences are often bought using borrowed funds. This level of debt can lead to issues for the individual and the community in trying to service the debt and especially if there is risk of loan default.

2.Operational Objective (plus justification)	Encourage the use of business planning to ensure the sensible use of debt for the funding of fishing activities within this fishery .
3.Indicators	Number of boat/licence owners that go bankrupt. Level of turnover in boat/licences
4. Performance Measure/Limit plus (justification)	
5.Evaluation	Using observer based information to assess the catch and catch rates. This is assessed and reported to parliament and the WCPO commission at regular intervals.
7. Fisheries Management Response	
-Current	Provide advisory materials Provide training opportunities for business planning
-Future	Encourage the fishers to get advice Have other agencies aware of the possibility of this outcome.
-Actions if performance limit is exceeded	Work with other agencies to minimise impact of bankruptcy. Have staff aware of other assistance that is available to help those seriously affected.
8. Other Issues	Environmental fluctuations. Market Fluctuations Cost fluctuations - fuel

SECTION 3 - RESOURCES FOR EAFM FACILITATORS

3.1 How to undertake a workshop to initiate review the EAFM process

3.1.1 HINTS FOR COMPLETING AN EAFM WORKSHOP - CONSULTATION

The possible consultative methods that can be used to generate the modified component trees to suite a particular fishing sector includes:

- 1) A manager/scientist by themselves.
- 2) A small group of agency/commission/FFA staff (i.e. both managers and scientists).
- 3) An Industry group
- 4) A working group of industry and agency staff.
- 5) A focused group containing representatives of all stakeholder groups (including industry, agency, other government and non-government).
- 6) An open, public meeting.
- 7) Some combination of the above.

The most efficient process for generating the modified component trees is using a combination of methods 1 and 5. This is done by getting the manager &/or scientist to come up with an initial draft version of the component trees, which are then finalised through a workshop that includes representation from each of the main stakeholder groups.

In all cases, one person should be defined as the local workshop coordinator. This is the person who will be responsible for ensuring that all the appropriate people attend the meetings, receive the material in a timely fashion and ensure that the reports are written in a consistent manner.

3.1.2 WHO SHOULD COME TO THESE WORKSHOPS?

The participants at these workshops could include:

- the workshop coordinator, (most likely to be the relevant fishery manager),
- an experienced facilitator to drive the process to completion
- relevant stakeholders including representatives from the industry sector being assessed, researchers, management and compliance staff,
- local community groups – particularly if the fishery operates in an area close to towns villages.,
- local conservation groups,

A strong level of local involvement is vital to ensure that the results of the workshop will be relevant (and acceptable) to local conditions/regulations/issues etc.

3.1.3 INSTRUCTIONS FOR WORKSHOP COORDINATORS

Before a Workshop

Send out background material to each participant at least two weeks before the workshop is to take place. This background material should include:

- the outline of what the process is trying to achieve – initiate an EAFM analysis for the ??? fishery (i.e. send them a copy of the ‘EAFM’ *Guide or at least the Overview* - or provide them with the web address where the guide is located).
- Send them any draft component trees that have been constructed for the fishery, emphasise that they are only a starting point. Also send them the generic component trees, so everyone can see where they have come from.

The background material should also include an outline of the industry, a summary of the biology of the species involved, and notes on the fishing methods involved and where the fishery operations are occurring. This is needed to give context to the discussions.

Also:

- (1) Arrange Venue and facilities
- (2) (a) If appropriate arrange for a high quality computer projector (1000 dpi resolution), electronic whiteboards etc. to display the material and also record the outcomes.
(b) The workshop can still be run without electronic aids – a whiteboard or blackboard can usually be used – it then requires an extra person to be there to transcribe the results from the boards onto paper or input into a laptop.
- (3) Develop attendee list (see above list of suggested attendee categories) and assist the main groups to attend. Obviously the location of the venue will make a big impact on whether it is easy or hard for certain groups to attend.
- (4) All relevant material can be collated- obtain copies of any relevant assessments, research data, management plans, regulations, codes of conduct etc. These are not presented at the workshops but it is useful to have when writing up the outcomes.
- (5) Organise a 15 minute talk on the industry (could be either the manager, an industry representative or both)

Instructions for All Attendees

In the information sent to the attendees let them know that they will be expected to contribute in a number of ways:

- Identifying the SPECIFIC issues relevant to this fishery and look for areas where additions or deletions will be necessary to the trees.
- Collating/ bringing/ distributing any relevant material for issues they are aware of to assist with the risk assessment.

Facilitation – Administration at the workshops

In circumstances where there is likely to be a large degree of dissent on issues, particularly between fisheries agency and other stakeholders, it may be prudent - or

more efficient - to use the services of an independent facilitator to manage proceedings. The alternative is to have the manager, or someone else from the agency chair the proceedings.

However, a vital element in this is that the facilitator (be they independent or agency/department-based) needs to have a good understanding of the EAFM process and at least a passing understanding of the fishery. Unless this is the case, it may be difficult to control proceedings and achieve a sensible outcome.

The use of a “parking space” whiteboard has been very useful on which issues that are not relevant to the current discussion but need to be addressed at some stage can be written down and not forgotten. The idea is that before the end of the workshop the group goes down this list to ensure that each of the points written has been attended to.

3.1.4 TIPS AND GUIDE TO USE FOR EXPLAINING THE CONCEPTS OF RISK ASSESSMENT

It often takes a reasonable length of time for participants at any risk assessment workshop to become familiar with the process and what is required. It is useful, therefore, to run through a few examples that provide sufficient contrasts in consequence and likelihood to demonstrate how issues should be rated. A second powerpoint presentation is located in Appendix 2 and can be downloaded from the website www.fisheries-esd.com

It is common for people to initially get confused in the assignment of issues to the correct categories within the impact and likelihood tables. This confusion often arises because they either try to directly rate the ‘risk’, not the two components of ‘risk’ separately; or they rate the likelihood of the activity occurring not the consequence actually occurring.

Some practical examples are shown below.

Example 1 – The pilchard mortalities that occurred around Australia's south coast some years ago. These caused a major ‘consequence’ (Consequence level 3) but this is an unlikely occurrence (Likelihood level 2). This is illustrated by the dark shaded section in Figure 16 – most of the time the consequence will be ‘nil’, but when a disease event hits, the consequence increases to ‘severe’. Hence the overall Risk Rating for this issue is 6 – which is a ‘medium’ risk.

Example 2 - The impact of the WCPFO fishery on the skipjack tuna stocks of the Pacific. With the current levels of effort and the dynamics of this species, the ‘likelihood’ is that every year (eg Likelihood level 4) there will be a ‘moderate’ consequence (Consequence level 2) on the stocks. The Risk Rating for this would be 8 - which is also only a ‘medium’ risk.

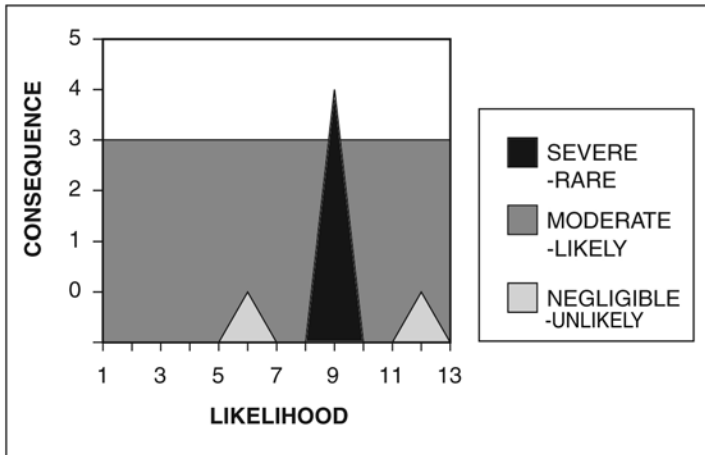


Fig. 16 Pictorial representation of the differences between consequence and likelihood. The height (y axis) represents the relative level of consequence of an “incident”, with the frequency of the incident shown on the x axis for each of three examples.

3.1.5 SUGGESTED AGENDA FOR WORKSHOP MEETINGS

Day One (until morning tea)

Task 1: *Provide an Overview of EAFM*

- What is EAFM?
- How does EAFM fit into Fisheries Management
- Describe the EAFM Framework
- Provide Descriptions of the industry to be assessed

An introductory talk should be given to clarify the scope of the workshop (which fishery and what elements of EAFM will be covered – all, or just the ecological etc). This is also useful to explain the process to those who did not read the material (which can be most of them!).

A copy of the powerpoint presentation that has been given at the beginning of these EAFM workshops is located on the website www.fisheries-esd.com

Day One (morning tea until lunch)

Task 2: *Develop component trees for this fishery (do not attempt to complete the risk assessment at this stage)*

1. Discuss each of the draft component trees. These discussions will be more fruitful and efficient if each of the attendees has examined the component trees before the meeting and comes along with their suggestions as to what amendments will need to be made.
2. The group will need to modify the trees to meet specific issues for the fishery by adding issues that are not covered adequately by the generic issues and deleting generic issues that are not relevant. If any are removed, you should provide written justification as to why they are not applicable to this fishery. This requires the issue to not be significant, not just that you have no data.
3. The discussions to adapt each of the 5 generic component trees should be restricted to no more than 30-45 minutes each.
4. If someone is using a computer with a projector and modify the trees during the discussions as the group agrees to any changes. The *ms organizational chart* software is relatively simple to use, but the person operating the computer should be familiar with this before the meeting.
5. The facilitator should provide a five-minute introduction on each of the component trees, to assist in the efficiency of the discussions.
6. Remember, at this stage of the process, it is about issue identification, not prioritisation, so there should be virtually no discussion of how important an

issue is. Even if the issue is not appropriate, this may be useful to document. In many cases, the articulation of what is *not* important is more valuable than what is. So, if someone raises something they think is an issue, deal with it.

Day One (Lunch till late)

Task 3: *Complete Risk Assessment for Identified Issues*

Outline the basics of Risk Assessment to provide the workshop participants with a better understanding of the concepts (use the PowerPoint presentation in Appendix 2).

Using the component trees developed earlier in the day, begin to step through each of the issues and determine risks associated with the operation of the industry. Pick an issue that there may be reasonable information about as the first issue assessed. Nonetheless, this first issue usually takes a long time to complete as the participants get used to the process. Try and get through at least one tree by the end of the first day.

Day two (Start – Morning Tea)

Task 3 (continued): *Completion of Risk Assessment*

Try and finish the risk assessment for all the environmental issues by morning tea.

Day two (Morning Tea - Lunch)

Go through the Human Wellbeing trees and use the risk assessment system to provide some insight into the level of priority/likely importance of the socio-economic and governance issues.

Day two (Lunch – Afternoon Tea)

Task 4: *Completion of Example Management Reports*

It is important to provide a few example reports for a number of the component trees. This may involve developing a report where there is already an objective/indicator/measure available from a current management plan/lease arrangement. In many cases, however, it will first need to involve discussions with the stakeholder group present as to what these might be.

Wherever possible, it will be helpful to get agreement during the meeting about what should be in each of these headings. Any proposed objective and performance measure would, in most cases, require subsequent ratification. If, however, agreement cannot be reached during the meeting on a specific objective or performance level, then each of the propositions can be recorded (along with any justifications) and used

as the basis for later consultation. This should not be seen as a failure, but as a means of identifying the specific issues that will require future attention.

It is expected that at best only brief notes would be made for the other headings (headings 4 – 10). These would need to be completed out of session.

Day two (Afternoon Tea)

It is best to finish by afternoon tea, because most participants will have already used up their energy/patience etc by this time and in most cases some participants will have to leave to catch planes

The workshop coordinator, facilitator and manager need to meet and determine the plan to complete the unfinished elements (of which there will be plenty). It needs to be reiterated to the participants that this is the start of a process, not a completion.

3.2 Hints for developing appropriate objectives etc.

3.2.1 TARGET SPECIES

Objectives

The most common objective for target species is:

To maintain the spawning stock of {insert species name here} at or above an appropriate level that minimises the risk of recruitment overfishing.

The justification for this objective relates to a normal fisheries management requirement to keep recruitment levels unaffected by a reduction in spawning stock. This does not mean that recruitment will necessarily be constant or high, just that it should only vary due to environmental factors – not from the impact of the fishery.

Meeting this objective should ensure sufficient spawning stock to continue recruitment at levels that will replenish that taken by fishing, predation and other environmental factors.

Depending upon the species and other issues, it may be required to have an objective that is more conservative than this (for example – if the decline in biomass that causes growth overfishing occurs before the level where recruitment overfishing occurs). There may be other economic or socially-based reasons for why this objective is not used, with either a more aggressive or more conservative approach taken. In either case, these would need to be justified. This may be the case where species is not the main target species but has a higher vulnerability – it may be agreed that this species can be ‘overfished’ to some degree. This degree would still need to be determined and justified.

Indicators

A variety of indicators that can be used to measure the performance of target species. A summary of these is presented in Table 9.

In general, the types of indicators and their robustness varies from relatively simple measures such as catch, to the use of sophisticated models that have estimates of actual spawning biomass derived from multiple fishery-dependent and independent inputs. There is a need to match the level of risk associated with the relative rate of exploitation with the types and quantities of data used to monitor performance (See Table 8). Where the risks (exploitation rate) are low, only crude indicators of performance are likely to be needed. Where the risks are higher and the management approach is more aggressive, leading to a relatively high exploitation rate, more robust and precise measures of abundance will be needed.

Table 8 Comparisons between the relative rates of exploitation of a stock and the different classes of indicators that could be used to measure performance.

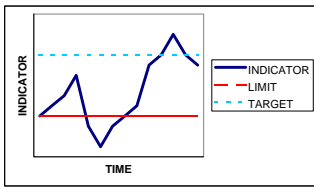
Exploitation Rate/Risk	Likely Indicators/Performance Limits Required
LOW	Catch or Effort Only Crude (Catch Per Unit Effort - CPUE) (i.e. low robustness).
MODERATE	Reasonable CPUE, possibly some extra/occasional biological sampling (i.e. moderate robustness).
HIGH	Good CPUE &/or Fishery Independent Surveys, probably biological sampling - leading to estimates of biomass/exploitation rates (i.e. high robustness).

In completing the initial assessment for a fishery, where there is a mismatch between relative exploitation and the method of monitoring, there are two courses of action available. The level of exploitation may need to be reduced to a level commensurate to the data quality being collected. Alternatively, the level of data quality could be increased to an acceptable level. This decision on which of these is the most appropriate is likely to be based on the value of the fishery - can the fishery 'afford' to increase the level of monitoring or not?

Performance Measures

Possible performance measures are located in Table A1.6

Table 9. Variations on the objective-indicator-performance measure-management response package for abundance of target species (from Fletcher et al., 2003).

Objective	Indicator*	Performance measure*	Management responses	Comments
Maintain abundance so that it satisfies specified criteria over a given period of time. Criteria can be a combination one or more limits and/or targets.	Probability that criteria will be satisfied during the time period assuming a particular course of action. Probability can be estimated using a range of techniques. Does not necessarily require 'data rich' fishery.	Probability must be greater than specified value, eg 0.9.	Select course of action, eg setting TAC/effort levels at regular intervals, so that required probability is achieved	Combines reporting and management response into a single, integrated process. Takes into account future as well as present stock status. Deals explicitly with uncertainty.
Maintain abundance so that it satisfies specified criteria. Criteria can be a combination one or more limits and/or targets.	Probability that current stock abundance satisfies criteria. Probability can be estimated using a range of techniques. Does not necessarily require 'data rich' fishery.	Probability must be greater than a specified value, eg 0.9.	If performance not satisfactory, take action to remedy situation, eg reduction in TAC, closures, effort controls. Switch to a rebuilding objective below.	Considers only current stock status for purpose of measuring performance. Deals explicitly with uncertainty.
	Estimate of stock abundance. Can be obtained from fishery-independent or fishery-dependent data using a range of techniques.	Abundance must satisfy criteria. If target is involved, could have the following form: 	If performance not satisfactory, take action to remedy situation, eg reduction in TAC, closures, effort controls. Switch to a rebuilding objective below.	Considers only current stock status for purpose of measuring performance. Does not deal explicitly with uncertainty.
Maintain abundance at current level.	Estimate of stock abundance relative to current level. Could use an indirect indicator such as catch rate in some cases.	Relative abundance must be sufficiently close to 1, ie no significant change. Could have following form:	If significant change then take action to remedy situation. Switch to a rebuilding objective below.	Special case of previous objective.
Return abundance to	Probability that target will be	Probability must be greater than a specified value, eg 0.9.	If performance not satisfactory,	Takes into account

previous level within specified time. (Rebuilding objective.)	achieved within specified time assuming a particular course of action.		select a course of action that achieves required probability. If none, close fishery.	future as well as present stock status. Deals explicitly with uncertainty.
Return abundance to previous level (Rebuilding objective.)	Estimate of stock abundance relative to previous level	Stock abundance should be increasing over time.	If stock abundance not increasing, take further action to remedy situation, including possible closure of fishery.	Considers only current trend in stock status for purpose of measuring performance. Does not deal explicitly with uncertainty.

3.2.2 BYCATCH SPECIES

Objectives

The types of objectives for bycatch species differ from the target species in that none are wanted to be caught. The question is whether the levels of removal are a real issue for the actual bycatch species, or whether the main impacts are generated from the discards they produce (i.e. provisioning) or whether the issue is largely socially driven community acceptance/wastage problems.

For some fisheries, the most practical objective is to reduce the levels of capture of non-retained species from the historical levels. For other fisheries, especially when dealing with threatened species, the total elimination of *all* capture may be the goal. Finally, for fisheries where the current levels are acceptable, the objective may merely be to avoid any future increases.

Consequently, the most common objectives developed for non-retained species so far are:

- *To minimise/decrease/eliminate the impact of the fishery on {insert name of species/group of species}.*
- *To maintain appropriately low levels of impact of the fishery on {insert name of species/group of species}.*

If it is largely a perception issue, or one only related to provisioning, then finding alternative markets for the species currently being dumped may be a sensible alternative. However, if it is because these species are being put at risk by the fishery, then the only alternative is to reduce/eliminate their capture in the first place. Finding alternative markets would probably exacerbate this problem.

Indicators

If the objective relates to a single species or a group of species then the indicator may need to be a direct measures of the levels of capture of these species.

Depending upon the species, the area of operation by the fishery compared to the area inhabited by the non-retained species may be a possibility to measure performance, with a justification that adequate refuge areas are available.

If the objective only relates to reducing a wastage problem or other perception issue, then processed based indicators relating to the percentage adoption of Bycatch Reduction Devices (BRDs), or some other fishing equipment based modification may be appropriate. These indicators are, however, unlikely to be appropriate in situations where the issue was related to specific concerns about one or more of the non-retained species.

Performance Measures

In general, precise performance measures for these objectives have not been developed so far. The most common form of limit/trigger used in the examples seen to date relate to using historical levels as the benchmark with some reduction on these levels used to gauge future performance. For example in some fisheries acceptable performance requires the amount of bycatch to be reduced to 40 per cent of current levels within five years.

Where there is specific concern about the stock status of a non-retained species, it is likely that a direct measure of their catch will be required and some threshold level of acceptable catch would need to be determined. This will be especially likely where 'icon' or highly threatened species are involved and would probably involve the use of observers.

3.2.3 ECOSYSTEM ISSUES

Objectives

This is probably the least well understood element of this reporting system. Consequently, the types of objectives developed for the issues in this category are probably the least well developed of the most common objectives developed so far:

To maintain any impact on the wider ecosystem within acceptable levels.

To maintain appropriate levels of biomass of target and other by-product species to minimize any significant impact on the broader ecosystem

To maintain the spatial extent of the fishing activity to a comparatively small percentage of the habitat/community

Indicators

The type of indicators appropriate for these ecosystem issues include:

Process/Pressure Indicators

- area trawled;
- effort levels;
- biomass reduction; and
- relative levels of biomass removed.

Direct Indicators

- Monitoring area of habitat; and
- Monitoring the community.

The latter group of indicators are only likely to be required if the impact of the activity is likely to be major and/or the fishery operates over a relatively wide area of the habitat (see Table 10). Precisely what can be measured beyond process/pressure-based indicators is not clear in most cases, except for the possibility to choose one or more 'indicator' species to measure overall performance.

The selection of these species would need to be justified. It is possible that the use of some multi-species analysis could be used, but this has not yet been seen in the completed studies to date.

Table 10 Comparison of impact versus likely management actions

Likely Level of Impact	Habitat interactions	Ecosystem Interactions
Low	Activity can occur across a large percentage of the area of the habitat	Stocks can be exploited to levels based only upon their own sustainability
Moderate	Activity may require some level of restriction in area	Consideration may need to be given to the level of exploitation on other species
High	Activity will need to be constrained to specific areas	Exploitation rate should be set based on avoiding major changes to other species or community structure

Performance Measures

Trophic Interactions/Biodiversity

Whilst much has been written in general about the need to maintain the ecosystem and have ecosystem-based management, there are few quantitative studies available upon which to base sensible performance measures for management. This is most notable

in trophic level interactions, where studies in this area show that interactions of this kind are usually non-linear and vary greatly amongst systems and species within a system. Thus, there is no precise ‘state’ that an ecosystem should be at, as natural systems vary (particularly the individual components) even without any human ‘assistance’.

Of note is that there are very few examples of strong trophic interactions leading to major changes in function (see Jennings & Kaiser, 1998 for review)⁴. Moreover, there are no examples of a fishery impacting indirectly on other trophic levels where the *initial* stocks targeted by the fishery are still in good shape.

The decision tree that could be used to assist in whether there is a high likelihood of interactions includes:

- Is there a single apical or keystone predator?
- Is there a keystone grazer in the system?
- Is there evidence or even a reasonable suspicion that strong interactions may be occurring in this system?
- Are there only one or two species within the affected trophic levels?

If all the answers to the above questions are “no”, then it *may* be possible to argue that the mere maintenance of reasonable levels of the harvested species should be sufficient to maintain general ecosystem function.

If the answer to one or more of these is “yes”, then there may be a need to directly monitor other elements of the ecosystem. Further, the level of reduction in target stocks may need to be set with this in mind – particularly with respect to minimising the risk of stock collapse.

Benthic Impacts

We have a reasonable understanding of the physical impacts of most fishing methods. A number of good reviews are available to start the analysis of what is likely to be acceptable or not. The most valuable of these is the review by Jennings & Kaiser (1998) and there are also a number of more recent publications such as the Meta-analyses done by Collie et al (2000)⁵, which could be most helpful. As a general rule of thumb, the more destructive the fishing method, the smaller the area that it should be allowed to operate (see Table 10).

The most logical approach to deal with these issues is to limit the area of fishing such that it is unnecessary to have detailed monitoring within the area affected (see below for example).

⁴ Jennings & Kaiser (1998) *Adv. Mar. Sci.* 34:203-352

⁵ Collie et al. (2000) *J. anim. Ecol.* 69:785-798

3.2.4 SOCIAL AND ECONOMIC REPORTS

Objectives – Preferred Outcomes

The decision to directly get involved in setting specific objectives for socio-economic elements will vary amongst different countries. This is usually a reflection that most community level objectives are set by the government and fisheries agencies may only play one part of the achievement of adequate performance.

The types of objectives that have been suggested include:

- Minimise the negative community impacts of fishery management decisions (and maximise the positive impacts).
- To have a safe and healthy work practices that minimise deaths and injuries of persons involved in the fishing activity.
- Maximise/optimize net economic return from the fishery.

However, in many cases, a desirable outcome rather than an actual objective was identified. This includes recognition of the broader benefits to the community from having the fishery – such as increased sea-rescue readiness provided by the presence of the fishing fleet - rather than this being a specific objective of the fishery.

A number of comprehensive reports have recently been completed that outline how to go about collecting socio-economic data for fisheries (Hundloe, 2002, 2005; Schirmer & Casey, 2005). A summary of the possible indicators is presented below in Table 11.

Table 11 Possible Socio-economic objectives, indicators and data requirements (from Fletcher et al., 2003).

Component	Objective	Indicator(performance measures)	Data requirements
Effects of fishery on communities <ul style="list-style-type: none"> ▪ Indigenous ▪ Economic 	Maintain or increase jobs, profits and flow-on benefits to the community	Direct and flow-on contributions to the region	Regional input-output analysis done periodically (e.g. 10 years)
<ul style="list-style-type: none"> ▪ Social ▪ Social capital 	Maintain or increase the contribution the fishery makes to social capital at the local scale	Indicator not developed	Interaction of fishers, their families and people in closely-related industries (e.g. boat building) in local social fabric. One-off survey required.
<ul style="list-style-type: none"> ▪ Employment 	Maintain or increase regional/local employment in the fishery and	Employment in the harvesting and processing sectors, and flow-on employment in other industries	Employment numbers

	related industries		
<ul style="list-style-type: none"> ▪ Regional industry 	Maintain or improve local/regional attitudes to the fishery	Positive and negative feelings to the fishery	Attitudinal surveys done occasionally. Ad hoc media comments
Effects of fishery on industry participants <ul style="list-style-type: none"> ▪ Economic 	Maintain or increase income to fishers	Net income	See above: economic survey data plus employment data
<ul style="list-style-type: none"> ▪ Social ▪ Health 	Reduce death and accidents rate for fishers	No greater than National average for work-related injuries	Injury data from relevant government authority
<ul style="list-style-type: none"> ▪ Lifestyle benefits and costs 	Maintain or improve lifestyle for fishers	Indicator not developed	
Effects of fishery on national economic wellbeing	Maintain or increase the contribution of the fishery to the national economy	Net economic return for the fishery. (Achieving MEY)	Economic survey data gathered periodically (e.g. 5 years)
Import replacement	Maintain or increase the proportion of domestically-harvested fish consumed	Consumption per capita of local seafood. To achieve at least an average consumption level of 6kg of locally-harvested seafood.	Consumption surveys
Distribution of benefits	Equitable distribution of benefits to fishers	Indicator not developed	
Social <ul style="list-style-type: none"> ▪ Health benefits/risks seafood eaten 	Improve human health/nutrition by increasing fish consumption	Consumption per capita of local seafood	Consumption surveys
<ul style="list-style-type: none"> ▪ Seafood quality 	Ensure seafood meets food safety requirements	Food safety reports	Food safety reports

3.2.5 ADMINISTRATION

Management Plans

The report on this aspect of governance should discuss the comprehensiveness of the management arrangements developed for the fishery. This can be done in terms of

what elements are currently contained within the current management plan (or other formal arrangement) of the fishery against what be deemed ‘best practice’ arrangements.

A series of 10 points covering the possible elements that could be presented in a management plan are listed below, but each jurisdiction must determine, based on their legislation, what their ‘best practice’ management plan would contain and then report against these criteria for the fishery being examined.

The suggested list of management arrangements that make up ‘best practice’ for a fishery should contain:

1. An explicit description of the management unit.
2. The issues addressed by the plan.
3. Descriptions of the stocks, their habitat and the fishing activities.
4. Clear operational (measurable) objectives and their associated performance measures and indicators.
5. Clearly defined rules, including what actions are to be taken if performance measures are triggered.
6. Economic and social characteristics of the groups involved in the fishery.
7. Management and regulatory details for the implementation of the actual management plan.
8. The reporting and assessment arrangements.
9. How and when reviews of the plan will occur (including consultation mechanisms).
10. A synopsis of how each of the ESD issues is being addressed.

The possible objective and justification for this component are:

Objective - In consultation with the relevant industry groups and other relevant stakeholders, periodically review the management plan, related legislation, regulations and arrangements to ensure they remains relevant and aligned with the fishery’s management objectives and that collectively they cover as many of the 10 main principles as possible.

Justification - To have an effective and understandable plan for the management of this fishery, all 10 principles need to be covered within the suite of arrangements developed for the fishery.

Compliance

The success of any set of management arrangements depends upon how well they are complied with. Consequently, there needs to be some assessment of this issue within each fishery and any related fisheries.

The reports on this issue could provide the opportunity to discuss the current levels of compliance with the management arrangements. These could either involve purely qualitative assessments, but preferably there should be some move to include quantitative data on rates of non-compliance.

Consultation

This report should describe all the formal, or semi-formal, consultation processes that are used to assist in the effective management of the fishery. Thus, it should describe how management plans are developed and amended – who is involved in these discussions, how do they find out about the issues and how do they have their inputs included.

There should also be a description of how ongoing management occurs – is there an ‘Advisory Committee’? If so, what are their terms of reference, which sectors are represented, and who appoints them, etc.

Reporting

What are the normal reporting arrangements for the fishery? It is important that the outcomes of the management processes administered by the fisheries department/agency are available for review by external parties. It is also important that the community is sufficiently informed on the status of the fishery, given that it is utilising a community resource.

The reports that may be provided on a regular basis include:

- Specific mention in the fisheries department/agency's Annual Report
- Publishing an annual status report of each fishery
- Less regular reports, possibly associated with some proposed change to management.
- Some jurisdictions also need to provide information to other departments for auditing purposes
- All information should, in most circumstances, be lodged on the relevant fisheries department/agency website, in addition to being distributed directly to the main stakeholder groups

3.3 References and other Useful Publications

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- Commonwealth of Australia (1998) *Australia's Oceans Policy*. Canberra, ACT, Australia. Volume 1, 52pp
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Appendix 1 – Details of Consequence Tables for Risk Assessment

Table A1 Consequence categories for the Major Target/Vulnerable species
(modified from Fletcher et al., 2002)

Level	Ecological (Target/Vulnerable Species)
Minor (1)	Either not detectable against background variability for this population; or if detectable, minimal impact on population size and none on dynamics. Spawning biomass 100% - 70% unfished levels
Moderate (2)	Fishery operating at, or close to, full exploitation rate such that the long-term recruitment/dynamics are not being adversely impacted. Spawning Biomass < 70% - B_{msy}
Severe (3)	Stock has been reduced to levels that are now directly affecting future recruitment levels or severely affecting their capacity to increase from a depleted state (i.e. recruitment overfishing). Spawning Biomass < B_{msy} - 5 %
Major (4)	Stock size and recruitment levels reduced to an extent that local extinctions or significant species range contraction > 50% have occurred. If it continues it would require listing in an appropriate endangered IUCN category and extinctions could result. Spawning Biomass < 5%

Table A2 Consequence categories for the By-Product Species/Minor bycatch species

Level	Ecological (By-product/General Bycatch)
Minor (1)	Take in this fishery is small (< 10%), compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small, compared to known area of distribution (< 20%).
Moderate (2)	Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits.
Severe (3)	No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species Relative levels of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly

Major (4)	N/A Once a consequence reaches this point it should be examined using Table A1.
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Table A3 Consequence levels for the impact of a fishery on the general ecosystem/trophic levels.

Level	Ecological (ECOSYSTEM)
Minor (1)	Interactions may be occurring but it is unlikely that there would be any change outside of natural variation. The captured species do not play a keystone role – only minor changes in relative abundance of other constituents.
Moderate (2)	Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components).
Severe (3)	Ecosystem: Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Recovery measured in years.
Major (4)	Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture) Recovery period measured in years to decades. Ecosystem: Total collapse of ecosystem processes. Long-term recovery period may be greater than decades

Table A4 Suggested consequence levels for the impacts on habitats. (Three levels – standard, fragile, critical)

Level	Ecological (HABITAT)
Minor (1)	Insignificant or barely measurable impacts on habitat(s) but these are very localised compared to total habitat area. <i>(Suggestion – these impacts could be < 5%; < 3%; <2%) of the original area of habitat)</i>
Moderate (2)	There are likely to be more widespread impacts on the habitat but the levels are still considerable acceptable given the % of area affected, the types of impact occurring and the recovery capacity of the habitat <i>(Suggestion – for impact on non-fragile habitats this may be up to 50% [similar to population dynamics theory] - but for more fragile habitats, to stay in this category the percentage area affected may need to be smaller, e.g. 20% and for critical habitats less than 5%)</i>

Severe (3)	<p>The level of impact on habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function.</p> <p><i>(Suggestion - Where the activity makes a significant impact in the area affected and the area > 25 - 50% [based on recovery rates] of habitat is being removed; whilst for critical habitats this would be < 10%)</i></p>
Major (4)	<p>Too much of the habitat is being affected, which may endanger its long-term survival and result in severe changes to ecosystem function and the entire habitat is in danger of being affected in a major way/removed.</p> <p><i>(Suggestion this may equate to 70 - 90% of the habitat being affected or removed by the activity; for more fragile habitats this would be > 30% and for critical habitats 10-20%)</i></p>

Table A5 Suggested consequence levels for economic outcomes.

Level	Economic
Minor (1)	Possible detectable, but no real impact on the economic pathways for the industry or the community.
Moderate (2)	Some level of reduction for a major fishery or a large reduction in a small fishery that the community is not dependent upon.
Severe (3)	Fishery/industry has declined significantly in economic generation and this will have clear flow on effects to other parts of the community. May result in some level of political intervention.
Major (4)	Total collapse of any economic activity coming from what was an industry that the community derived a significant level of their income or employment (resource dependency), including possible debts. High levels of political intervention likely.

Table A6 Suggested consequence levels for social disruptions.

Level	Social Implications
Minor (1)	None, or not measurable. Includes situations where there is no direct involvement by a community in the fishery.
Moderate (2)	Some direct impacts on social structures but not to the point where local communities are threatened or social dislocations will occur
Severe (3)	Severe impacts on social structures, at least at a local level.

Major (4)	Changes will cause a complete alteration to some social structures that are present within a region of a country
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Appendix 2 Summary of risks, attributes and fishery interactions for various Finfish Species

Table A7 Summary table from Fletcher et al (2003)

	Tropical Snapper	Mid size Pelagics	Temperate Snapper	Tuna & Billfish	Sharks (Short lived)	Sharks (long lived)
Characteristic						
Vulnerability to Fishing	MOD-HIGH	MOD	MOD-HIGH	LOW-HIGH	MOD	HIGH
PERFORMANCE MEASURES						
BIOLOGICAL REFERENCE PTS						
Spawning Biomass	30% (WA)	Unknown	30% -40% suggested	20%	30%	40%
Lowest Level				5% Southern Bluefin		
Max. Expl. Rate		35% for Sth Africa & Oman		~ 10% (Atlantic)		
ECONOMIC REFERENCE PTS						
MSY/MEY	40% (WA)		40% Shark Bay			
INDICATORS (robustness)						
Catch	LOW-MOD	LOW-MOD	LOW	LOW	LOW - MOD	LOW
Catch Rate	MOD	LOW-MOD	LOW	LOW	MOD	LOW - MOD
Independent Survey	HIGH	N/A	MOD-HIGH	LOW-MOD	MOD	MOD
Age/Size Models	MOD-HIGH	MOD	HIGH	MOD	MOD - HIGH	MOD - HIGH
Probability of Future	MOD-HIGH	-	-	HIGH	MOD	MOD
Recruit. Surveys	LOW-HIGH	N/A	LOW	LOW	NA	NA
MANAGEMENT RESPONSES (Effectiveness of Tools)						
Size Limits	LOW-MOD	MOD - HIGH	MOD-HIGH	MOD	LOW	LOW
Reproductive	MOD	N/A	LOW	N/A	N/a	N/a
Closures	MOD	LOW	MOD	NEG	LOW	LOW

	Tropical Snapper	Mid size Pelagics	Temperate Snapper	Tuna & Billfish	Sharks (Short lived)	Sharks (long lived)
	HIGH					
Effort	MOD-HIGH	MOD	LOW-MOD	LOW-MOD	MOD	MOD
Output	MOD-HIGH	MOD-HIGH	MOD-HIGH	MOD-HIGH	MOD	MOD
Ecosystem						
Impacts on Prey	LOW-MOD	LOW	LOW	LOW - MOD	LOW	LOW - MOD
Impacts on Predators	LOW	LOW	LOW	LOW	LOW	LOW

Appendix 3 Summary of risks, attributes and fishery interactions for various Invertebrate species

Table A8 (from Fletcher et al, 2003)

Attribute	ROCK LOBSTER	CRABS (DEEP)	CRABS (Shallow)	PRAWNS
Vulnerability to Fishing	MOD – LOW	MOD	LOW-MOD	LOW-MOD
BIOLOGICAL REFERENCE POINTS				
Spawning Biomass	10-22% B ₀ Tas & WRL	40% B ₀ (VIC), 50% B ₀ (WA)	??	20-25% B ₀ Brown Tiger Prawns (WA and NPF)
Lowest Level Reached	<10% (Tas) 15% (WRL)			15%
Max. Expl. Rate	60% (WRL)		70% (NT Mud Crab)	
ECONOMIC REFERENCE POINTS				
MSY/MEY	MSY/MEY used for WRL	MSY (TAS – giant crab)	MSY (mud & spanner crabs in Qld)	MSY (used for a number of fisheries)
INDICATORS OF ABUNDANCE (Robustness)				
Catch	LOW-MOD	LOW	LOW	LOW-MOD
Catch Rate	MOD	MOD	MOD	LOW-MOD
Independent Survey	MOD-HIGH	MOD-HIGH	MOD-HIGH	MOD-HIGH
Current Stock Size (Models)	MOD-HIGH	MOD-HIGH	MOD-HIGH	MOD-HIGH
Probability of meeting “target”	MOD-V HIGH	MOD-HIGH	MOD-HIGH	MOD- V HIGH
Mean Size			MOD	
Recruit. Surveys	LOW-HIGH	MOD		LOW-MOD
MANAGEMENT				

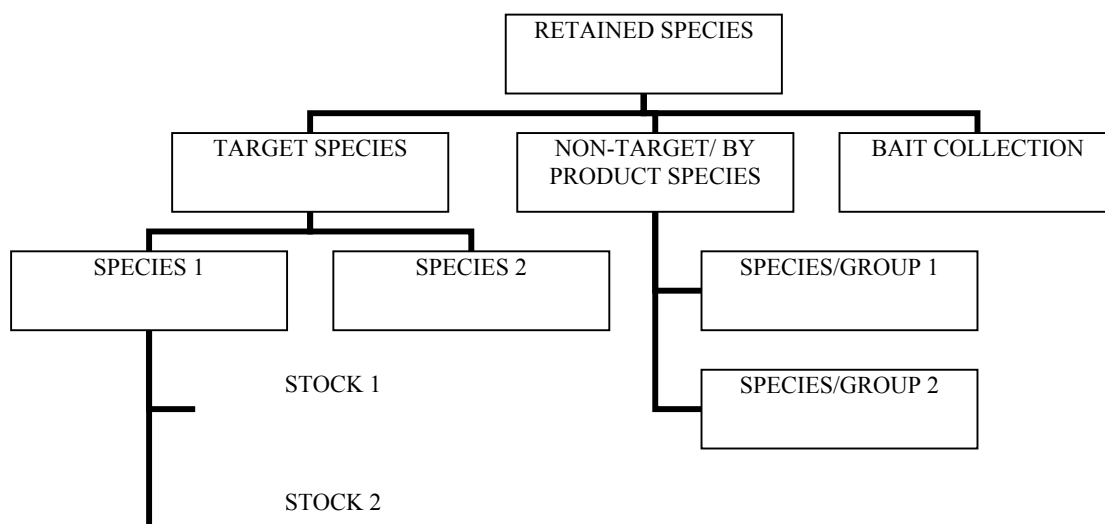
Attribute	ROCK LOBSTER	CRABS (DEEP)	CRABS (Shallow)	PRAWNS
<i>RESPONSES</i> (Effectiveness of tools)				
Size Limits	MOD-HIGH	MOD-HIGH	MOD-HIGH	LOW
Reproductive Closures	MOD	MOD	MOD	LOW
Effort	MOD-HIGH	LOW-MOD	MOD	MOD
Output	MOD-HIGH	MOD	MOD-HIGH	
Monitoring				
<i>ECOSYSTEM</i>				
Impacts on Prey	LOW-MOD	MOD	LOW	LOW
Impacts on Predators	LOW	LOW-MOD	LOW	LOW

Appendix 4 Summary of Likely Ecological Risk Ratings for various fishing methods

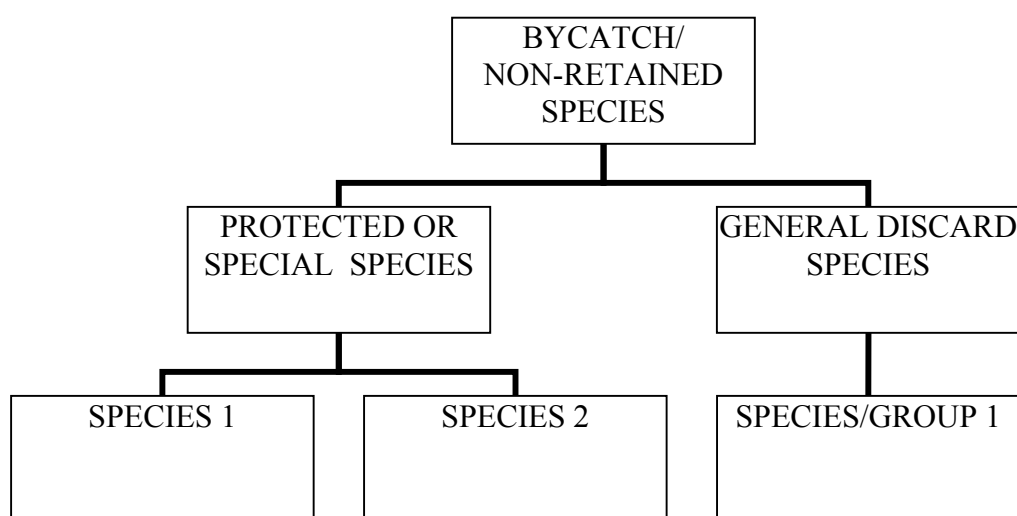
Table A9 (from Fletcher et al., 2003)

Method	Overall	General Bycatch	Listed Species	Ghost Fishing	Benthic Effects	Discards/ Prov.
Hand gathered	LOW	Nil	NIL	NIL	NIL	NEGL.
Line	LOW	LOW	LOW	NIL	LOW	LOW
Potting/ Trapping	LOW	LOW	LOW-MOD	MOD-HIGH	LOW-MOD	NEGL.
Pole & Line	LOW	LOW	LOW	NEGL.	NEGL.	LOW
Haul Nets	LOW – MOD	MOD	LOW	NEGL.	LOW - MOD	LOW
Purse Seine	LOW	LOW	LOW – HIGH	NEGL.	NEGL.	LOW
Longlines	LOW-MOD	LOW	LOW-HIGH	LOW	NEGL.	LOW
Demersal Gillnets	LOW	MOD	MOD	LOW - MOD	NEGL.	LOW
Prawn Trawl	MOD-HIGH	MOD – HIGH	LOW – HIGH	NIL	MOD-HIGH	MOD
Fish trawl	HIGH	MOD – HIGH	LOW – HIGH	NIL	HIGH	LOW -MOD
Chemicals	HIGH					
Blasting	V HIGH				V HIGH	
Dredge	HIGH	MOD	LOW-MOD	NIL	HIGH	HIGH

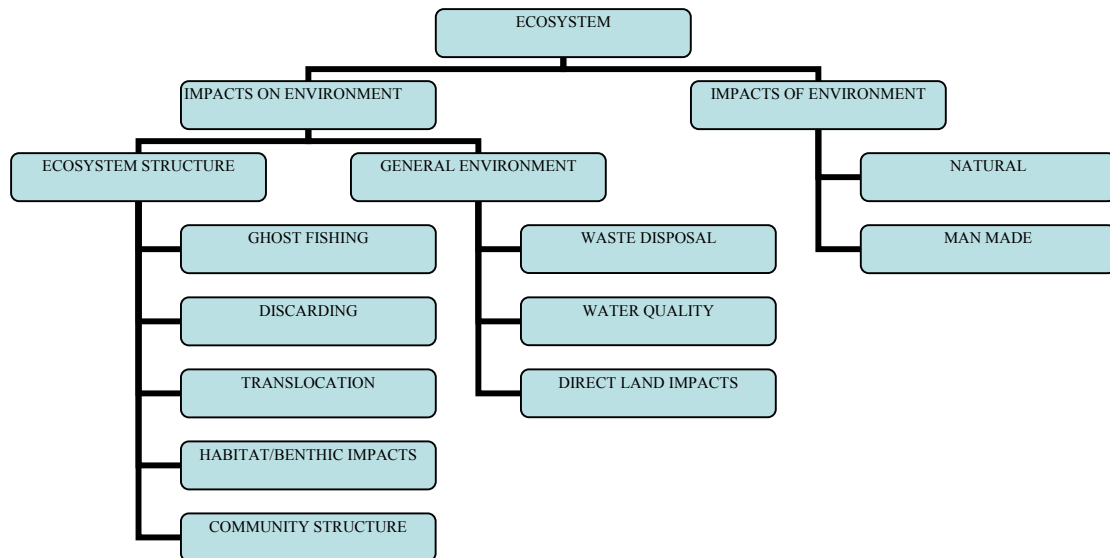
Appendix 4 – Generic Component Trees developed in Windows XP/2003[®] organisational chart software.



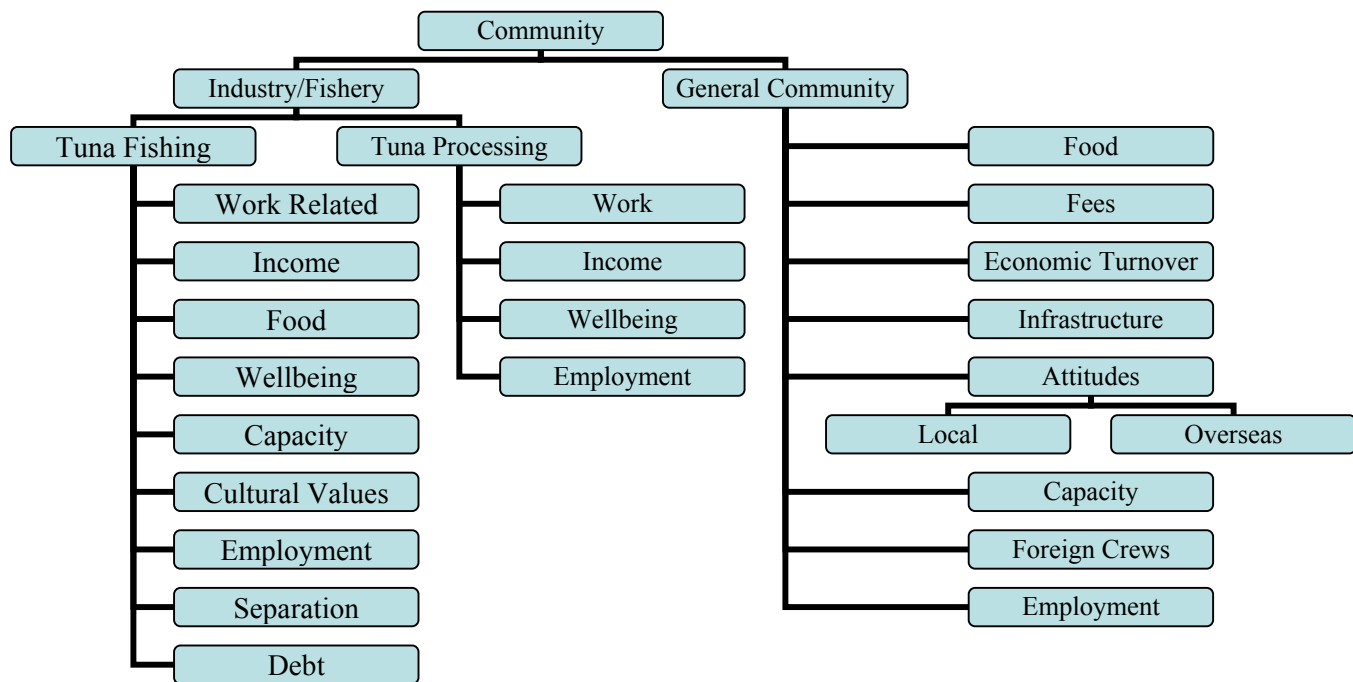
A4.1 Generic retained species tree



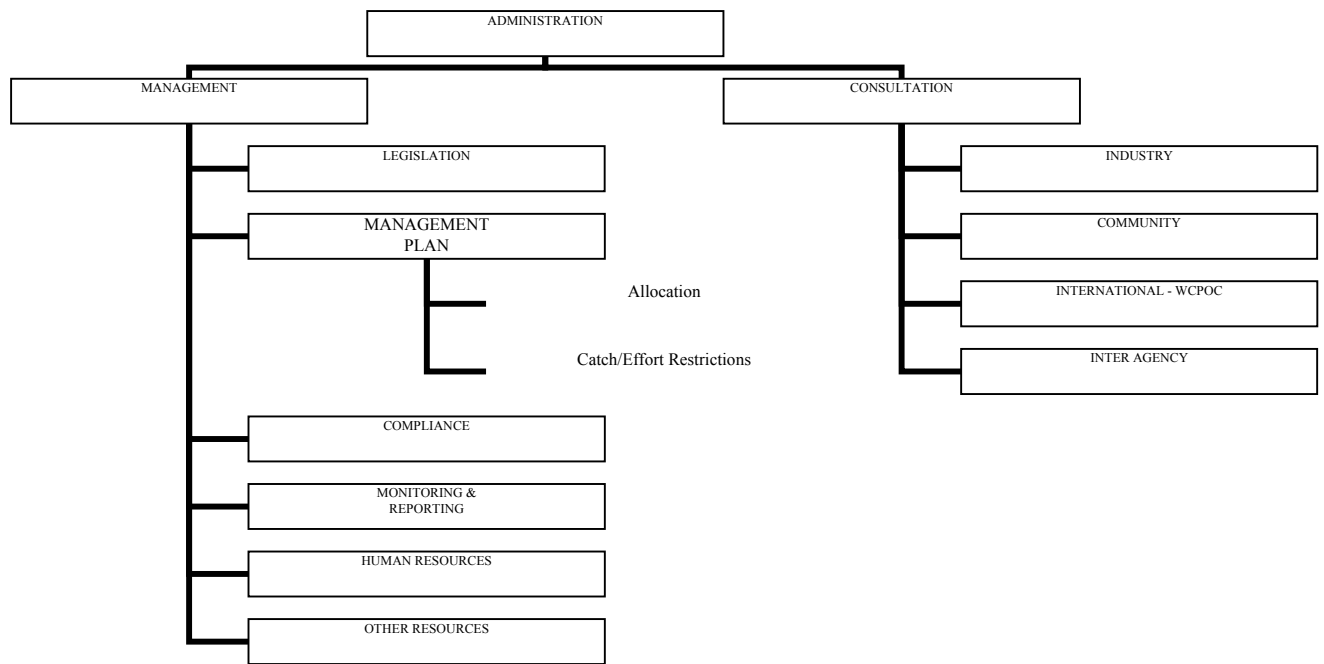
A4.2 Generic non-retained species tree



A4.3 Generic component tree for ecosystem effects



A 4.4 Generic component tree for Community Wellbeing



A4.5 Generic component tree for Administration

