

**CURRENT USE AND RECOMMENDATIONS FOR FUTURE  
DEVELOPMENT OF SUSTAINABILITY INDICATORS TO  
MEASURE PERFORMANCE OF AUSTRALIAN  
FISHERIES AGAINST ESD OBJECTIVES**

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**Project No. 98/168**

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## NON-TECHNICAL SUMMARY

### **98/168 Current Use and Recommendations for Future Development of Sustainability Indicators to Measure the Performance of Australian Fisheries against ESD Objectives**

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#### **Objectives**

- To review the responses by fisheries management agencies and Fishery Research Advisory Bodies (FRABs) to the Fisheries Research and Development Corporation (FRDC) questionnaire on the status, development and future directions in the use of sustainability indicators, and to identify gaps and implications for research and development (R&D);
- To obtain national agreement across fishery management agencies, FRABs and fishing industry leaders for the review, and to identify areas of partial agreement or contention; and
- To provide a report suitable for distribution to all interested parties.

#### **Background**

Ecologically sustainable development (ESD) has been accepted as the foundation for the management of natural resources in Australia since 1992, when the National Strategy for ESD was released. ESD was specifically identified as an objective of fisheries management in the 1991 *Commonwealth Fisheries Management Act*. It is also a key management objective in fisheries legislation in most States and Territories. One aspect of the ESD strategy is to develop and apply sustainability indicators to measure performance against ESD objectives.

#### **Summary of Implications and Recommendations for Research and Development**

National coordination of R&D on the definition and use of sustainability indicators was suggested or agreed to by all jurisdictions. A recommendation is the development of a nationally coordinated R&D program on sustainability indicators. The main aims of the program would be to develop options for sustainability indicators and guidelines for their use that are acceptable to all jurisdictions. The program would be linked to Standing Committee on Fisheries and Aquaculture (SCFA) processes and be inclusive of all jurisdictions.

Four main areas needing research and development were frequently raised and are supported in the review of this report. These needs, and the suggested approaches to meeting them, are:

1. Define terminology and framework for indicators of ESD performance

A guide is needed to define the terms used in relation to sustainability indicators and to provide a consistent framework for their use. This review began the process of developing a consistent terminology and use for sustainability indicators. This work should be completed, and a guide produced that is acceptable to all jurisdictions.

2. Capture experience nationally and internationally

The experience of what has been tried, and with what results, should be critically reviewed and consolidated nationally and internationally for fisheries and other sectors. An important aspect is that the review must be critical and address outcomes not just report on existing practices.

3. Develop guidelines for using sustainability indicators

A working group should develop national guidelines for using sustainability indicators. It should draft the scope and criteria for the guidelines, and submit them to SCFA and individual jurisdictions for consideration. Once the draft is agreed, the working group should oversee and guide the developing and testing of options for sustainability indicators.

4. Develop and test options for sustainability indicators

The consolidation of existing experience, is a necessary preliminary to developing a national approach to using sustainability indicators. It would substantially increase mutual understanding among Australian jurisdictions, provide numerous ideas for indicators, and provide some indication as to their appropriateness in different circumstances.

Simulation testing across a range of realistic but standardised fishery and ecological situations is also required to understand the performance of sustainability indicators in different situations and the degree of precaution required. The results would be used to tabulate the relative risks of using various sustainability indicators in particular fishery situations. Together the meta-analysis and simulation testing would enable sustainability indicators to be selected and justified in a risk management context.

**Keywords**

Ecologically Sustainable Development (ESD), Indicators, Sustainability Indicators, ESD Objectives.

## **ACRONYMS**

<b>AFMA</b>	Australian Fisheries Management Authority
<b>AMC</b>	Australian Maritime College
<b>ANAO</b>	Australian National Audit Office
<b>ANZECC</b>	Australian and New Zealand Environment and Conservation Council
<b>ASIC</b>	Australian Seafood Industry Council
<b>DPIE</b>	Department of Primary Industry and Energy
<b>FAO</b>	United Nations Food and Agriculture Organisation
<b>FRABs</b>	Fisheries Research Advisory Boards
<b>FRDC</b>	Fisheries Research and Development Corporation
<b>ICES</b>	International Council for the Exploration of the Sea
<b>LWRRDC</b>	Land and Water Resources Research and Development Corporation
<b>MACs</b>	Ministerial Advisory Committees
<b>MCFFA</b>	Ministerial Council on Forestry, Fisheries and Aquaculture
<b>SCFA</b>	Standing Committee on Fisheries and Aquaculture
<b>TAFI</b>	Tasmanian Aquaculture and Fisheries Institute

## **Current Use and Recommendations for Future Development of Sustainability Indicators to Measure the Performance of Australian Fisheries against ESD Objectives**

### **Background**

Ecologically sustainable development (ESD) has been accepted as the foundation for the management of natural resources in Australia since 1992, when the National Strategy for ESD was released. ESD was specifically identified as an objective of fisheries management in the 1991 *Commonwealth Fisheries Management Act*. It is also a key management objective in fisheries legislation in most of the States and Territories.

One aspect of the ESD strategy is to develop and apply sustainability indicators to measure performance against ESD objectives. Some indicators, such as measures of stock status relative to biological reference points, require a quantitative assessment of the status of the resource. Others are simpler and more easily estimated indicators, such as changes in catch rate or size structure of the catch.

### **Need**

Despite the increasingly widespread use of sustainability indicators across all fisheries management jurisdictions, there is so far little evidence of a consistent approach. Consistency would not only assist individual jurisdictions and individual fisheries to better achieve ESD objectives, but also assist in national reporting of ESD performance in fisheries management.

### **Objectives**

- To review the responses by fisheries management agencies and Fishery Research Advisory Bodies (FRABs) to the FRDC questionnaire on the current status, development and future directions in the use of sustainability indicators, and to identify gaps and implications for research and development (R&D);
- To obtain national agreement across fishery management agencies, FRABs and fishing industry leaders for the review, and to identify areas of partial agreement or contention; and
- To provide a report suitable for distribution to all interested parties.

### **Methods**

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- Compile, integrate and review the responses to FRDCs questionnaire, sorting them under the categories of (i) status, (ii) development (iii) future directions in the use of sustainability indicators, and (iv) to identify gaps and R&D implications;
  - Travel to all capital cities and discuss the contents of the draft review with the senior staff of fishery management agencies, FRAB chairpersons, and key industry leaders. These discussions were to ensure that the intent and content of the responses to the questionnaire had been correctly interpreted, to develop areas of national agreement, and to identify areas of contention; and
  - Provide a report suitable for distribution to all interested parties.

The process is described in this report in the Review under Methods.

## **Results**

The results of this study are presented in Part 2 of this report, “A Review: Use of Sustainability Indicators to Measure the Performance of Australian Fisheries against Ecologically Sustainable Development Objectives”. The following summary of results is taken from Section 4 of the review. Sections referred to in this summary are from the review.

### **Summary of Implications and Recommendations for Research and Development**

National coordination of R&D on the definition and use of sustainability indicators was suggested or agreed to by all jurisdictions. There was also agreement on the purpose of a coordinated approach, and how it should proceed. That is:

- The national approach should consist of sharing experience, developing guidelines for using sustainability indicators, and developing a ‘tool-box’ of options from which sustainability indicators could be selected. The guidelines and options should be non-binding. There should be a process that supports continued learning from the experiences of the jurisdictions;
- The development of national coordination should build on the efforts already made within jurisdictions, and should not preclude independent R&D within each jurisdiction. In addition to any national effort it was recognised that there was need to continue development of indicators separately within jurisdictions, especially for the more important fisheries in each jurisdiction;
- The Standing Committee on Fisheries and Aquaculture (SCFA) should be involved in developing national standards, in R&D projects to develop guidelines, and the ‘tool-box’ of options;
- The guidelines and options should be written in plain English for the use of non-specialist stakeholders and Fishery Management Advisory Committees involved in the development of fishery management plans;

- The guidelines and options for sustainability indicators must be scientifically defensible. They should outline the strengths and weaknesses of prospective indicators, including when they should and should not be used, based on a transparent and reviewable assessment. This should include providing a risk assessment of the options. The aim is for the guidelines and options to provide a sound basis and justification for using particular approaches in particular circumstances, and that they provide a defensible approach even in the absence of adequate information;
- Development of the national approach should focus on the practical use of indicators in management plans, and involve the planners in fisheries management; and
- Fishery sustainability indicators need to gain greater acceptance and financial support from other sectoral interests, including environmental managers and the State of Environment Reporting. A process is needed to encourage cross-sectoral support.

Together these imply the need for a nationally coordinated R&D program on sustainability indicators. The main aims of the program would be to develop the options for sustainability indicators and guidelines for their use that are acceptable to all jurisdictions. The program would be linked to SCFA processes and be inclusive of all jurisdictions.

The development of a FRDC subprogram or a similar coordination initiative across existing FRDC subprograms are possible mechanisms to support a national R&D program. The key objective of the coordination mechanism would be to ensure that R&D on sustainability indicators is dealt with coherently and with a clear focus, rather than being diffusely or incidentally dealt with across a number of FRDC programs and subprograms.

Four main areas needing research and development were frequently raised and are supported in the review of this report. These needs, and the suggested approaches to meeting them, are:

#### 1. Define terminology and framework for indicators of ESD performance

A guide is needed to firstly, define the terms used in relation to sustainability indicators and, secondly, to provide a consistent framework for their use. At present the same concepts are being commonly applied, but different jurisdictions (and even fisheries within a jurisdiction) are using different terms to express what they are doing, or using the same term to mean different things. This review began the process of developing a consistent terminology and use for sustainability indicators (see Section 3.2 of the review). This work should be completed and a guide produced that is acceptable to all jurisdictions.

#### 2. Capture experience nationally and internationally

Experiences of what has been tried, and with what results, should be critically reviewed and consolidated nationally and internationally for fisheries and other sectors. Several suggestions were made during the review as to what should be included and how it could be approached



(see Section 3.6 of the review). An important aspect is that the review must be critical and address outcomes, not just report on existing practices.

The review should separately examine the experience with respect to ESD objectives for (i) the target species, (ii) the direct ecosystem support of the target species (e.g. habitat and food requirements), (iii) the broader ecosystem (e.g. both dependent and essentially independent species), (iv) economic performance, and (v) social performance. It should also categorise the types of fishery situation being managed, and the information available on the fishery.

Three critical reviews are implied:

- A review and consolidation of the experience with fishery sustainability indicators (including broader ecosystem issues) in other nations that have put significant effort into this area. These include United States, Canada, New Zealand, and some ICES nations; FAO could also assist. A relatively small team could undertake this review;
- A review of the experience with sustainability indicators in other Australian resource management sectors, especially forestry and freshwater ecosystem health management; and
- A review and consolidation of the experience with fishery sustainability indicators (including broader ecosystem issues) in Australia. A large number of people would need to participate in this review to adequately reflect the Australian jurisdictions and the diversity of situations. A series of multi-day workshops, in addition to consolidated evaluation of approaches, would be needed.

### 3. Develop guidelines for using sustainability indicators

A working group should develop national guidelines for using sustainability indicators. The core of the working group could consist of the combined Research and Management Subcommittee of SCFA (perhaps also with input from the Environment and Health sub-committee), together with the leader of a Sustainability Indicators R&D program.

This working group could draft the scope and criteria for the guidelines, and submit them to SCFA for consideration. This draft could be developed concurrently with activity 2 above, as the scope and criteria for the guidelines could not be developed without the detailed consolidation of experience. After SCFA has agreed on the scope and criteria, the working group could oversee and guide the developing and testing of options for sustainability indicators (i.e. activity 4 below). After activities 1, 2 and 4 are completed, the group could provide final draft guidelines for consideration by SCFA and individual jurisdictions on the use of sustainability indicators in Australian fisheries.

### 4. Develop and test options for sustainability indicators

The consolidation of existing experience through activity 2 is a necessary preliminary to developing a national approach to using sustainability indicators. It would substantially increase mutual understanding among Australian jurisdictions, provide numerous ideas for indicators, and provide some indication as to their appropriateness in different circumstances. It will also provide an agreed approach to categorising fisheries and ESD indicator types. However, the complexity of fisheries is such that it will often be difficult to determine what contribution the use of a particular indicator made to the outcome seen in a fishery. Also, the existing experience with indicators for ecosystem integrity and sustainability is extremely limited, both in terms of the types of indicator that might be used and their effectiveness. To a large extent, indicators of ecosystem sustainability have yet to be developed and experience in their use accumulated.

Consequently the scientific justification and defence of the use of particular indicators in particular circumstances will not be provided by the consolidation and meta-analysis of existing experience alone. Simulation testing across a range of realistic but standardised fishery and ecological situations is also required to understand how sustainability indicators perform in different situations and what degree of precaution is required. The results would be used to tabulate the relative risks of using various sustainability indicators in particular fishery situations. Together, the meta-analysis and simulation testing will enable sustainability indicators to be selected and justified in a risk management context.

## **Benefits**

Benefits flow to all jurisdictions.

## **Intellectual Property**

There is no owned intellectual property in this report.

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# **A Review: Use of Sustainability Indicators to Measure the Performance of Australian Fisheries against Ecologically Sustainable Development Objectives**

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## **1. Introduction**

The National Strategy for ESD (NSES) was released in 1992 after several years of extensive consultation among all levels of Government, industry, academic and community-based organisations. Since then, Ecologically Sustainable Development (ESD) has been the accepted basis for management of natural resources in Australia. The goal of the NSES is 'development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends'. The core objectives of the NSES are:

- To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- To provide for equity within and between generations; and
- To protect biological diversity and maintain essential ecological processes and life support systems.

ESD explicitly underpins the Inter-Governmental Agreement on the Environment (IGAE). This agreement established agreed principles for environmental policy, and the roles and responsibilities for environmental management among the Governments of Australia. It was agreed to in 1992 by the Commonwealth Prime Minister and the Premier or Chief Minister of all Australian States and Territories.

These initiatives significantly changed the focus of fisheries management agencies in all jurisdictions and helped to prompt changes in fisheries legislation. During the 1990s all Australian governments incorporated the goals and principles of ESD into new or amended fisheries Acts, although their approaches and expressions differed. ESD was identified as an explicit objective by the Commonwealth, New South Wales, Tasmania (via the Resource Management and Planning legislation), and Victoria. In Queensland the Act identified ecologically sustainable use as an objective. Western Australia, Northern Territory and South Australia cited the main principles and intended outcomes of ESD (e.g. stock sustainability, habitat/ecosystem management, economic performance and social equity) as legislative objectives, without explicitly using the term ESD.

A common feature of the approaches taken by all jurisdictions is the requirement that indicators be developed and used to measure performance against ESD related objectives. These indicators require operational and measurable interpretations of the objectives of the

NSESD and that jurisdiction's fisheries legislation. Such indicators are usually required in management plans and are often required for statutory reporting or government audits. Consequently there has been considerable effort put into developing indicators for performance against ESD objectives. But, despite the increasingly widespread use of sustainability indicators within all fishery management jurisdictions, there is so far limited mutual understanding of the experience and approaches taken by each jurisdiction, and little evidence of consistency of approach. A degree of consistency would assist both individual jurisdictions and individual fisheries to better achieve ESD objectives. It will also assist in national reporting of ESD performance in fisheries management.

In this context the Fisheries Research and Development Corporation (FRDC) initiated this review of the use of sustainability indicators in Australian fisheries management. The specific topics for review were:

- the current status of the use of sustainability indicators;
- planned development in the use of sustainability indicators; and
- future directions in the use of sustainability indicators, gaps and implications for research and development.

In addition, the review would also emphasise identification of agreed issues and ways forward – rather than attempting to solve issues or resolve differences at this stage. The aim was to provide a comprehensive outline of how sustainability indicators are currently used, and to identify areas of national agreement or significant contention about future directions. The review was to include comprehensive consultation with the peak industry bodies, fishery management agencies and FRDC Fishery Research Advisory Bodies (FRABs) in all jurisdictions.

Some of the issues dealt with in this report are also covered in a number of other reports, agreements or by organisations, including:

- “Implementation of Ecologically Sustainable Development by Commonwealth Departments and Agencies”. Productivity Commission Inquiry into the Implementation of ESD by Commonwealth Departments and agencies.
- “Code of Conduct for Responsible Fisheries”. FAO Fisheries Department
- The Agreement for the United Nations convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
- ISO 14000 and Marine Stewardship Council (MSC)

## **2. Methods**

In late 1997 the FRDC Board developed and circulated a questionnaire on ESD sustainability indicators to the peak industry bodies, fishery management agencies and FRABs in each jurisdiction. The questionnaire asked for information on the current usage, planned development and ideal/desired future development of sustainability indicators. The authors of

this report summarised the replies and identified general issues, including example indicators and suggested definitions of terms. The summary was circulated to all participants and follow-up interviews were arranged.

The interviews were partly to ensure that the questionnaire responses had been correctly interpreted. They were also to seek additional information and detail, because it was clear that the questionnaire responses did not fully reflect the range and depth of ideas and activities occurring across Australia. Draft summaries of the interviews were later provided to the participants for comment and correction.

The agencies, organisations and individuals involved with the questionnaire and interviews are listed in Appendix A.

A third source of information was the background documentation for fishery management in each jurisdiction. These documents included fishery management legislation, fishery management plans, institutional strategic plans, and fishery status reports. These were reviewed for the use of indicators related to ESD objectives, and in some cases, discussed during the interviews.

### **3. Results**

The contents of the background documents for fishery management in each jurisdiction are summarised in Appendix B. The views expressed by each jurisdiction in the questionnaire and interviews are summarised in Appendix C under the headings:

1. Status and current use of indicators
2. Issues
  - (a) National approach
  - (b) Terms and definitions
  - (c) Indicators and broader issues
  - (d) Use and selection of indicators
  - (e) Issues of cost recovery, target and non-target species, rich and poor fisheries
  - (f) Experience elsewhere
  - (g) State of Environment reporting
3. Development and future directions
4. Implications for R&D

There was a very positive attitude to the review, clear recognition of the importance and difficulty of the issues being addressed, and strong agreement on several key issues. In general:

- There is strong support for using sustainability indicators in all jurisdictions, and many indicators are currently being used. There was strong support for a nationally coordinated effort to develop and use sustainability indicators, with this focused on providing guidelines and options for selection rather than prescriptive actions. The guidelines and a 'tool-box'

of methods that draw on Australia's pooled expertise should be practical. This would provide national consistency of approach and usage while recognising the diversity of situations in which sustainability indicators are used;

- There was a strong and repeated comment that, to be practical, the development of indicators must be focused on their use in management plans and performance evaluation, rather than on general theories, broad principles or policy. There was support for a 'bottom-up' process aimed at developing practical and operational ESD input for management plans. In contrast, past attempts were perceived to have failed, having relied mainly on 'top-down' processes, general theory, and policy statements. Although 'top-down' inputs were recognised as being necessary, it was now necessary to develop and apply the 'bottom-up' component to support existing policies and principles;
- There was strong agreement that sustainability indicators needed to relate to the broad ecological sustainability of fishing, including ecosystem and environmental issues, beyond the target species. Most existing use of indicators relates to the target species, but there was agreement that broader ecosystem and environmental indicators should be developed; and
- There was broad recognition that ESD has biological, economic and social objectives. However, there was also recognition that the degree of responsibility and management control possible through fisheries agencies implied a hierarchy of objectives. Fishery agencies have the most direct responsibility and management control with respect to the biological objectives related to sustainable harvesting and conservation, although they do not directly control the impact of other industry sectors (especially relating to pollution and coastal habitat damage). Economic performance in fisheries is influenced by many factors other than fisheries management decisions. Social performance is influenced by even more factors, and is primarily in the realm of political decision-making. Consequently, the value of sustainability indicators for fishery management and assessment was seen to be greatest for biological objectives, intermediate for economic objectives and lowest for social objectives. This hierarchy in the focus and use of sustainability indicators was common across jurisdictions, although the balance between biological and economic objectives varied somewhat. Some jurisdictions gave these reasonably similar priorities, but most put the priority overwhelmingly on the biological objectives. Most jurisdictions wished to include at least some indicators across all three types of objectives, even if there was no immediate or direct use of the indicators in fisheries management decision-making or performance reporting. Some indicators were specifically intended for use in lobbying relevant decision-makers about outcomes that fishery managers were concerned about but had little direct management control over.

Seven key areas of agreement were identified in the review:

### 3.1 Attitude to the use and scope of sustainability indicators

There was broad and strong support for the use of sustainability indicators among the industry, managers and scientists from all jurisdictions. All jurisdictions have ESD objectives either explicitly or implicitly within their legislation. Many also require their management plans to develop and monitor performance measures against management objectives, and therefore need to develop sustainability indicators.

All jurisdictions agreed that the scope of ESD extended beyond the target species to include the supporting ecosystem, and ecosystem health in general. Some of the specific issues were management of by-catch, effects of fishing on habitat and protected species, the effects of fishing on ecologically related species (e.g. food chain effects), and the effects of other human activities on fish stocks and the marine environment.

Most jurisdictions agreed that social and economic considerations also needed to be within the scope of ESD. There appeared to be three views on incorporating social and economic concerns. (1) Social and economic objectives and performance are very important, but arguably are outside the institutional mandate; consequently, development and use of relevant indicators is not warranted in a fisheries management context. (2) Social and economic objectives and performance should be included, but are very difficult to deal with, as they fall primarily within the political arena where scientific indicators are of limited use; consequently, development of relevant indicators is unlikely to be useful and has low priority. (3) Social and economic objectives and performance indicators were seen as important and within the responsibility of fisheries management to a significant extent; although their development and use is very difficult there is a clear need for them.

### 3.2 Consistent terminology

The need for consistent terminology was frequently identified. Even between management plans within the same jurisdiction, terms were used inconsistently. For example, basic terms such as indicator, sustainability indicator, performance measure, reference point, limit, target, and trigger point do not have agreed definitions.

Suggested definitions for some terms was briefly outlined to each jurisdiction during the interviews simply to facilitate discussions. The definitions were broadly accepted.

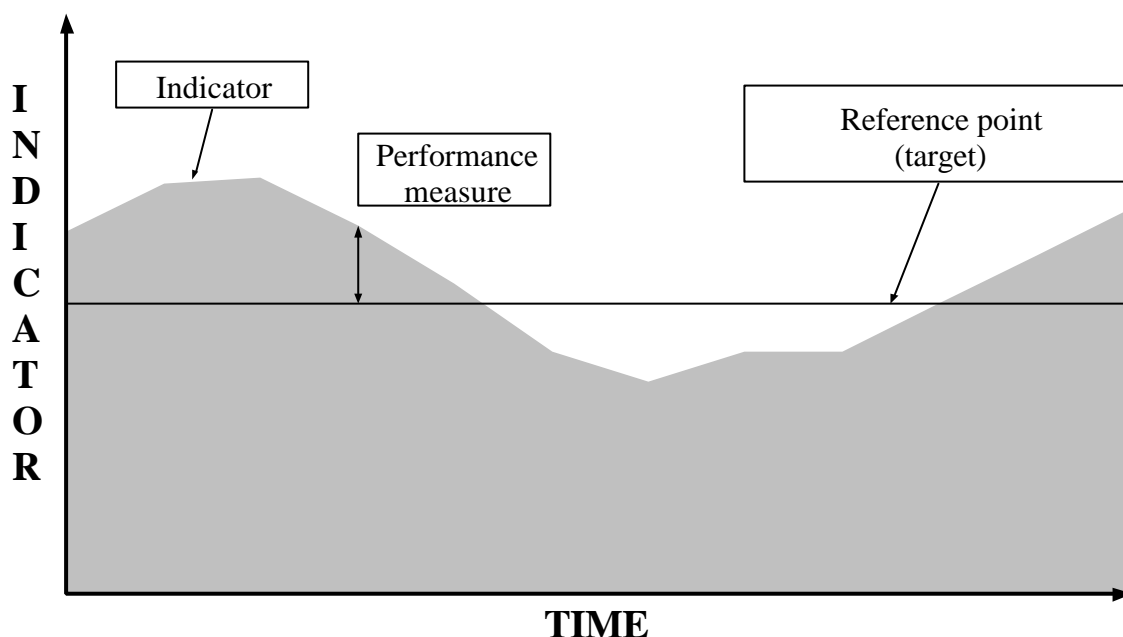
Development of a full glossary is a recommendation of this report. Three are defined below:

- *Sustainability indicator*: a quantity that can be measured and used to track changes in the status of a key component of the system that is thought to relate to sustainability.
- *Reference point*: the value of a sustainability indicator that corresponds to some agreed management target, limit or trigger for management action.

- *Performance measure*: a quantity that can be used to measure management performance against objectives, and particularly the value of a sustainability indicator in relation to a reference point.

For example, in a stock for which a quantitative stock assessment is available:

- A sustainability indicator could be the estimate of current biomass  $B_t$ ,
- A limit reference point could be 20% of unexploited biomass  $B_0$ , and
- The corresponding performance measure (related to an objective to minimise the chance of stock collapse) could be the probability that the stock is currently above the reference point (i.e.  $\text{Prob}[B_t > 0.2B_0]$ ).



**Figure 1: An example of the relationship between an Indicator, a target Reference Point and a Performance Measure over time. The indicator is a quantity of relevance selected for measurement, the appropriate target reference point for this indicator is derived from the management objectives, and the performance measure is (in this case) the difference between the indicator and the target reference point. Note that in practice indicators are measured with error (both bias and noise) which accounts for some of the variation over time.**

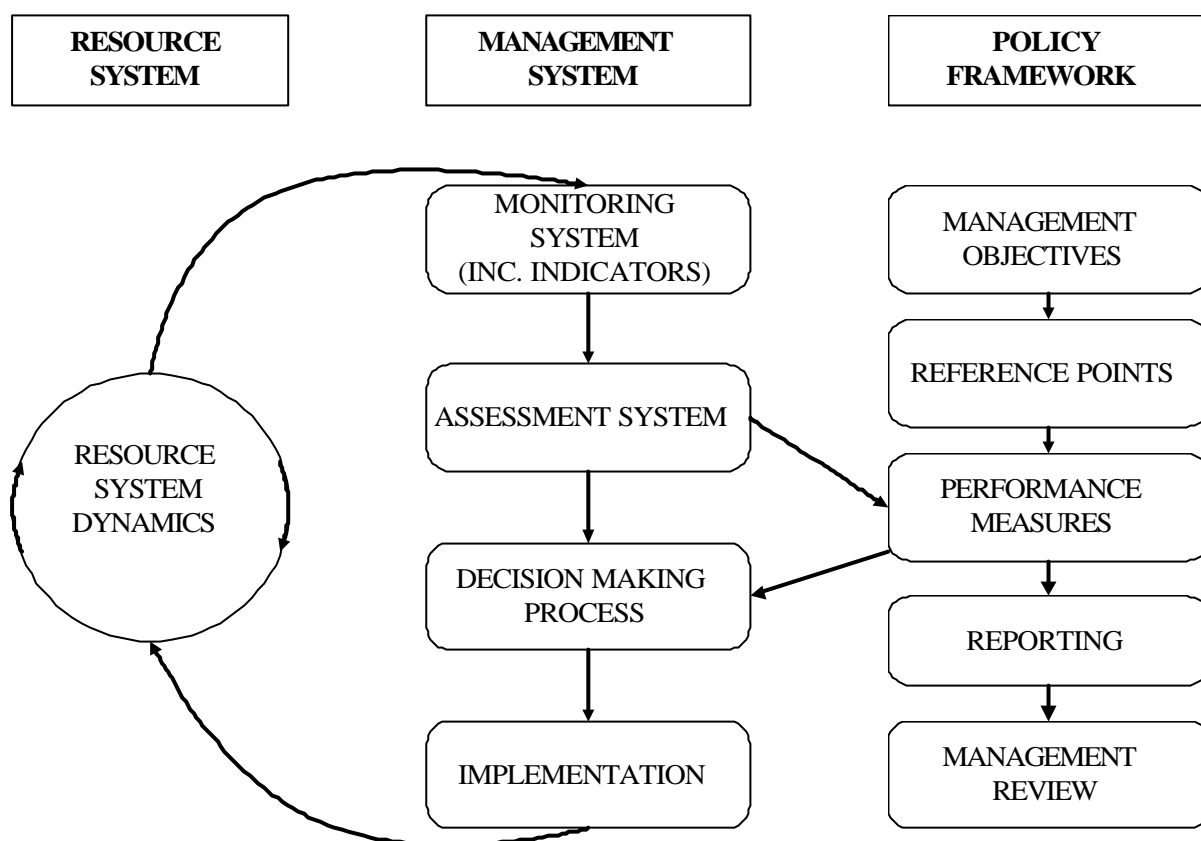
### 3.3 Current use and implementation of sustainability indicators

There are two ways in which sustainability indicators can be, and are, used in fisheries management: as a means to report progress in meeting ESD objectives, and as a basis for making decisions. Both are part of the process of fishery management see Figure 2. This



process includes a (usually annual) management cycle of monitoring, assessment and decision making, within an overall policy framework of legislative and other objectives. The performance of management is reported and assessed with respect to policy aims, usually on annual or multiyear cycles. Sustainability indicators, reference points and performance measures are integral to the processes. For example, as indicated in Figure 2, performance measures may be used directly in making decisions about management measures (such as quotas or effort controls). They may also be used to report on progress in achieving management objectives, and be used in reviewing the management system as a whole.

Currently all jurisdictions make some use of sustainability indicators for reporting, as described in Appendix B. Sustainability indicators are often an outcome of an annual stock assessment, and are sometimes included in formal reports to Parliament or in statutory audits. In addition, a number of jurisdictions make use of sustainability indicators and associated reference points to trigger specific actions or management decisions. Several jurisdictions have examples in which a formal management review is triggered if a certain threshold reference point is exceeded. These indicators and thresholds often relate to fishery catch or catch-rate. An example is the South Australian rock lobster fishery. There are a few examples of even more explicit “decision rules” linked to performance indicators, where the performance measure is used to set annual Total Allowable Catches (TACs) or to decide on fishery closures. The Commonwealth eastern gemfish and school shark fisheries and the Queensland scallop fishery are examples of explicit decision rules linking TACs or fishery closure to performance indicators.



**Figure 2: A general framework for renewable resource management. The three main elements shown are: (i) the resource system dynamics, (ii) the monitoring, assessment, management decision and implementation processes, and (iii) the setting of management objectives and management review. This figure is depicted in terms of the resource system and its dynamics. Similar and linked processes relate to the dynamics of the economic and social systems, and the use of economic and social indicators.**

A variety of indicators are in current use in fisheries management around Australia. Some of these are listed in Appendix B. The indicators can be grouped into those used for target species, for the broader ecological/environmental aspects, and for economic and social aspects.

Table 1 lists some examples of indicators under each of these categories, together with associated target (T) and limit (L) reference points. Each of the listed indicators can also be used to identify trends over time, and where no reference point is listed, only trends are used. Many of the indicators are drawn from existing management plans or assessment reports, but the list is by no means comprehensive. The limit reference points, which are also called threshold or trigger points, are sometimes incorporated in decision rules that specify the management's actions to be taken if the limits are exceeded. Several of the reference points consist of values of the indicators in reference years. A notable feature of the target species indicators and reference points is the absence of any expressed as fishing mortality  $F$ . These are commonly used in other countries, (e.g. Caddy and Mahon 1995), but biomass indicators

seem more common in Australia. Note that two of the indicators -- mean size of the catch and catch rate -- have been used as both target species and economic indicators.

**Table 1: Examples of indicators under each category, together with associated reference points**

INDICATOR	Target/Limit	REFERENCE POINTS
<b>Target Species</b>		
Catch	T, (L)	MSY
	L	Specified maximum <sup>1</sup>
	T	Specified range <sup>2</sup>
	L	% of reference year
	L	TAC <sup>3</sup>
Effort	L	Specified maximum
Catch rate (CPUE)	L	% of reference year
Mean size	-	
Spawning biomass	T, L	% of B <sub>0</sub> <sup>4</sup>
	T, L	% of B in reference year
	T	% of B at MSY
Egg production	L	% of reference year
Recruitment index	L	% of reference level
<b>Ecosystem/Environmental</b>		
By-catch (tonnes)	L	Level in reference year
By-catch (end. spp.)	L	% of reference year <sup>5</sup>
Area fished (% of total area <sup>6</sup> )	-	
Area of key habitat	L	% current level
<b>Economic</b>		
Catch rate	-	
Mean size	L	Specified minimum
Value of licences	-	
Price	-	
Value of production	-	
Return on investment	-	
<b>Social</b>		
Recreational fishing participation level	-	

**Notes**

1. Developmental fishery: temporary catch threshold
2. Predicted range for next year's catch (W.A.)
3. The TAC is an upper limit for catch in a given year, but is not a true reference point as it changes year from to year.
4. Both target and limit reference points are often expressed as a percentage of virgin or unfished biomass B<sub>0</sub>. Targets are usually in the range of 30-50% B<sub>0</sub>, while limits are usually in the range 20-40% B<sub>0</sub>.
5. Catch of endangered species. Generally, the aim is to reduce the catch to some fraction of current levels (e.g. Seabirds to 10% of current level).
6. Used in some trawl fisheries as an index of environmental impact.

### *Target species*

Sustainability indicators have been most fully developed for target species. Many indicators are used, depending on what data and information have been collected, and especially whether a formal and quantitative stock assessment has been made. A sustainability indicator for target species is the type of indicator most frequently linked directly to management actions and decisions. Reference points for target species are used either as threshold or limit points, to define lower bounds for stock size, or as targets for rebuilding depleted stocks and fishing-down newly fished stocks.

The indicators used form a rough hierarchy that depends on the type and quality of data available.

- (i) At the lowest level in the hierarchy, trends in catch are often used as an indicator of resource status. Often there is no other information available, although it is well recognised that catch is a poor indicator of stock size. Catches significantly above recent levels are sometimes used as a trigger to initiate management reviews of developing fisheries. However, at this and other levels in the hierarchy there are many examples of trigger points being identified without the action being specified, or its adequacy considered.
- (ii) The next level in the indicator hierarchy for target species consists of data on the composition of the catch, such as size, age and sex structure. These are used in some circumstances discern variations in recruitment or even abundance, although variations in mean size need to be treated carefully, as major shifts in either direction can indicate (different) problems with the stock. Age data are sometimes used in catch curve analyses to estimate total mortality for use as an indicator, again under certain restrictive assumptions.
- (iii) Indicators of relative abundance provide the next level in the hierarchy. These can be either fishery-dependent (e.g. commercial catch-per-unit-effort) or fishery-independent (based on trawl, acoustic or egg production surveys).
- (iv) All the indicators mentioned so far are derived directly from observational data (e.g. often they are simple averages). The next level generates indicators from combining of data with models (e.g. from quantitative stock assessment) that integrate several types and sources of data and make many assumptions. The resulting indicators may be estimates of current abundance, current fishing mortality, or current abundance relative to unfished levels. Such estimates may take account of risk and uncertainty, with performance measures being expressed by, for example, the probability that the stock size exceeds some reference level.

Respondents were generally confused about how management would use indicators and reference points, with multispecies fisheries in which several species are simultaneously fished. There was neither experience, nor acceptance of appropriate indicators for the related issues of:

- Fishing down some species to achieve a desired aggregate yield from a multispecies fishery;

- Fishing down the food chain (i.e. sequentially overfishing predators and keeping them depleted while the fishery targets prey species); or
- Overfishing some species when technology and markets can replace (or are developed to replace) them by previously uneconomic species. Some of the unresolved questions relate to whether these practices are acceptable at all under ESD objectives, and if they are acceptable, then how far overfishing across and within species is appropriate. So even within the subject of sustainability indicators for fishery target species, indicators are poorly developed for multispecies fisheries – arguably one of the most directly relevant ecosystem issues in fisheries management.

### *Ecosystem/environmental indicators*

These indicators are generally listed as “under development” rather than in actual use.

There are few examples of indicators of the status of ecological systems. An exception is the initial exploration of the use of different aspects of bycatch, such as its quantity and species composition. There have also been suggestions that key sensitive species could be used, such as sharks and marine mammals as indicators of wider ecosystem health. The bycatch of species with high conservation value is being actively examined (e.g. turtles, seabirds, seals, dugong) and their use as indicators for use in fisheries management is being considered. Indicators and trigger points designed to ensure adequate prey for unfished predator populations when the prey is being fished have been developed and applied in some Southern Ocean fisheries.

There are rather more examples of indicators that measure human response to environmental or ecosystem concerns than there are that measure changes in the ecological systems themselves. That is, for ecosystem indicators the indicators are frequently management process-oriented rather than management outcome-oriented. Examples are indicators that measure the adoption of bycatch reduction methods or compliance with net attendance regulations. Often these process-oriented indicators are directly linked to more restrictive management actions if specified targets are not achieved. However, such indicators are often not accompanied by direct indicators relating to the target components of the ecological or economic system for which they were introduced (i.e. the management outcome). This means that the indicator is of little use in measuring performance against the underlying objectives and desired outcomes of management.

For example the level of compliance with seabird bycatch mitigation measures is a process-oriented indicator for the objective of re-establishing some endangered seabird populations. The mitigation measures could be fully adopted, but the indicator will not show whether the population recovered. The quantity of seabird bycatch is also not directly related to the management objective, so it is also a poor indicator. For example, even if the seabird bycatch were monitored and found to have gone down, this could be due to either the continued decline of the seabird population, the success of the mitigation measure in reducing capture rates with or without population recovery, or some combination of both. The quantity of bycatch alone cannot provide a clear performance measure for the management objective. An

indicator is needed that relates directly to the ecological objective of management as well as to the management process.

A third type of ecological/environmental indicator in this category arises directly from spatial management strategies. It consists of measures of protection afforded to critical habitats or chains of habitats that are critical to different life-history stages. The most common indicator used is the proportion of an area or habitat that is in fishery protection or conservation zones. This interacts closely with current initiatives to expand the use of Marine Protected Areas as a tool for marine environmental, and possibly fishery, management. There has been very little development or evaluation of the most appropriate indicators/reference points and performance measures to use in relation to critical habitats and spatially based management, including management of MPAs.

There was general agreement on the need to develop indicators to cover aspects of habitat, bycatch, endangered species, spawning and nursery areas, and biodiversity. It was also recognised that indicators are needed for broader environmental threats to stocks and ecosystems stemming from human use outside of fishing (such as land use, other uses of the marine environment) as well as natural changes. It was recognised that this would require coordination, not just between jurisdictions, but across sectors within jurisdictions.

Respondents generally perceived a lack of baseline information against which to evaluate changes in ecosystems over time. There is also a lack of understanding on what sustainability for ecosystems means, but they agreed that the development of meaningful and practical indicators for the ecosystem and marine environment needed serious attention.

### *Economic indicators*

Economic objectives are recognised as being critically important in all commercial fisheries, whether explicitly stated in legislative objectives or not. All commercial fishers are vitally interested at least in their own economic performance. Economic viability is ultimately essential for commercial fisheries, and fishery managers agree that it is easier to manage an economically healthy fishery than an economically ailing one.

The simplest economic indicators use information that is routinely collected for biological analyses. Both catch rates and the size composition of the catch can also be useful indicators of the economic health of a fishery. Another useful proxy can be the goodwill value of licences or value of quota holdings. More comprehensive indicators of economic performance, such as returns on investment, would require dedicated surveys of fishing fleets. Time series of such data are rare. There are almost no examples of reference points for economic indicators, and few examples of their use in decision rules.

### *Social indicators*

While social objectives were recognised as important the response to developing and implementing indicators ranged from viewing that as a political rather than a fisheries management responsibility, to including the social with economic indicators rather than as a separate indicator. The main reason for these responses is the perceived difficulty in identifying useful indicators that can be measured and monitored.

Where social aspects have been included, they have been in terms of equity, access and cultural interests. Inter-generational equity is seen as being potentially useful if it could be expressed in terms of resource abundance or health. Community access to recreational fishing could be measured and monitored through surveys. Aboriginal and Torres Strait Islander cultural interests include issues of access and recognition of traditional management of resources.

### *Performance Indicators*

Existing management plans provide some examples of performance indicators relating to “process” or “governance”. While not indicators of the state of the fishery, resource or environment, they do indicate how well (or whether) aspects of the management plan are being implemented. Issues covered include levels of participation in management processes, development of specific aspects of the plan (such as bycatch strategies), and other “process” aspects of management.

#### 3.5 Realistic guidelines for indicators and their use

The review highlighted “design criteria” for developing a national system of indicators. These were:

- Indicators should be easy to understand and to use. Terms and definitions should be simple, clear and unambiguous;
- Indicators should be reliable, robust and defensible. They also need to deal with risk and uncertainty. Guidelines will be required for selecting and using indicators for particular circumstances, and especially for not using them in other circumstances; and
- Indicators need to be understood and accepted by stakeholders. It may take time to build confidence in their use, both within fisheries and in the wider community, and specific effort will be needed to achieve this.

The following points were made about use of indicators:

- There was consensus that a range of indicators, rather than a single indicator should be used, where possible. This would provide a more robust measure;
- Given the frequent use of commercial catch rates (i.e. catch-per-unit-effort) as an indicator of relative abundance, guidance was needed on their interpretation and use; and

- Indicators should not be seen an end in themselves; they need to be linked clearly to management objectives, and also to trigger actions or decision rules.

Several questions were raised about cost recovery and cost effectiveness. It was recognised there are difficulties in collecting adequate information from fisheries that are of low value or difficult to monitor (such as recreational and traditional fisheries). Nevertheless these fisheries still require monitoring, assessing and managing. Cost-effective indicators for low-value and data poor fisheries are needed, together with the best means of collecting the required information. The involvement of fishing operators and data-quality assurance programs was commonly emphasised as a way to achieve this.

Overall, there were some concerns that expectations for the development of indicators not be set too high. The scope and limits of fisheries management responsibilities should be recognised, and realistic time-lines set for developing and implementing a national system.

### 3.6 Capturing experience across national and international jurisdictions and sectors

The widespread support for a national approach was matched by widespread support for capturing past experience of identifying and using sustainability indicators, and for establishing processes to continue learning. There were two threads running through these comments. The first was the desire to consolidate the information and experience gained in the past, the second was the need to build ownership among practitioners for the results of this consolidation. The latter point requires that practitioners involved at the operational level from all jurisdictions need to participate in the consolidation process.

Specifically there was general support for:

- A critical review of the experience with sustainability indicators in other industries in Australia (especially the forestry industry and the protocols for measuring the health of freshwater ecosystems, developed through Land and Water Resources (LWRRDC), and in fisheries management in other countries (especially New Zealand, the United States, Canada and Europe). The United States experience with overfishing definitions and reference points, and determining sustainable by-catch levels, is particularly relevant. The review should also draw on experience developed through FAO, for example in the technical consultancy on sustainability indicators.

The key questions are: what has been tried? what has worked and not worked and why? to what extent are quantitative indicators necessary? and what is relevant to Australian fisheries management?

- An in-depth review and evaluation of sustainability indicators being used by the fisheries jurisdictions in Australia. The aim would be to consolidate empirical experience of the strengths and weaknesses of different approaches in different circumstances. There were several suggestions that this review should group the main fishery types (e.g. temperate



estuarine, tropical demersal shelf), and the different levels of information (e.g. research, monitoring) available for the fisheries; examine the indicators used; and evaluate their success or failure against clear criteria. Several respondents suggested that this review should separately examine objectives relating to (i) target species, (ii) the supporting ecosystem of the target species (e.g. habitat and food requirements), and (iii) the broader ecosystem (e.g. predators of the target species and aspects of the environment not directly connected with the target species). Some respondents extended this to include (iv) economic objectives and (v) social objectives.

The key questions were: what indicators were associated with success or failure in which circumstances? in the case of failure, was this because the indicator was inappropriate, inadequately measured, or inappropriately used? It was recognised that there may be limitations in what can be concluded from an empirical review, because fisheries are complex and many things contribute to success or failure, but there was widespread support for an attempt. This review would require specific and focused involvement of staff from all jurisdictions.

- Development of a ‘tool-box’ of sustainability indicators that have been tested and their strengths and weaknesses described in easy-to-understand language. The information should include guidelines for using the different options in different circumstances, and a general justification for selecting indicators. Several groups suggested that the options and guidelines should be developed and presented in a risk context, so that indicators are selected with an understanding of the risk levels judged appropriate for a given situation. Several groups suggested that the question of how much monitoring is reasonably enough should be included in these national guidelines. Some groups suggested that the guidelines and options could be used to develop, through mechanisms such as the Standing Committee on Fisheries and Aquaculture, national benchmarking and standards for using indicators in management plans.

### 3.7 Cross-sectoral issues

Three related cross-sectoral issues were raised by most jurisdictions, and similar approaches to each of these issues were suggested.

- (i) The use of fishery indicators by, or integration with, the State of the Environment Reporting. The State of Environment Reports currently make little use of fishery-derived sustainability indicators. This was seen as undesirable for two reasons. The first is the resulting perception by other sectoral managers, the public, politicians and interest groups that fisheries indicators are inadequate to reflect environmental values and trends, or simply do not exist. This reflects badly on the credibility and responsibility of fishery management in an era when such perceptions are important. The second reason concerns costs and efficiency. Some currently used or recommended State of Environment indicators may be most effectively measured through fisheries, so State of Environment Reporting processes should contribute toward the costs of indicator measurement.

There was agreement that fisheries should play a more active leadership role in State of Environment Reporting, that fisheries input could help improve the transparency and consistency of State of Environment Reporting, and that fisheries-derived indicators should be used and valued in State of Environment Reporting. Several jurisdictions pointed out that the fishing industry could provide considerable support for cost-effective monitoring.

The suggested solution is to develop fisheries sustainability indicators that are clearly and objectively defensible, and include cost-effective quality assurance protocols. Effort would then be put into having these indicators adopted and at least part funded by the State of Environment Reporting process. At some stage this would require involving State of Environment staff in developing or reviewing fisheries sustainability indicators.

- (ii) Several other industry sectors are likely to be interested in some of the sustainability indicators that are relevant to fisheries management. There is the potential for sharing the costs or responsibility for certain indicators. Monitoring of sustainability indicators, and especially of indicators relating to aspects of the ecosystem beyond the target species, is costly, but the results are potentially useful in contexts beyond fisheries management. Potential users should be encouraged to use fishery sustainability indicators and to contribute toward monitoring costs. The sectors identified in this context were recreational fishing, charter boats, aquaculture, ports, coastal zone development, and catchment management.
- (iii) Many other users of the marine environment were recognised as affecting the sustainable development of fisheries and hence the sustainability indicators used by fisheries management. The misinterpretation of indicators to attribute environmental degradation to fisheries when another user of the marine environment is the true cause was frequently raised as an important issue. The potential consequences of such an error are both inappropriate actions by fisheries and management and the continued, unmanaged, environmental degradation by the other user.

The suggested solution was to develop indicators that could distinguish the effects of the fishery from the effects of other users, and that were clearly and objectively defensible. These indicators could be used to lobby decision-makers about the effects of other users on the sustainability of fisheries. It might be possible to obtain funding to measure these indicators from the management agencies of other industry sectors.

## **4. Implications and Recommendations for Research and Development**

National coordination of R&D on the definition and use of sustainability indicators was suggested or agreed to by all jurisdictions. There was also agreement about the role of this coordination and the way it should proceed. That is:

- The national approach should consist of sharing experience, developing guidelines for using sustainability indicators, and developing a ‘tool-box’ of options from which sustainability indicators could be selected. The guidelines and options should be not be binding. There should be a process that supports continued learning from the experiences among jurisdictions;
- The development of national coordination should build on the efforts already made within jurisdictions, and should not preclude independent R&D within each jurisdiction. In addition to any national effort, there was a need to continue developing indicators separately within jurisdictions, especially for the more important fisheries in each jurisdiction;
- The Standing Committee on Fisheries and Aquaculture (SCFA) should be involved in developing national standards, and in R&D projects to develop guidelines and the ‘tool-box’ of options;
- The guidelines and options should be written in plain English for the use of non-specialist stakeholders and Fishery Management Advisory Committees developing fishery management plans.
- The guidelines and options for sustainability indicators must be scientifically defensible. They should outline the strengths and weaknesses of prospective indicators, including situations when they should and should not be used, based on transparent and reviewable assessment. This should include providing a risk assessment of the options. The aim is for the guidelines and options to provide a sound basis and justification for using particular approaches in particular circumstances, and that they provide a defensible approach even in the absence of adequate information;
- Development of the national approach should focus on the practical use of indicators in management plans, and involve the planners in fisheries management; and
- Fishery sustainability indicators need to gain greater acceptance and financial support from other sectoral interests, including environmental managers and the State of Environment Reporting. A process is needed to encourage cross-sectoral support.

Together these imply a need for a nationally coordinated R&D program on sustainability indicators. The main aims of the program would be to develop the options for sustainability indicators and guidelines for their use that are acceptable to all jurisdictions. The program would be linked to SCFA processes and be inclusive of all jurisdictions.

The development of a FRDC subprogram or a similar coordination initiative across existing FRDC subprograms are possible mechanisms to support a national R&D program. The R&D identified here for the support of sustainability indicators has close affiliation with aspects of several existing FRDC Programs. It has close affiliation with Fisheries Management Improvement within the Resources Sustainability Program and with Ecosystems Management Improvement within the Ecosystems Protection Program. It also has close affiliation with aspects of the recently released Draft Action Plan for Fisheries Ecosystems Protection. So in the FRDC context the key objective of the coordination mechanism would be to ensure that R&D on sustainability indicators is dealt with coherently and with a clear focus, rather than being diffusely or incidentally dealt with across a number of FRDC programs and subprograms.

The national program would need to report to, or be overseen by SCFA, or its research and management subcommittees, and at least the peak fishing industry body (ASIC). The R&D program combined with SCFA processes would develop the guidelines and options for indicators and also the mechanisms for continuous learning. A reporting structure that included other sectoral interests (e.g. ANZECC, LWRRDC) would enhance coordination and collaboration in the development, use and funding of sustainability indicators. The national fisheries R&D program should have a steering committee and reporting structure that recognises these links. The steering committee should include a research leader who would be involved with all elements of the program and be responsible for R&D continuity. The scientific content of the guidelines and options should be peer-reviewed nationally or, if necessary, internationally.

Four main areas needing research and development were frequently cited during this review. These needs, and suggested approaches to meeting them, are:

#### 4.1 Define terminology and framework for indicators of ESD performance

A guide is needed to firstly define the terms used in relation to sustainability indicators and secondly to provide a consistent framework for their use. This is not a huge task, but it is clearly a very necessary one. At present, the same concepts are commonly applied, but different jurisdictions --and even fisheries within a jurisdiction --are using different terms to express what they are doing, or using the same term to mean different things. In part this confusion is more widespread than just in fisheries: several disciplines, each with different terminologies for similar processes, have all recently contributed to quantitative management evaluation (e.g. engineering control theory, operations research and business management). Some of the important terms are: indicator, performance measure, reference point (limit, target and threshold), decision rule and management trigger. There is also some confusion about the

difference between objectives, strategies and performance measures, which partly reflects confusion about outcome versus process indicators.

This review began the process of developing a consistent terminology and use for sustainability indicators (see Section 3.2). This work should be completed and a guide produced that is acceptable to all jurisdictions.

#### 4.2 Capture experience nationally and internationally

Experience of what has been tried, and with what results, should be critically reviewed and consolidated nationally and internationally for fisheries and other sectors. Several suggestions were made during the review as to what should be included and how it could be approached (see Section 3.6). An important aspect is that the review must be critical and address outcomes not simply report on existing practices.

The review should examine the usefulness (or otherwise) of what has been attempted to achieve sustainability in fisheries production, achieving environmental outcomes, and contribute to broader stakeholder debate and understanding. It should separately examine the experience with respect to ESD objectives for (i) the target species, (ii) the direct ecosystem support of the target species (e.g. habitat and food requirements), and (iii) the broader ecosystem (e.g. both dependent and essentially independent species), (iv) economic performance and (v) social performance. It should also categorise the types of fishery situation being managed. The categorisation would be both of the fishery (e.g. the broad technology, broad ecology, stage of fishery development, the main management controls, and the extent of management control) and the information available (e.g. the extent and detail of the information available or likely to be available from the fishery). The review would be expected to refine these categories of fishery situation and ESD objective as appropriate.

Three critical reviews are implied:

- A review and consolidation of the experience with fishery sustainability indicators (including broader ecosystem issues) in other nations that have put significant effort into this area. These include United States, Canada, New Zealand and some ICES nations. FAO could also assist. A relatively small team could undertake this review;
- A review of the experience with sustainability indicators in other Australian resource management sectors, especially forestry and freshwater ecosystem health management; and
- A review and consolidation of the experience with fishery sustainability indicators (including broader ecosystem issues) in Australia. The review would be detailed and include how indicators are calculated and used. It should involve people practically involved in developing fishery management plans from all jurisdictions, and include 'fearless and non-partisan' assessment of success against agreed criteria. Attempts should be made to conduct this review in the form of a 'meta-analysis'. Although meta-analysis is

unlikely to resolve all of the issues involved, it should prove useful for some. A large number of people would need to participate in this review to adequately reflect the Australian jurisdictions and the diversity of situations. A series of multi-day workshops in addition to consolidated evaluation of approaches would be needed.

#### 4.3 Develop guidelines for using of sustainability indicators

A working group should develop national guidelines for using sustainability indicators. The core of the working group could consist of the combined Research and Management Subcommittee of SCFA (perhaps also with input from the Environment and Health sub-committee), together with a leader of the Sustainability Indicators R&D program, if such a program were developed.

This working group could draft the scope and criteria for the guidelines, and submit them to SCFA for consideration. This draft could be developed concurrently with activity 4.2 above, as the scope and criteria for the guidelines could not be developed without the detailed consolidation of experience. After SCFA has agreed on the scope and criteria, the working group could oversee and guide the developing and testing of options for sustainability indicators (i.e. activity 4.4 below). After activities 4.1, 4.2 and 4.4 are completed the working group could provide final draft guidelines for consideration by SCFA and individual jurisdictions on the use of sustainability indicators in Australian fisheries.

#### 4.4 Develop and test options for sustainability indicators

The consolidation of existing experience through activity 4.2 is a necessary preliminary to developing a national approach to using sustainability indicators. It would substantially increase mutual understanding among Australian jurisdictions, provide numerous ideas for indicators, and provide some indication as to their appropriateness in different circumstances. It will also provide an agreed approach to the categorisation of fisheries and ESD indicator types. However, the complexity of fisheries is such that it will often be difficult to determine what contribution the use of a particular indicator made to the outcome seen in a fishery. Also it is clear that the existing experience with indicators for ecosystem integrity and sustainability is extremely limited, both in terms of the types of indicator that might be used and their effectiveness. To a large extent indicators of ecosystem sustainability have yet to be developed and experience in their use accumulated.

Consequently the scientific justification and defence of the use of particular indicators in particular circumstances will not be provided by the consolidation and meta-analysis of existing experience alone. Simulation testing across a range of realistic but standardised fishery and ecological situations is also required to understand the performance of sustainability indicators in different situations and the degree of precaution required. The results would be used to tabulate the relative risks of using various sustainability indicators in particular fishery situations. Together the meta-analysis and simulation testing would enable sustainability indicators to be selected and justified in a risk- management context.

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*The South East Fishery 1996 Fisheries Assessment Report* (AFMA, Canberra, 1997).

*The Southern Shark Fishery 1996 Fisheries Assessment Report* (AFMA, Canberra, 1997).

*The Torres Strait Lobster Fishery 1997 Fisheries Assessment Report* (AFMA, Canberra, 1997).

*The Torres Strait Prawn Fishery 1997 Fisheries Assessment Report* (AFMA, Canberra, 1997).

*Torres Strait Turtles 1997 Fisheries Assessment Report* (AFMA, Canberra, 1997)

## Appendix A: AGENCIES, ORGANISATIONS AND INDIVIDUALS THAT PROVIDED INPUT TO THIS REVIEW

### 1. The agencies and organisations sent the FRDC Questionnaire in November 1997

	SA	WA	NT	QLD	NSW	VIC	TAS	COMWTH
Fishery Agency	Primary Industry and Resources	Fisheries Western Australia	Primary Industry and Fisheries	QLD Fisheries Management Authority	NSW Fisheries	Department of Natural Resources and Environment	Department of Primary Industry, Water and Environment	AFMA, AFFA BRS
FRAB	SA Fisheries Advisory Board	WAFIC Aquatic Resources R & D Advisory Committee	NT Fisheries Research and Development Advisory Committee	QLD Fishing Industry Research Advisory Committee	NSW Advisory Council on Fisheries Research	VIC Fisheries Research Advisory Committee	TAS Fisheries Research Advisory Board	Commonwealth Research & Environment Committee
Industry	SA Fishing Industry Council  Seafood Council SA	WA Fishing Industry Council	NT Fishing Industry Council	QLD Commercial Fishermen's Organisation	Ocean Watch Ltd	VIC Fishing Industry Federation	TAS Fishing Industry Council	Australian Seafood Industry Council Ltd

## 2. The participants in the interviews and consultative process for this review

	SA	WA	NT	QLD	NSW	VIC	TAS	COMWTH
Fishery Agency	* Garry Morgan (S A Primary Industries & Resources) * Keith Jones *Paul McShane * John Keesing (SARDI)	Peter Rogers *Jane Borg (Fisheries W A)	David Hall * Rex Pyne (N T Dept of Primary Industry & Fisheries)	* R Crossing (QFMA)	John Glaister * John Diplock *Steve Dunn *Paul O'Connor (NSW Fisheries)	* R McLoughlin (Dept of Natural Resources & Environment),	* Alex Schaap *Dennis Witt (TAS Dept of Primary Industry and Fisheries)	Glenn Hurry (DPIE) Derek Staples (BRS) * R Stevens *K Maguire *Shaun Sloan (AFMA), *Murray Johns *Kerry Truelove *Peter Cassels (DPIE) *Jean Chesson (BRS) *Patrick Hone (FRDC),
FRAB	Bill Williams (S A Fisheries R&D Board)	John Newby (WAFIC)	*Nic Rayns (FRAB)	Jim Miller (QLD Fishing Industry Research Advisory Committee)	* Rick Fletcher (NSW Advisory Council on Fisheries)	Dave Smith (MAFRI), * G Newman (VIC Fisheries Research Advisory Committee)	* Geoff Pickard (TAS Fisheries Research Advisory Board)	Rob Lewis (Commonwealth Research & Environment Committee)
Industry	Brian Jeffries (ATBOA) *Henry Jones *L Rosenberg *Bob Lewis (SAFIC)	Brett McCallum John Cole (WAFIC) *Tony Gibson (representing WAFIC)	Nigel Scullion *Ian Smith (NTFIC)	Ted Loveday *Daryl McPhee *Martin Breen (QCFO)	*John Smyth (NSW Abalone Fisheries), *Rob Toyer (NSW Northern Prawn Trawl)	Tom Davies *Ross Hodge (VIC Fishing Industry Federation)	* Colin Buxton (TAFI) *Bob Lister (TAS Fishing Industry Council)	* Bill Nagle (ASIC)

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Note: \* participants in the interviews conducted between August and September 1998

## **Appendix B**

Summary of the supporting documents (fishery management legislation, institutional strategic plans, fishery status reports and fishery management plans) examined during this review for:

South Australia

Western Australia

Northern Territory

Queensland

New South Wales

Victoria

Tasmania

Commonwealth

In the tables Y indicates that an issue was addressed in the document, and brief detail follows. N indicates that an issue was not addressed.



## SOUTH AUSTRALIA

### ACTS

Date & Title	South Australia Fisheries Act 1982 Fisheries (Misc.) Amendment Act 1991 No. 76 1991	
Objectives	Y	Part 3 Division 1: 20 a) ensuring through proper conservation, preservation and fisheries management measures, that the living resources of the to which this Act applies are not endangered or overexploited (b) achieving the optimum utilisation and equitable distribution of those resources
Management Plan	N	
Reference points/performance indicators	N	
Other related issues	Y	Division 2 Protection aquatic habitat, Amendment 17 s48 marine parks
Definitions	N	

### SUPPORTING DOCUMENTATION

1. Marine Scalefish, Primary Industries SA
2. Inland Waters, Primary Industries SA
3. South Australian Fisheries and Aquaculture Five Year Research and Development Strategy

### MANAGEMENT PLANS

1. Draft Management Plan for the Spencer Gulf and West Coast Prawn Fisheries. July 1998
2. Management Plan for the South Australian Southern Zone Rock Lobster Fishery December 1997
3. Management Plan for the South Australian Gulf St. Vincent Prawn Fishery. December 1997
4. Management Plan for the South Australian Northern Zone Rock Lobster Fishery. December 1997
5. Management Plan for the South Australian Abalone Fishery September. September 1997
6. Wild Fisheries with a Future! Environmental Management Plan of the Southern Fishermen's Association 1998

Example: Draft Management Plan for the Spencer Gulf and West Coast Prawn Fisheries

Fishing Areas		Commercial
Operational objectives	Y	Section 2 Scope <ul style="list-style-type: none"> <li>• Maintain biomass within historical levels and eliminate risk of recruitment decline due to over fishing</li> <li>• Ensure harvesting procedures are directed towards optimising size at capture</li> <li>• Maintain and enhance profitability of the fishery by optimising</li> </ul>

		<p>prawn size, market timing, minimising the costs fishing and admin costs of managing fishery</p> <ul style="list-style-type: none"> <li>Minimise bycatch and trawl impact on the benthos through development more effective and efficient gear and harvesting strategies</li> </ul>
Performance Indicators	Y	Section 5, 5.1 Biological, 5.2 Economic 5.3 Environmental, 5.4 social Objectives
Trigger points	Y	Section 6 reference points 6.1.1 Biological, 6.1.2 Economic 6.2 management 6.3 compliance
Other related issues	Y	Section 3.2 biological characteristics, 3.3 ecological characteristics 3.4 research, stock assessment and management surveys
Definitions	N	

### Sustainable Indicators

Objectives	Performance Indicator (Strategy)	Trigger point (Reference point)
<p>Biological</p> <ol style="list-style-type: none"> <li>maintain spawning stock biomass above 50% virgin biomass</li> <li>prevent growth over fishing and minimise capture small prawns</li> </ol>	<ul style="list-style-type: none"> <li>adopt precautionary approach</li> <li>collect catch effort data, shot by shot basis, supported fishery independent surveys provide essential biological data necessary to monitor fishery's performance against ref points and performance indicators</li> <li>maintain exploitation rate that ensures sustainable fisheries that are adaptable in order to maintain efficiency fishery</li> <li>receive annual stock assessment report upon which to determine appropriate harvesting levels for following years</li> <li>ensure monitoring of level effort applied in each fishery</li> <li>review annually all biological research programs to ensure they are effective meeting the needs each fishery and management committee</li> <li>provide ongoing improvements in harvesting practices and strategies that ensure biological sustainability of stocks and conserve integrity ecosystems</li> </ul>	<ol style="list-style-type: none"> <li>maintain exploitation rates at present levels of effort</li> <li>maintain at least 50% virgin spawning biomass</li> <li>maintain recruitment index at a level which ensures suitable recruitment to the fishery</li> </ol>
<p>Economic</p> <ol style="list-style-type: none"> <li>maintain prawn stocks at a level that provides optimum return on investment by license holders</li> <li>provide for economic efficiency and flexibility in management and compliance arrangement by developing harvest strategies that minimise costs</li> <li>recover attributed costs management, research and compliance for fishery based</li> </ol>	<ul style="list-style-type: none"> <li>provide flexible harvesting strategies to achieve maximum returns from the market for each fishery's production</li> <li>undertake regular assessments of the economic performance of harvesting strategies and identify opportunities for improved returns on investment</li> <li>participate in meaningful discussions and negotiations aimed at setting license fees at a</li> </ul>	<p>Establish a size at first capture which ensures the optimum utilisation of the resource</p>

best practice and efficient management	<p>level sufficient to recover attributed management, research and compliance costs</p> <ul style="list-style-type: none"> <li>• promote world best practice in harvesting, processing and management of resource</li> <li>• comply with Govt Mngmt Framework principles for period to Jly 2002</li> </ul>	
Objectives	Performance Indicator (Strategy)	Trigger point (Reference point)
<p>Environmental objectives</p> <ol style="list-style-type: none"> <li>1. ensure the activity prawn trawling carried out such manner as to minimise environmental impact within region each fishery</li> <li>2. research options for minimising incidence bycatch in order to maintain biodiversity marine environment</li> <li>3. maintain close vigilance on marine environment Spencer Gulf &amp; West Coast to prevent fisheries being threatened by pollutants or other harmful activities of other users of the environment</li> </ol>	<ul style="list-style-type: none"> <li>• Maintain ongoing assessment of bycatch levels to conserve marine ecology of the fishing grounds</li> <li>• Develop harvesting techniques and gear technology to assist in minimising impacts on the benthos within the area of each fishery</li> <li>• Promote and maintain practices which minimise impacts of prawn trawling on other commercial and recreational fisheries</li> <li>• Maintain a close dialogue with other users of Spencer Gulf and West Coast waters particularly the industrial business sector</li> <li>• Promote the conservation of seagrass and prawn nursery habitat areas</li> </ul>	
<p>Social Objectives</p> <ol style="list-style-type: none"> <li>1. Provide community with safe source naturally produced seafood</li> <li>2. Provide amenable lifestyle for those engaged in the industry</li> <li>3. Minimise conflict between other users of the marine environment through development of transparent and clearly defined policies</li> <li>4. Ensure good relationships between the Government, industry and community are maintained</li> <li>5. To be known as a responsible corporate citizen</li> </ol>	<ul style="list-style-type: none"> <li>• Inform and educate community about responsible management of prawn resources in Spencer Gulf and West Coast</li> <li>• Establish and maintain regular contact with other fishery management committees and other interest groups</li> <li>• Develop information articles on the prawn fishery for the public and provide an annual report to the Minister for Primary Industries, Natural Resources and Regional Development on the operations and economic status of the fishery</li> </ul>	

### *Management Action on Reaching a Limit Reference Point*

1. Notify Minister for Primary Industries, Natural Resources and Regional Development and participants in the fishery as appropriate
2. Implement alternative management strategy as defined in decision rules or as developed by the management committee
3. Undertake an examination of the causes and implications of "triggering" a limit reference point
4. Provide a report to the Minister and industry, within three months of the initial notification, on the outcomes of a review of the effect of triggering a limit reference point

### *Summary of biological and economic reference points for use in the Spencer Gulf prawn fishery*

Reference Point	Target	Limit
Effort (days)	70-80	85
Spawning biomass (% virgin biomass)	50%	40%
Recruitment Index	40	35
Prawns per kilogram	<40 prawns per kg	40 or more prawns per kg

### *Management Committee Performance Indicators*

Primary performance indicators used to assess effectiveness and efficiency of the management committee is:

- Acceptance of advice from the committee by the Minister for Primary Industries, Natural Resources and Regional Development
- Quality of information supplied to the Minister and the feedback from the "Committee at Sea"

### *Compliance Performance Indicators*

An outline of the compliance program

Objective	Strategy	Indicator
Compliance with survey plans	<ol style="list-style-type: none"> <li>1. Point of landing inspections</li> <li>2. Periodic on-board monitoring of surveys by observers</li> </ol>	<ol style="list-style-type: none"> <li>1. Number of boats checked on landing for each period</li> <li>2. Frequency of reported non-compliance</li> </ol>
Compliance with gear configuration	Random inspection of trawl gear	<ol style="list-style-type: none"> <li>1. Frequency of non-compliance with</li> </ol>

		trawl gear 2. Random inspections conducted
Compliance with bycatch restrictions	Random inspection of boats landing (at sea on suspicion)	1. frequency of non-compliance 2. random inspections conducted
Compliance of boats regarding closure lines	Support for "Committee at sea" and reporting to Fishwatch 1800 number of breaches	1. Frequency of non-compliance
Compliance of boats regarding fishing periods	Support for "Committee at sea" and reporting to Fishwatch 1800 number of breaches	1. Frequency of non-compliance

## WESTERN AUSTRALIA

### ACTS

Date & Title	Western Australia Fish Resources Management Act 1994 No 53 of 1994	
Objectives	Y	Part 1 3 (1) the objects of this Act are to conserve, develop and share the fish resources of the State for the benefit of present and future generation. 3 (2) In particular, this Act has the following objects a) to conserve fish and to protect their environments b) to ensure that the exploitation of fish resources is carried out in a sustainable manner c) to enable the management of fishing, aquaculture and associated industries and aquatic eco-tourism d) to foster the development of commercial and recreational fishing and aquaculture e) to achieve the optimum economic, social and other benefits from the use of fish resources f) to enable the allocation of fish resources between users of those resources g) to provide for the control of foreign interests in fishing, aquaculture and associated industries h) to enable the management of fish habitat protection areas and the Abrolhos Islands reserve
Management Plan	Y	Part 6 division 2
Reference points/performance indicators	N	Part 19 Section 263 of the WA Fish Resources Management Act requires provision of an annual State of the Fisheries report to Parliament. The report is against Key Performance Indicators. These indicators are the exploitation status (over, fully, under), breeding stock level, catch level, previous catch projections and current catch projections for all major stocks. Additionally the performance measures used in the Annual Report of the Fisheries Department are audited for adequacy by the Auditor General under the Financial Administration and Audit Act 1985. The performance measures used in 1996/7 are outlined below.
Other related issues	Y	Part 11 fish habitat protection areas and Abrolhos Islands reserve
Definitions	N	

### SUPPORTING DOCUMENTATION

1. Annual Report 1996-97
2. State of the Fisheries Report 1996-97
3. Rock Lobster Industry Advisory Committee Coastal Tour 1997 Program and Background Papers
4. Status of Northern Shark Section Research Advice Number 10
5. Stock Assessment of Large Coastal and Demersal Sharks Final Report Sept 1996 Project 93/067

## MANAGEMENT PLANS

WA management plans list regulations but do not specify objectives and performance measures.

Fishing Areas		
Operational objectives	N	
Performance Indicators	N	
Trigger points	N	
Other related issues	N	
Definitions	N	

### WA Fisheries Annual Report 1996/7

WA management plans list regulations but do not specify objectives and performance measures.

Fishing Areas		
Operational objectives	Y	<ol style="list-style-type: none"> <li>1. Sustainable fisheries management</li> <li>2. Maximise the economic benefit to the State</li> <li>3. Maximise the social benefit to the State</li> </ol>
Performance Indicators	Y	<ol style="list-style-type: none"> <li>1.1 The proportion of fish stocks identified as a being at risk or vulnerable through exploitation</li> <li>1.2 The proportion of commercial fisheries where predicted catches are achieved</li> <li>1.3 The number of fish stocks and other marine species at risk or severely depleted as a result of habitat degradation</li> <li>2.1 The movement of the real goodwill values of licences over time</li> <li>2.2 The contribution to the State's gross value of output</li> <li>3.1 The participation rate in recreational fisheries</li> <li>3.2 The satisfaction rating of those engaged in recreational fishing</li> <li>3.3 The satisfaction rating of the broader community as to their perceptions of the extent to which the Department is achieving sustainable fisheries management objectives</li> </ol>
Trigger points	N	
Other related issues	Y	<p>Management efficiency indicators given for major fisheries. The indicators are measure by:</p> <p>Commercial fisheries: the trend in the relationship between the total cost of the Commercial Fishing Program to the number of commercial fisheries managed by7 the Dept. for each year over time.</p> <p>Pearling and Aquaculture Program: efficiency is measured by two separate trends 1. The trend in the relationship between the total cost of the Pearling sub-program to the number of pearling authorisations and pearl farms licenced by the Dept. for each year over time. 2. The trend in the relationship between the total cost of the Aquaculture sub-program to the number of aquaculture sites or leases licenced by the Dept. for each year over time.</p> <p>Recreational Fishing Program: The trend in the relationship between the total cost of Recreational Fishing Program to the number of management programs within the program, per recreational fisher, per year over time</p>

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		Fish and Fish Habitat Protection program: the trend in the relationship between the total cost of the Fish and Fish Habitat Protection Program and the number of conservation projects undertaken by the Dept. per year over time
Definitions	Y	'At risk' is defined as fish stocks likely to become extinct if the current level of exploitation and/or rate of degradation of the environment is allowed to continue.



## NORTHERN TERRITORY

### ACTS

Date & Title	Northern Territory of Australia Fisheries Act 1998	
Objectives	Y	Part III 21 Purposes of Part 21.1 the purpose of this part is to conserve, enhance, protect, utilize and manage the fish and aquatic life resources of the Territory to a) protect, develop and maintain commercial and amateur fishing b) provide for optimum yields from a fishery and maintain the quality of the yield c) ensure that the fisheries of the Territory are not endangered or over exploited a) encourage tourist and scientific interest in fish and aquatic life; and/or d) ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected
Management Plan	Y	Part 111
Reference points/performance indicators	N	
Other related issues	N	
Definitions	N	

### SUPPORTING DOCUMENTATION

#### MANAGEMENT PLANS

1. Mud Crab Fishery Management Plan as in force 29 November 1995
2. Spanish Mackerel Fishery Management Plan Draft 25 Feb 1998
3. Barramundi Fishery Management Plan 29 Jan 98

Objectives and performance measures are being developed.

Fishing Areas		
Operational objectives	N	
Performance Indicators	N	
Trigger points	N	
Other related issues	N	
Definitions	N	

## QUEENSLAND

### ACTS

Date & Title	Queensland Fisheries Act 1994 Act No.37 of 1994	
Objectives	Y	Part 1 Division 2 (3.1) The objectives of this Act include a) ensuring fisheries resources are used in an ecologically sustainable way b) achieving the optimum community, economic and other benefits obtainable from fisheries resources c) ensuring access to fisheries resources is fair
Management Plan	Y	Part 5
Reference points/performance indicators	N	
Other related issues	Y	Part 6 Protection & conservation of fish habitats
Definitions	N	

### SUPPORTING DOCUMENTS

1. Queensland Trawl Fishery Proposed Management Arrangements (East Coast - Moreton Bay) 1998-2005.
2. Queensland Trawl Fishery Discussion Paper No. 5. December 1996
3. Moreton Bay Fishery Discussion Paper No. 6. February 1997

### MANAGEMENT PLANS

1. Draft Management Plan Queensland Spanner Crab Fishery. April 1997
2. Draft Management Plan and Regulatory Impact Statement Queensland Gulf of Carpentaria Inshore Finfish Fishery. April 1997

Example: Draft Management Plan Queensland Spanner Crab Fishery. April 1997

Fishing areas		Commercial, Recreational, Indigenous
Operational objectives	Y	Part A Schedule 3.(1) Objectives (a) ensure spanner crab stocks are used in an ecologically sustainable way; (b) manage the spanner crab fishery resource in a way that gives optimal community benefit on a sustainable basis; and (c) ensure economic is taken into account in putting into effect management arrangements for spanner crab resources efficiency, (d) ensure a fair division of access to spanner crab resources for commercial, recreational and indigenous fishers, (e) monitor the extent of spanner crab resource used by the several harvest groups (f) ensure the management of, and the information on, spanner crab resources meets community needs
Sustainability Indicators	Y	Part A Schedule 3
Trigger points	Y	Part A Schedule 3 Events

Other related issues		Part A Schedule 2: Description fishery, Habitat requirements, Stock recruitment relationship
Definitions	N	

## Sustainable Indicators

Objective as section 3 (1)	Performance Indicator	Event
(a) ensure crab stocks are used in and ecologically sustainable way	Maximum sustainable yield from the fishery	<ul style="list-style-type: none"> <li>Significant departure of annual catch from maximum sustainable yield or</li> <li>Change in spawning stock biomass or in overall CPUE</li> </ul>
(b) manage the spanner crab fishery resource in a way that gives optimal community benefit on a sustainable basis	All stakeholders interests are reflected in the plan	Lack of <ul style="list-style-type: none"> <li>appropriate consultation with stakeholders or</li> <li>community support for plan</li> </ul>
(c) ensure economic efficiency is taken into account in putting into effect management arrangements for spanner crab resources	Maximum use of ITQs to obtain annual quota	<ul style="list-style-type: none"> <li>Inability to take annual quota.</li> <li>Significant non-fishing period (excluding spawning closure)</li> </ul>
(d) ensure fair division of access to spanner crab resources for commercial, recreational and indigenous fishers	Interests of all stakeholders in the plan	Lack of <ul style="list-style-type: none"> <li>appropriate consultation with stakeholders; or</li> <li>community support for the plan.</li> <li>Significant change in the number of breaches and serious fisheries offences for the previous fishing season</li> </ul>
(e) monitor the extent of spanner crab resource use by the several harvest groups	Compliance with the Authority's requirement to lodge logbook returns on a regular basis	Significant non-compliance with lodgment of logbook returns
(f) ensure the management of, and the information on, spanner crab resources meets community needs	Timely availability of information to all stakeholders	Lack of appropriate consultation with stakeholders

## Example: Draft Management Plan and Regulatory Impact Statement Queensland Gulf of Carpentaria Inshore Finfish Fishery QFMA April 1997

Fishing areas		Commercial, Recreational, Indigenous
Operational objectives	Y	Section 1 (3) Plan objectives <ul style="list-style-type: none"> <li>To maintain inshore finfish stocks at sustainable levels</li> <li>To protect spawning target species</li> <li>To minimise the effects of fishing on protected wildlife</li> <li>To provide a viable commercial net fishery that gives</li> </ul>

		<p>economic and social benefits to local, regional and State economies</p> <ul style="list-style-type: none"> <li>To provide a recreational fishery that gives economic and social benefits to local and regional economies</li> <li>To satisfy the traditional or customary needs of Aborigines and Torres Strait Islanders</li> </ul> <p>Section 1 (4) Benefits of the management plan</p> <ul style="list-style-type: none"> <li>An enhanced capacity to implement ESD principles in the management of the fishery</li> <li>A greater certainty in the long-term sustainability of Gulf of Carpentaria inshore finfish resources</li> <li>Enhanced long-term industry profitability through reduced commercial fishing effort</li> <li>Increased community confidence in the ability of management agencies and resource users to manage GoC inshore finfish resource for all users</li> <li>Greater protection of the resource to protect and enhance indigenous people's traditional and cultural rights</li> </ul>
Sustainability Indicators	Y	Section 3 Schedule 2
Trigger points	Y	Section 3 Schedule 2 Events
Other related issues		Description fishery, Regulatory Impact Statement
Definitions	N	

### Sustainable Indicators

1. Maintenance of inshore finfish stocks at sustainable levels		
Achieving Maintenance	Performance Indicator	Review Event
<p>(a) limiting harvest of the target species to their maximum sustainable yield</p> <p>(b) monitoring target species stock status through regular stock assessments</p> <p>(c) regulating fin fish under part 4 of this plan and minimising the catch of non-target species</p> <p>(d) controlling fishing by commercial, recreational, and Aboriginal and Torres Strait Islanders</p> <p>(e) reviewing the effectiveness and appropriateness if the closed waters declarations under part 3 of this plan</p> <p>(f) the Authority assisting the commercial fishing industry in developing marketing incentives to reduce waste of species that are not target species</p>	<p>(a) Scientifically established maximum sustainable yields applied by the Authority in restrictions of fishing activity for target species, using best available information</p> <p>(b) Reporting to the Authority by all sectors of the fishery on catch and effort information</p> <p>(c) Any fishery status reports given to the Authority by the departments at the end of every second fishing year</p> <p>(d) Relevant information given to the Authority by anyone about routine stock assessments for target species</p> <p>(e) Regional mean finfish catch size distributions remaining stable compared with 1997 figures</p> <p>(f) Levels of compliance with this plan by fishers</p> <p>(g) CPUE (standardised in the same way) for any sector of the fishery</p>	<p>(a) relevant catch and effort data for commercial, recreational or Aboriginal or Torres Strait Island fishing is not available to the Authority to help decide appropriate maximum sustainable yields</p> <p>(b) commercial fishing effort is more than 12000 days in which boats fished in any period of 12 months</p> <p>(c) mean finfish catch size distributions in any part of the fishery show significant decline</p> <p>(d) CPUE (standardised in the same way) for a target species in any sector of the fishery significantly declines over 3 consecutive years</p> <p>(e) A significant change occurs in the area in</p>

		which a particular commercial fishing activity happens
2. Protecting spawning target species		
Achieving Maintenance	Performance Indicator	Review Event
(a) the closed season, closed waters and regulated fish declarations under parts 2, 3 and 4 of this plan (b) the other management arrangements under this plan introduced to maintain adequate spawning target species	Protection of spawning target species to be measures by the abundance of juvenile target species	Measures for protecting spawning target species are to be reviewed if the abundance of juvenile target species significantly declines
3. Minimising the effects of fishing on protected wildlife		
Achieving Maintenance	Performance Indicator	Review Event
(a) the requirements under this plan for attending certain types of net (b) putting into effect closed waters declarations under part 3 of this plan in areas identified by the Authority as being important for the species	(a) implementation by the Authority of recording of the incidental catch of species (b) compliance with net attendance requirements and closed water declarations under this plan	(a) increase in the recorded incidental catch of the species (b) decline in the level of compliance with the attendance requirements and closed water declarations under this plan
4. Providing a viable commercial net fishery that gives economic and social benefits to the local, regional and State economies		
Achieving Maintenance	Performance Indicator	Review Event
(a) providing for adequate sustainable access to fisheries resources by commercial fishers (b) combining fishery symbols	(a) the level of participation in combining fishery symbols under this plan (b) fishery economic studies undertaken or accepted by the Authority (c) annual commercial catches	(a) combining fishery symbols does not happen to a significant level (b) economic studies accepted by the Authority show a significant decline in viability within the commercial net fishery (c) commercial catches significantly decline over 3 consecutive years
5. Providing for a recreational fishery that gives economic and social benefits to the local and regional economies		
Achieving Maintenance	Performance Indicator	Review Event
(a) providing for adequate sustainable access to finfish by recreational fishers (b) the regulated fish declarations under part 4 of this plan	(a) surveys of participation in recreational fishing undertaken or accepted by the Authority (b) compliance with the provisions of this plan relating to recreational fishing	(a) surveys of recreational fishing that are accepted by the Authority show a significant decline in catches or participation (b) the Authority becomes aware of a progressive and

		significant decline in compliance with the recreational fishing provisions of this plan
6. Satisfying the traditional or customary fishing needs of Aborigines and Torres Strait Islanders		
Achieving Maintenance	Performance Indicator	Review Event
<p>1. Satisfying the traditional and customary fishing needs of Aborigines or Torres Strait Islanders is to be achieved by the measures under this plan that regulate commercial and recreational access to finfish</p> <p>2. The measures also ensure adequate access to finfish under Aboriginal tradition or Island custom</p>	<p>(a) surveys of participation in traditional or customary fishing that are accepted by the Authority</p> <p>(b) the Authority having an agreed process in place with Aboriginal and Torres Strait Islander communities by 2002</p> <p>(c) maintaining access to , and catch of, finfish under tradition or custom</p>	<p>The provision of a fishery that satisfies the traditional and customary fishing needs of Aborigines or Torres Strait Islanders is to be reviewed if surveys of participation in traditional or customary fishing that are accepted by the Authority show a significant decline in catches or participation</p>

## NEW SOUTH WALES

### ACTS

Date & Title	Fisheries Management Act New South Wales 1994 No. 38	
Objectives	Y	Part 1 (3.1) The objects of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations 3.2 a) conserve fish stocks and protect key fish habitats b) promote viable commercial fishing and aquaculture industries c) to provide quality recreational fishing opportunities d) to appropriately share fisheries resources between the users of those resources
Management Plan	Y	Part 3 Division 5
Reference points/performance indicators	Y	Part 3 Division 57 (a)
Other related issues	Y	Part 7 Division 1 Protection aquatic habitats, Schedule 1 Threatened species conservation
Definitions	N	

### SUPPORTING DOCUMENTATION

#### 1. Status of Fisheries Resources 1996/97 NSW Fisheries

#### MANAGEMENT PLANS

NSW is in the process of developing management plans for its fisheries. Currently a multi-disciplinary team is assigned to oversee each fishery. Objectives, strategies and performance indicators will be used, and each team is responsible for monitoring the fishery over time.

Fishing Areas		
Operational objectives	N	
Performance Indicators	N	
Trigger points	N	
Other related issues	N	
Definitions	N	

Some broad information is provided in the Status of Fisheries Resources report. For 1996/7 these were:

Fishing Areas		
Operational objectives	N	
Performance Indicators	Y	Stock and fishery status is reported broadly and descriptively under the headings <ul style="list-style-type: none"> <li>- Landings, fishing effort, catch rates and value</li> <li>- Stock assessment</li> <li>- Breeding stock levels</li> <li>- 5y trends</li> </ul>
Trigger points	N	
Other related issues	N	

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Definitions	N
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## VICTORIA

### ACTS

Date & Title	Victoria fisheries Act 1995 Act No. 92/1995	
Objectives	Y	Part 1 (3) (a) to provide for the management, development and use of Victoria's fisheries, aquaculture industries and associated aquatic biological resources in an efficient, effective and ecologically sustainable manner (b) to protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity (c) to promote sustainable commercial fishing and viable aquaculture industries and quality recreational fishing opportunities for the benefit of present and future generations (d) to facilitate access to fisheries resources for commercial, recreational and traditional and non-consumptive uses (e) to promote the welfare of persons engaged in the commercial fishing industry and to facilitate the rationalisation and restructuring of the industry (f) to encourage the participation of resource users and the community in fisheries management
Management Plan	Y	Part 3 28
Reference points/performance indicators	Y	Part 3 28 (f)
Other related issues	Y	Part 4 Quotas, Part 5 Protection fisheries, Fisheries Reserves, Part 6 Code of fishing practice
Definitions	N	

### SUPPORTING DOCUMENTS

1. Fisheries assessment Report Series Reports 1 - 16 Fisheries Victoria
2. Fisheries Strategy Towards 2000 Fisheries Victoria

### MANAGEMENT PLANS

1. Eel fishery Management Plan 1995 Victoria Fisheries

Fishing Areas	Commercial, Recreational, traditional	
Operational objectives	Y	<ul style="list-style-type: none"> <li>• To manage for ecologically sustainable harvest from commercial and recreational sectors by ensuring sustainable harvest from both Crown and private waters; and providing gear/effort controls to prevent over fishing and impact on non-target species</li> <li>• To provide stability to the commercial sectors in terms of access to the resource</li> <li>• Provide for the conservation of areas and species that share eel habitats</li> <li>• Provide for the recruitment of new commercial fishers</li> </ul>

		<ul style="list-style-type: none"> <li>• Provide equitable return to the community</li> </ul>
Performance Indicators	Y	<p>Major indicator for plan is that for the Action Plan the consultation process is followed and the schedule for decisions, policies, legislation etc is adhered to. Realistic indicators for the industry must be set on a long time-scale and may of necessity constitute trends and directions rather than set figures or amounts. Proposed targets are:</p> <ul style="list-style-type: none"> <li>• Long-term maintenance or enhancement of the total annual yield of the industry above 300 tonnes</li> <li>• A 15-30% reduction in the number of licensed fishers in the next ten years via implementation of the proposed licensing system</li> <li>• An increase in the area of water subject to fish culture permits</li> <li>• An increase in the % of fish culture permits involving habitat restoration</li> <li>• Maintenance of access to waters currently open to eel fishing</li> </ul>
Trigger points	N	
Other related issues		Culture and wild stocks, Recreational & traditional fishery, Environment, Action Program and Review, Develop catch/effort reporting system for comment, Gear
Definitions	N	

## TASMANIA

### ACTS

Date & Title	Living Marine Resources Management Act 1995 No. 25 1995	
Objectives	Y	Part 1 Division 1 (7.1) the purpose of this Act is to achieve sustainable development of the living marine resources having regard to the need to: a) increase the community's understanding of the integrity of the ecosystems upon which fisheries depend b) provide and maintain sustainability of living marine resource c) take account of the community's need in respect of living marine resource d) take account of the community's interests in living marine resources
Management Plan	Y	Part 3
Reference points/performance indicators	N	
Other related issues	Y	Part 5 Protection marine areas & habitats, Part 10 Regulations re MPAs, fish habitats, misc. pollution, Schedule 1 Objectives resource management & planning system of Tasmania, Sustainable development
Definitions	N	

### SUPPORTING DOCUMENTATION

1. Rock Lobster Fishery Policy Document. December 1997
2. Recreational Scalefish Fishery Policy Paper Tasmania. May 1998
3. Scalefish Fishery Policy document Tasmania. July 19981

### MANAGEMENT PLANS

1. Draft Fishery Management Plan and Policy document for the Tasmanian Abalone Fishery. September 1997

Fishing Areas		Commercial, recreational, Aboriginal cultural Fishing
Operational objectives		Part 1 Section 4.4.2 (i) protecting greenlip abalone stocks ii) maintaining the opportunity for value adding from the Furneaux Group and other areas
Performance Indicators	Y	Part 1 section 6
Trigger points	Y	Part 1 Section 6.2 and 6.3
Other related issues		Part 1 Section 5 Policy objectives and management strategies 5.2 maintain biomass and recruitment, 5.3 sustaining yield and economic return, 5.4 commercial fishing interactions 5.5 access to fish stocks by non-commercial fishers 5.6 marine farming interactions 5.7 environmental interactions 5.8 enforcement 5.9 cost recovery and return to the community 5.10 quality assurance 7.3 costs and benefits proposed plan and alternatives

Definitions	N
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### Sustainable Indicators

Objectives	Performance indicator	Trigger point
Maintaining biomass and recruitment, success of quota management, economic stability of the fishery	1. Catch per unit effort (CPUE) used with caution. Areas producing large catch are of greatest concern. Significant change in catch level (higher or lower) used as an indicator.	1. Catch per unit effort (CPUE) annual CPUE at State level from diver returns fall below 95% of CPUE for ref year with lowest catch rate. Non standardised data used until standardisation been undertaken 2. Level of catch for a region or block annual catch for region reaches ref level which are specific to each region
	2. Egg production maintenance sufficient to prevent declining recruitment and eventual recruitment. High degree uncertainty. Important to apply precautionary approach	At present no trigger points can be set, however may be possible to develop

#### 6.2.1 Proposed Regions for use in Performance Indicators or Trigger Points

The 57 blocks used for the reporting of fishing activity divided into 9 regions

#### 6.3 Management action upon reaching trigger points

When one or more of the performance indicators described have reached their respective trigger point, then the Secretary will undertake following actions:

1. Notify minister and industry
2. Undertake examination of:- status of fishery at State and regional levels, via performance indicators and any indicator of the fishery or its stocks and information from divers and processors, and the resulting implications and available management options
3. Consult with the industry and the public on the examination and development of management options
4. Report to the Minister and the industry, within 3 months of the initial notification, on the outcomes of the examination and the proposed management options

*Available Management Options*

A wide range of management options are available for inclusion in any amended Plan or subsequent Plan. They can be applied either on a statewide or regional basis, as needed. They may also be applied to one or both of the main commercial species. The main options are listed below but the list is not comprehensive, nor should it limit the options to be considered:

1. Adjust the TAC for subsequent years
2. Introduce a system of zones, with catch limits for each zone, under the overall TAC
3. Introduce species-specific management, such as catch limits, under the overall TAC
4. Change the size limits, including the possibility of introducing maximum size limits
5. Introduce seasonal closures
6. Introduce area closures

## COMMONWEALTH

### ACTS

Date & Title	Fisheries Management Act 1991 No. 162 of 1991	
Objectives	Y	<p>Part 1 (3.1)</p> <p>a) implementing efficient and cost effective fisheries management on behalf of the Commonwealth</p> <p>b) ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment;</p> <p>c) maximising economic efficiency in the exploitation of fisheries resources</p> <p>d) ensuring accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources</p> <p>e) achieving government targets in relation to the recovery of the costs of AFMA</p> <p>Part 1 (3.2)</p> <p>a) ensuring, through proper conservation and management measures, that the living resources of the AFZ are not endangered by over-exploitation</p> <p>b) achieving the optimum utilisation of the living resources of the AFZ; but must ensure, as far as practicable, that measures adopted in pursuit of those objectives must not be inconsistent with the preservation, conservation and protection of all species of whales</p>
Management Plan	Y	Part 3 Division 2
Reference points/performance indicators	N	
Other related issues	N	
Definitions	N	

### SUPPORTING DOCUMENTATION

1. The South East Fishery 1996, Fishery Assessment Report compiled by the SEF Assessment Group.
2. Statutory Fishing Rights in the Southern Bluefin Tuna fishery. February 1995
3. Fisheries Assessment Reports:
  - Southern Shark Fishery 1996
  - Northern Prawn Fishery 1996
  - Torres Strait Prawn Fishery 1997
  - Torres Strait Lobster Fishery 1997

- Torres Strait Turtles 1997
- 4. Southern Squid Jig Fishery 1997 Catch Report
- 5. Stock Assessment Report School Shark 1996 Southern Shark Assessment Group
- 6. Fishery Assessment Report The Great Australian Bight Trawl Fishery 1997
- 7. Stock Assessment Report Gummy Shark 1996 Southern Shark Fishery Assessment Group
- 8. Bass Strait Central Zone Scallop Fishery Assessment Report 1997
- 9. Bass Strait Central Zone Scallop Fishery Data Summary 1997

## MANAGEMENT PLANS

1. South East Trawl Fishery Management Plan 1998
2. Great Australian Bight Trawl Fishery Management Plan May 1993
3. Northern Prawn Fishery Management Plan 1995
4. Southern Bluefin Tuna Fishery Management Plan 1995

Example: South East Trawl Fishery Management Plan 1998

Fishing Areas		Commercial
Operational objectives	Y	Part 1 (3) a) to pursue the sustainable use of resources of the SET Fishery in a manner consistent with the exercise of the precautionary principle, while seeking to minimise any adverse impacts of fishing on the marine environment b) promote the rebuilding of any depleted fish stocks of the SET Fishery c) to encourage economically efficient harvesting of the resources of the SET Fishery d) to promote a cooperative approach by stakeholders to managing the resources of the SET Fishery and the associated marine environment e) to increase the asset security of the SET Fishery f) to implement efficient and cost-effective management of the SET Fishery
Performance Indicators	Y	Part 1 (5)
Trigger points	Y	Part 5 Performance criteria against which the measures taken may be assessed
Other related issues	Y	Part 2 Fishing rights and permits, quotas Part 4 TAC,
Definitions	N	

## Sustainable Indicators

Objectives	Performance Indicator (measures)	Trigger point (Performance criteria)
a) to pursue the sustainable use of resources of the SET Fishery in a manner consistent with the exercise of the precautionary principle, while seeking to minimise any adverse impacts of fishing on the marine	Measures by which objectives of this plan are to be attained a) ensuring that research in relation SET Fishery focused on key issues relating to assessment fish stocks b) using results of research in	The performance criteria against which the measures taken may be assessed a) fish resources of SET Fishery are being maintained at

<p>environment</p> <p>b) promote rebuilding of any depleted fish stocks</p> <p>c) encourage economically efficient harvesting of the resources of the Set Fishery</p> <p>d) promote cooperative approach by stakeholders to managing the resources of Set Fishery and associated marine environment</p> <p>e) implement efficient and cost effective management of the SET Fishery</p>	<p>relation SET Fishery to aid in development and implementation of strategy that ensures fishing in SET Fishery is carried out in ecologically sustainable way</p> <p>c) monitoring by collecting data and samples, the impact of fishing in the SET on ecologically related species and the marine environment, implementing practical strategies that are necessary to ensure sustainability of those species and the marine environment</p> <p>d) developing and implementing a research strategy for SET Fishery to ensure that sufficient information is available to assist in making management decisions in relation to SET Fishery</p> <p>e) developing and implementing bycatch action plan (including approp. research strategy)</p> <p>f) developing and implementing if possible, biological and economic reference points for any species of fish taken in the area of SET Fishery</p> <p>g) determining for each fishing year trawl TAC for each quota species for which statutory fishing rights been granted</p> <p>h) developing and implementing approp. processes to formulate management measures</p> <p>i) continually evaluating mechanisms put in place to monitor fishing against quota statutory fishing rights, and modifying those mechanisms, as necessary, to improve monitoring</p> <p>j) checking accuracy and consistency information kept in relation to SET(logbook returns, records disposal fish) by cross referencing information</p> <p>k) granting transferable statutory fishing rights to eligible persons for purpose providing stability and a market basis for adjustment for SET Fishery</p> <p>l) ensuring SETMAC and its assoc. sub committees given detailed info about all aspects SET to enable them to provide</p>	<p>or above agreed limit biological reference levels</p> <p>b) effective strategies in place to ensure stocks of any depleted fish resources are being rebuilt</p> <p>c) the amount of a quota species that may be taken in a fishing year (trawl TAC, carryover fishing permits) is not exceeded in that year</p> <p>d) that the quota of a quota species that may be taken under each quota statutory fishing right or carry over fishing permit is not exceeded</p> <p>e) that cost effective and high quality research is carried out in relation SET in accordance 5 year strategic research plan, results which i) included in assess process ii) published in assess reports iii)taken into consideration determining trawl TAC for quota species in a fishing year</p> <p>f) that a bycatch action plan has been developed for the SET that i) assesses impact trawling in SET ii) provides for research into alternative management strategies inc. fishing gear iii)implements measures to minimise adverse effects fishing on environment</p> <p>g) that data are collected and</p>
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	<p>effective advice to AFMA for purpose enabling SET Fishery to be managed efficiently and cost effective manner</p> <p>m) enabling ESD development of fishing of non-quota species in SET Fishery</p> <p>n) ensuring management and conservation measures specified in this plan are implemented in relation to SET Fishery by way of efficient and cost effective compliance arrangements</p>	<p>analysed in a timely manner to enable i) evaluation of effectiveness strategies to maintain or rebuild resources SET at or to a sustainable level ii) modification as necessary of strategies</p> <p>h) that there has been an improvement in economic efficiency of SET measured in terms i) periodic assessment of overall operating costs ii) levels of structural adjustment iii) relative movements in yield value and returns on investment</p> <p>i) strategies implemented under 4 (c) to ensure sustainability of ecologically related species and the marine environment are meeting their objectives</p> <p>j) budgetary objectives SET are achieved</p> <p>k) statutory fishing rights granted</p> <p>l) relative changes in whole weight of non-quota species being taken in SET are monitored</p>
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5.2 : AFMA and SETMAC must, from time to time, assess, by reference to the performance criteria, the effectiveness of the measures taken to implement the objectives of this plan

5.3 : AFMA must include in its annual report, an assessment of the performance of this plan with reference to the most recent assessment carried out under subclause 5.2

## Appendix C:

Summary of the combined results from the FRDC Questionnaire and interviews.

The combined results from the FRDC Questionnaire and interviews are summarised here for each jurisdiction in the order South Australia, Western Australia, Northern Territory, Queensland, New South Wales, Victoria, Tasmania, Commonwealth. Each is summarised separately under a common heading structure. This heading structure is:

1. National Approach
2. Terms and definitions
  - (a) Indicators and broader issues
  - (b) Use and selection of indicators
  - (c) Issues of Cost recovery, target and non-target species, and rich and poor fisheries
  - (d) Experience elsewhere
  - (e) State of Environment reporting.
3. Development and future directions
4. Implication for R & D

## SOUTH AUSTRALIA

### 1. Status and Current Use of Indicators

- Management plans completed or late stage draft for all main fisheries. Minor species have very 'rough and ready' indicators because there is neither the funding nor information to do better. This is primarily where it would be useful to have some default criteria and guiding principles.
- Inconsistency of terminology.
  - S R Lobster plan uses reference point instead of indicator St Vincent Gulf prawns ie.
    - Reference point is 'outside range of last 5y'
    - Prescribed action provided if reference pt exceeded
  - St Vincent Gulf prawns
    - Indicator and target reference point with correct terminology, but different from lobster management plan
    - Economic indicator, target and limit reference points are simple biological measures (mean weight) derived from bioeconomic model. Good example of finding simple but robust measures for complex problem, and using accessible biological indicators to address a less accessible economic objective.
- While the inclusion of social issues was accepted to be a part of ESD, it was recognised that this was very difficult and confronting to do in practice via indicators and reference points. The SA plans do not have indicators of social equity etc despite that being an objective in the Fisheries Act. Allocation of resources is a political decision and part of the political process. Optimising economics and making the social consequences explicit is seen as being confronting and counter-productive. Arguably Australia's success in fisheries management compared to other countries was due to the early adoption of limited access (input) controls, which act against some aspects of equity and may not have been possible if these implications had been made explicit. The basic values are hard to quantify (e.g. the owner operator vs multinational, decentralised vs centralised). Possible role for indicators that could be usefully monitored, but kept well apart from management decision making. Particularly useful perhaps during restructuring and in addressing interactions with other users or interest groups (e.g. recreational fishing, aquaculture, tourism, conservation groups). An indicator relating to inter-generational equity would be potentially useful, especially if it could be expressed in resource abundance/condition terms.
- Mainly use indicators based on CPUE, and fishery independent measurements of spawning stock and pre-recruits. New fishery management plans include reference points and performance indicators.

## 2. ISSUES

### A. National Approach

- Want to see the same standards used for all Australia
- Performance indicators for the same type of resource and fishery should of the same style across all management plans. This is especially true for stocks that are shared across jurisdictions or uses within a jurisdiction
- Recognised that the information base will vary across jurisdictions; but that should not be used to stop development of general performance indicators that might help ‘focus’ research and monitoring effort.
- This need for standards applies mainly to biological indicators; economic and social indicators more difficult because they are more political and may be harder to standardise.
- Need a national approach and project to consolidate approach and experience
  - Categorise main fishery types (e.g. temperate estuarine, tropical slope etc)
  - Pull together the indicators presently being used. Review/evaluate. Develop default indicators, performance measures and guidelines.
  - Build mechanisms for continued learning about what did and did not work. When fisheries have failed or become over fished address why did the problem occur. Were the indicators of the wrong type, or not measured adequately, or not used adequately. Looking back will be of use, but establishing a mechanism for ongoing review of even more value. Learn what indicators are most appropriate in the Australian context.
  - Overseas experience should be used, but recognise that Australia is a world leader in this area anyway, especially in developing collaborative approaches between scientists, managers and industry.
- Sustainability indicators nationally must go beyond the jurisdictionally based fisheries legislation
  - Need to identify what needs to be nationally collected. Jurisdictions can pick and chose what they want to use or add to meet their specific management needs. But there needs to be a national and consistent minimum.
- Standard indicators and methods are needed to help reduce duplication and repeated studies that don’t relate to one another (e.g. studies done every few years but use different methods so the results cant be related to one another).
- A key question is how much monitoring is enough. What accuracy/precision needed? What level of detail (spatial coverage or frequency of monitoring).
  - What basic questions could be used to form the basis of default national standards for precision? Perhaps something like x% chance of detecting y% change or trend over z years. Such things could be used to provide default guidance on the level of monitoring.

- What basic questions could be used to form the basis of default national standards for what to monitor? Experience summary from categories of fishery?

### B. *Terms and Definitions*

#### ESD definitions

- Basic acceptance of definitions. Check consistency with FAO Code of Conduct.
- ESD means all of conservation, economic and social objective.
- Draft definition of sustainability indicator should make some reference to sustainability.
- Suggested indicators for social and economic objectives provided in our circulated discussion documents seem a reasonable start.

#### Terms

- Indicator – something measured. May or may not be used to track something. If used to detect trends/patterns in time or space then there is a need to specify methods/analysis to maintain consistency.
- Sustainability indicator should have some notion of sustainability in the definition. Measurements of something chosen with the intention that it will help address some aspect of sustainability. The something is selected because it is thought to be important. Process of selection a step in itself.
- Reference point. Ensure difference between target and threshold/limit reference point clear.

### C. *Indicators (biological, economic, social and others) and Broader Issues*

- Need to consider and recognise that the biological, economic and social indicators interact, and need to be considered as a whole (as per NSESD), and so indicators are needed for all.
  - Need to include indicators that relate to the broader environment, for things such as water quality, land use etc that are beyond fisheries management control but that are likely to be important. This will allow issues impacting fisheries to be recognised and put fisheries in a better position for influencing toward desired outcomes.
  - General suggestion of two categories of indicator
  - Primary being biological stock abundance and condition. These must be measurable and robustly established.
  - Secondary being information mainly used to interpret the first, such as broader environmental conditions, economics etc (e.g. if CPUE is used for a primary indicator of stock abundance the secondary indicators must include factors that

might effect CPUE other than stock abundance, such as environmental conditions or price).

- Need Sustainability indicators that are defensible to outside groups. These groups will mainly be focused on the biological indicators and their adequacy. But must also be understood and supported by industry, and meet jurisdictional management needs. Key ingredients for success
  - The biological/social/conservation indicators must allow the interactions between uses to be recognised (i.e. the things other than commercial fishing that may be having an effect, such as recreational fishing, illegal fishing, environmental degradation).
  - Scientific definitions of indicators must be defensible (against outside criticism and against industry criticism about interpretation).
  - Scientific definitions of indicators must be understandable to industry. Some are very confusing (e.g. F0.1 and egg per recruit indicators). Industry needs to understand and agree with what is being used, and that will help with defence, support and measurement.
- Must be clear that not sufficient to look at single species. Must include ecosystem and environmental context. Present focus of ESD in fisheries is on the market species, and in part this is because these species are the direct basis of the levy and research/management cost recovery mechanisms. The extent of the need to take in other aspects of the ecology is not well established or accepted at the level of practical decision making. The ecological effects of fishing are a growing concern in the community, and is a major part of the recent focus on establishment of marine parks.
- There is a need to capture the broader range of impacts in consideration of ESD and Sustainability indicators, not just the fishing industry impacts (e.g. recreational fishing, land use, and aquaculture). A shared responsibility. Property rights and responsibilities for all?
- ESD implies maintaining something through time forever. But what exactly. And what of natural change, or change that is caused elsewhere (global warming, land and river use). And when do we start counting – from the arrival of the European?
- Terrestrial models are being applied to environmental management of the sea (e.g. a focus on marine parks and reserves and on endangered species). But it is likely that these models are of limited use in the sea (because of high levels of interconnection between areas and the proven resilience of marine species against extinction through exploitation). There is a serious need to look broadly at the use of these terrestrial approaches, and how the broad use of Sustainability indicators and performance measures might provide a better approach.
- The by-catch problem needed to be addressed. Property rights solution?

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

- The uncertainty and lack of understanding about marine systems, and about the effects of management decisions, should be made more explicit and be recognised by managers and the community. This uncertainty, and pretending it does not exist, often makes the scientific advice challengeable and supports the idea that MPAs are needed because nothing else works. There is often an inequity in the standards being applied (e.g. oil platforms have to meet standards that would stop many trawl fisheries, scallop dredging in Port Phillip Bay was stopped whereas shipping has probably done more environmental damage through the introduction of pest species).
- Concerns that present indicators may not stand rigorous scrutiny. Industry wants to be involved in development of research on sustainability indicators. Indicators being used to demonstrate to the community the effect of management in meeting biological, economic, environmental and social objectives. The exact measures are developed case by case. Use of indicators seen as part of developing 'worlds best practice' fisheries management.

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Greater use should be made of industry in the measurement of indicators. With understanding and agreement the industry would be keen to help. Scientists should design robust methods, including robust equipment where necessary, for industry to use. A quality control process may be required for external confidence.
- Based on a perception of risk. Could be intuitively identified and weighed risk, or could be formal risk assessment. Need to trade off such things as the risk of over-reacting (indicator and reference point together result in conclusion of problem when there is none – environmental fluctuation or change in targeting for example) with failing to react until too late (indicator and reference point together result in over fishing being interpreted as due to something else for too long). Value of combined use of multiple indicators (e.g. CPUE+environment+targeting) to improve performance. The risks often arise for the desire for evenness of cash flow to industry while there are fluctuations in the stock abundance (natural and human induced).
- Key issue though, is that selection of indicators and reference points are a risk based decision. Consequently it is difficult to make a selection without reference to the management or community objectives. Key issue in development of general standards and guidelines is how to get around the paradox – general standards need to cross jurisdictions but management objectives which flow from jurisdictions are needed to evaluate risk and so select indicators/reference points. Solution probably in seeking a minimal set of objectives common to all jurisdictions or provided by inter-governmental agreements.

- Linkage of indicators and reference points to prescriptive action only effective (and usually only possible) where there is confidence in the indicators and reference points. In a few cases these have been established more casually (e.g. SEF shelf species and BB Swordfish) with the result that when the reference points are exceeded there is no agreement on what to do and whether the indicators/reference levels were reasonable in the first place. Prescriptive action in SA rock lobster management plan reflects confidence in the indicators and reference points. The prescribed action is to initiate an inquiry on options that must report to the minister within a relatively short time.

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- Cost recovery policy is limiting what can be done for many fisheries – ‘rich fisheries’ get great detail (more than enough sometimes?) while ‘poor fisheries’ cant afford even what would be regarded as a reasonable minimum. And the cost recovery policy prevents cross subsidy – research levies in one fishery may even be reduced, because that fishery does not need further work, while another fishery is not meeting what is a basic recognised need because it cannot afford the cost. There is a need for broader community/interest group contribution to achieve broad ESD objectives. Also recognition that ultimately it is not good for industry/management as a whole if fishery failures or ecological damage is done by fisheries that cannot afford a basic level monitoring and management. State and Commonwealth Environment Departments request and expect data from fisheries for inclusion in their State of Environment reports – so they should help pay for this.

#### *F. Experience Elsewhere SWOT*

#### *G. State of Environment Reporting*

- Sustainability indicators should influence and be used in State of Environment Reporting. This is a part of the credibility building for outside groups.
- Fisheries indicators should be developed to be accepted as valid environmental indicators by Environmental Departments and groups
- Environmental Departments should contribute to monitoring costs where the resulting indicators are used in this broader context.

### **3. Development and future directions**

- Development of indicators for prey species that account for predator-prey interactions. SA EPA paper due on environmental sustainability indicators.
- Improved stock assessments of key species, including use of spatially structured models and food-chain models where necessary



#### **4. Implications R&D**

## WESTERN AUSTRALIA

### 1. Status and Current Use of Indicators

- Most indicators used in performance reporting based on monthly logbook returns. These logbooks were not designed to meet this use, but are what is available. The logbooks record fishing method, days fished and catch (usually retained catch) by 1 degree square and month; one degree covers a very wide range of habitats and fisheries in most cases.
  - In a small number of valuable fisheries more detailed ‘research’ logbooks are used or fishery independent surveys are used to provide the information for indicators and performance measures.
  - There is reasonable confidence in the indicators and performance measures for the main and valuable fisheries. Information and analysis, and confidence, is lacking in the case of the minor fisheries.
  - There is a need to do something better with the lower value fisheries and species, including by-catch, within the constraints of the funds available and in a cost-effective way.
  
- A state of fisheries report is provided annually to Parliament (and has been for the last 4y). Although there has been some further development of the indicators and performance measures, mostly they were the same as those used previously in annual reports. The need for improved indicators and performance measures was recognised and emphasised by the managers, as the management issues became more complex – and especially the interaction with other users and conservation interests.
  
- The indicators used for performance reporting and the management plans are very broad, and there are no targets/limits set against them and no indication of what management action would be initiated if the indicators changed (or failed to change).
  - There are more detailed and specific indicators and targets used in the assessments (such as the level of reduction in the spawning biomass) but these are not linked to any management or fishery level performance measure.
  
- No economic, marketing or social targets are used, and only in a very few cases are there indicators. Where there are indicators (mainly the rock lobster fishery) they relate to markets and expected short term trends; they are not used explicitly in management decision making or performance reporting. There is a recognised need socio-economic indicators, as these are becoming increasingly important issues. However, it is also recognised that these are very different ‘in kind’ to biological indicators. There is no notion of managing to meet economic or social targets or objectives; that is acting specifically to achieve a socioeconomic target in the way that management action might be directed specifically to achieve a biological target. Although the Act contains broad social and economic objectives the Fisheries Dept would not specifically act to achieve targets in these areas. The broad social and economic issues and balance are achieved essentially through the political process. So while it is important to have indicators or measures of the

broad social and economic trends, it is not appropriate to have targets of performance measures relating to these.

- The formal management plans do not contain objectives. Rather they describe the management rules and measures, with no description or indication of how these rules and measures relate to achievement of objectives and no performance measures relating to desired outcomes. The management plans were structured this way to ensure that the Dept is not vulnerable to failure to achieve objectives (especially because in fisheries not all things are under tight management control and so failure can occur for reasons beyond the control of the Dept). Fishery background and management objectives are provided in 'Fishery Overview Papers', which is not binding on the Department in a statutory and auditing sense.
- The indicators used focus on the target species and habitat (following initiation of the habitat program in 1996, so this is at an early stage). Broader multiple use issues are the new focus areas, and this is where any new initiative funding will go in future. Indicators and performance measures are needed, and fisheries must deal with this challenge effectively – otherwise other Departments will take over. Dept Fisheries is preparing an over-arching policy document for integrated regional management. This will deal with recreational fishing, commercial fishing, aquaculture and environmental management (i.e. the habitat issues that fit under fisheries Dept) for each of 5 regions, where regions relate to species distributions and compositions (i.e. are essentially defined ecosystems). Regional management plans that integrate the sector specific uses and management plans will be developed.
  - Sustainability indicators are imperative for this to work. Also the regional management context is a better and more useful 'environment' for the use of Sustainability indicators than any one sector. The concept of the sustainability indicator makes more sense, and more management use, in a regional multiple use context than in the single sector use context.
  - Draft due for comment in about a month.
- Biological reference points and indicators provided annually to Parliament on 30 stocks. Over fishing definitions and indicators used. Mainly used to report on target species status and management performance.

## 2. Issues

### A. *National Approach*

- National guidelines will need to be broad to deal with the differences in information availability and circumstances. But useful issues to address nationally include definitions, how indicators etc should be used, what are some reasonable starting values (so that don't have to start from scratch with every new fishery).

- The national approach should make use of the US approach to the definition of over fishing, and how that was used. That is require definitions to be provided, have a process for review of suggestions and refinement of them to be a standard as possible, then require annual reporting against those definitions for all stocks.
- Indicators need to relate to management objectives, including short term (typical 5y plan objectives). E.g. of how this was done in Pilberra trawl fishery – objectives ‘workshopped’ with industry, over fishing defined, main species checked against this definition, management decisions made.
- It would be useful to have an over-arching and guiding framework for the development and use of sustainability indicators for ESD. This would need to recognise that there are very different conditions within and between jurisdictions. It would need to be accepted that different jurisdictions would pull the bits out that they can use, but standardisation of use and reporting would be useful.

### *B. Terms and Definitions*

#### ESD definitions

- ESD not specifically in the WA fisheries legislation. The concept is very diffuse and difficult to ‘pin down’, and nobody can really say what exactly it is really. In the WA legislation the approach taken is to identify objectives/outcomes for the main key sub-topics of ESD, and understanding that achieving the desired outcomes in these sub-topics will achieve ESD. The sub-topics are
  - Sustainable stock
  - Economic performance
  - Social equity
- WA uses stated definitions in the Departments Annual Report and the annual Status of Fisheries report to Parliament.

### *C. Indicators (biological, economic, social and others) and Broader Issues*

- ESD for Dept of fisheries has come to involve many users other than just commercial fishing, and is particularly having to deal with different ideals about sustainable levels across different users, equitable sharing of resources and access. Other major users involved are recreational fishing, conservation/MPAs, aquaculture (for access to area, grow-out stock and brood stock), and coastal development (for habitat impacts and pollution). Only about 30% of the business of the Dept is now about commercial fishing – 10y ago it was close to 100%. Social pressure is driving political desire for acceptable multiple use outcomes more and more. So Sustainability indicators must look beyond the commercial fisheries.
  - Key need is for indicators and performance measures that can be used to reassure the interest groups and broader community that all is OK and responsible management

decisions/outcomes are being achieved. No longer sufficient to just rely on ‘trust me’ response from managers and government.

- Fishing industry embarking on active PR effort to explain to the community that they are responsible and can share/coexist with other community interests and uses of marine resources. This includes booths and demonstrations at major public shows (such as the Easter Shows), and establishing dialogue with various green groups.
- The new MAC system is improving relationships between industry, managers and scientists. Scientists are on the MAC in the new system; under the old system scientists were not part of the formal management-industry groups, and instead delivered their results through presentations and talks. The new structure is building a better team spirit, recognition of need and ownership of results.

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

- Need some idea of reliability and uncertainty in the indicators. Could be just a qualitative statement, but need some guidance on the risk levels and for the indicators to be developed and understood in a risk assessment context. None of the existing indicators have been developed in a risk assessment context, and this leaves the managers without a good idea of what the risks are (what kind of risk and what risk level). No idea of what risks are associated with the use of the current indicators in their current context of use. May be fine – but may not - and some probably more risky than others – but which ones (those based on most information not necessarily the safest). Need some guidance on this.
- Managers want to know what is causing the uncertainty, and what the implications/risks are in relation to the key management decision variables (stock size/condition, effect of different catch levels etc). Relative statements of uncertainty could be enough (e.g. this years measure half as reliable as last years, or this indicator twice as reliable as that one). Looking at management scenarios for high, medium and low risk interpretations is useful, and this should be part of the process of identifying indicators.

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Most indicators are based on commercial vessel CPUE, and this is hard to quantify even in a risk context. Recognised that scientists cannot answer accurately because of limited information and they are being asked difficult questions.
- Scientists have been slow to provide appropriate input, and even now (with better structures to aim research) the 2-3y wait for answers to questions that have been posed can be a major problem. What to do while waiting? What guidance/advice could be given?

- What other information needed to improve robustness of CPUE (in cost effective manner – e.g. what improvement by combining CPUE with simple environmental or price measurements (that are mostly available already).
- Need indicators that can be measured on a regular basis and that robustly tell whether the objective is being achieved. Robust indicators, even if very broad or general, of more use than indicators open to various interpretations. Some existing indicators are well based, have clear interpretation, and sufficient information for measurement. These are mostly in the big fisheries (although even for these some indicators are weak). But in many cases the indicators are ‘waffly’ and poorly estimated. Where the indicators are weak management tends to be conservative.
- Stocks that are highly variable naturally present a special problem. The indicators, even if well based and measured, jump about so much that they are difficult to use in management.

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- There is a serious problem of what indicators and performance measures to use in the low valued species, where there is likely never going to be enough money to support detailed analysis.
  - What indicators and how measured? The potential for significant involvement of industry in the data collection in these fisheries should not be under-estimated. Usually they are very keen to help this – if they know what the purpose is, agree with the purpose, and see the information being used for that purpose. Voluntary provision of detailed data from the big fisheries is a key part of calculating indicators for those fisheries, and this could be extended to the smaller fisheries. To be done cost effectively this would need to be done to a general plan (couldn’t afford to develop new approach each time), give robust interpretations, and be easy/cheap to quality control.

#### *F. Experience Elsewhere SWOT*

#### *G. State of Environment Reporting*

### **3. Development and future directions**

- Habitat sustainability indicators being considered for inclusion in stock sustainability indicators. Research report on biological indicators in preparation.

### **4. Implications R&D**



## NORTHERN TERRITORY

### 1. Status and Current Use of Indicators

- Very few fisheries have specifically identified indicators. Most fisheries are in the early stages of development. There is data available to construct indicators of a range of complexities, but this has not been done as yet. The first step is to answer the question what are the most useful indicators and how will they be used. Input and national standards/guidelines on this would be very useful.
  - CPUE is the main data available so comment on the best ways of using it would be particularly useful.
- No general structure for use of sustainability indicators, but used for some species where there is sufficient information for a comprehensive stock assessment available.

### 2. Issues

#### A. National approach

#### B. Terms and Definitions

- Need for standardisation of terminology and approach to ESD. Useful outcomes
  - What is the scope of fisheries management responsibility; what objectives are being sought and balanced? How broad and how far beyond the target/commercial species? What is the role in economic and social issues?
  - What is an acceptable definition/interpretation of ESD that can be used in practical fisheries management. The existing definition is just 'fancy words' without clear meaning, and this is partly why there is confusion and lack of clarity in identifying the scope of management. There is conflict between using and conserving, and what exactly are the parameters of the management role in this. The ESD words may be difficult to change, but this should not stop a re-look at them.
  - With or without a change in the words the key need is to get clear statements of the core objectives and principles, and from these clear guidelines for their practical application (including guidelines for the use of sustainability indicators). This would be the basis of a coherent fisheries approach to ESD.
  - This would need ultimately to be developed and agreed to through the SCFA/MCFFA process. A sequence something like SCFA/MCFFA agree to (1) ESD definitions, (2) core objectives and guiding principles, (3) clear guidelines for use of the objectives and principles. The jurisdictions would then adopt and use these.
  - The approach must (1) be easily understandable, (2) be practical, and this would be helped if approaches built on existing usage/actions/indicators, (3) be kept simple. A useful guide is to approach the guidelines with the journalists Why, What, When, Where, How series of questions, and answer them in plain English.



- This might all sound ‘high minded’ but the lack of clarity and agreed approaches has very real impact ‘on the ground’ in decision making. Examples in the NPF relate to the differences in interpretation and objectives between State and Commonwealth over the consideration of effects on regional development and employment; State directly affected and wants these factors included explicitly, Commonwealth uses an ‘economic efficiency’ objective that is simply not understood and does not seem to relate explicitly to the State objectives.
- The FRDC has a very useful role to play, but this must link with SCFA processes.

#### Definitions

- Indicators are just the things measured.
- Use the demo graph (like the one drawn at the meeting) to explain the terms and their interaction – that was useful.

#### C. *Indicators (biological, economic, social and others) and Broader Issues*

- The social and economic objectives and measures are a particular problem. They are there in ESD (even if some chose to try to deny it), they are very important in the real-world operation of fisheries management, they need to be included in some way, but how? Several issues involved.
  - The issues are complex and not easily grasped or quantified.
  - There is a lack of standard methodology for measuring even some of the ‘simpler’ things (such as the economic value of recreational fishing and commercial fishing, or how to value the economic flow-on effects of commercial fishing), let alone social values.
  - The fisheries managers are not in control of many of the social and economic outcomes. For example what could/should a manager do if employment reduces? This could be due to events in other sectors, inefficient business management or an increase in efficiency of staff use that is desirable from the viewpoint of the individual businesses. What use would an employment indicator be, either to measure an outcome from fisheries management or to guide management decisions? It would be very difficult, probably impossible for fisheries to actually manage the mix of fishing types and levels to achieve some ‘optimum’ across social and economic outcomes, even if this ‘optimum’ could be defined and agreed to.
  - There is a problem dealing across sectors. E.g. mangroves managed as a habitat important to fishing by the Fisheries Dept, but management control becomes very complex if a coastal development is planned/constructed or if a conservation value is declared.
  - A healthy biological stock is required for ESD and the desired social and economic outcomes, so this is the practical focus of fisheries ESD. This should remain a focus, but there is a need to do something more reasoned in the economic and social dimensions of ESD.

- The push for MPAs is at least partly in response to recognition that there is not the knowledge or management control to be really sure that the ecosystem is being protected by the sector specific management approaches (including fisheries). They are a kind insurance policy for achievement of the broader ecological objectives of ESD.
  - MPAs will be an integral part of the future overall management strategy for regions.
  - They could be managed under a shared approach (fisheries and Environmental Departments) or control could be transferred to conservation groups. Strong support for the former, and for inclusion of fisheries (recreational and commercial) in the decision making to ensure practical outcomes and continuation of fishing.
  - Ecosystem indicators are very important and desirable in this. The issues are difficult, especially because natural ecosystem change must be factored into the design and interpretation of ecosystem indicators, but this must be tackled.
  - Very useful to pull together existing experience and options, with a view to developing a fisheries approach that is consistent across Australia and can be put at the highest levels of negotiation.
  - Start with what are the specific core objectives and principles from a fisheries ESD viewpoint. From that what are the indicators of whether or not those objectives and principles are being achieved. This could include tackling the 'how much is enough' questions.
  - The development of indicators in the specific context of MPAs in fisheries ESD could be a useful path for development of indicators relating to the ecosystem objectives of fisheries ESD more generally.
  
- There is a need for a serious effort in explaining the ESD and sustainability indicators approach to managers and industry. Most practicing managers don't even know what the ESD objectives really mean (or about the existence of documents such as the Inter Governmental Agreement on the Environment), and that they do imply a social and economic objectives.
  - Need to publicise the ESD definitions and their practical interpretation for fisheries
  - Need to stress that all of the objectives and guiding principles need to be considered as a package, and it is not adequate to pick and choose from among them
  - Key simple message is we can fish and ensure our children have the same opportunities that we do; from this flow the core objectives and principles.
  - The social and economic objectives in particular need to be clearly explained. How is economic efficiency related to things like the level of enforcement/administration staffing in fishery management agencies, industry profitability, industry employment, direct and indirect economic flow-on benefits from industry (e.g. service industries), and diversity of ownership (e.g. one large vs many small companies, and balance between subsistence vs recreational vs lifestyle commercial vs corporate commercial styles of fishery)? The guidelines would need to make clear what the objectives were, in a fisheries context.

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

- Treatment of uncertainty is a key issue in the development and use of indicators. They usually have to be set with very little background data and information.
  - The kinds of uncertainties and risks associated with particular indicators need to be made clear
  - The intended interpretation and use of indicators need to be made clear when they are introduced. This can cause difficulties if the interpretations need to be changed later as a result of improved understanding, but it is still better to make the intention clear to begin with.

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- A specific practical outcome would be to develop some guidelines about the use of reported commercial catch per unit effort and size composition as indicators. Is CPUE any good, and under what circumstances? What simple things can be done to make it better (can 'standardise' it, but it is a guess whether the standardisation is dealing with the important influences). What can be said if CPUE it is all the data that there is available. Is there some minimum standard, or set of increasingly high standards that will give increasing reliability of use and interpretation.
  - Guidelines need to make it clear that the use of a sustainability indicator is specified up front. What is it meant to be measuring, and how will changes be interpreted? Lack of this clarity causes problems if interpretations are changed and industry does not agree or understand why the change was made (e.g. gemfish: decreasing mean size of fish used to indicate potential over fishing, then when mean size went up it was interpreted as serious over fishing – industry asks how can this be and how they win?).
- The issue of 'one good indicator' or 'many diffuse indicators' is an important one. In practical terms managers and industry are happier with many diffuse indicators; if they are all pointing the same way then there is confidence in the overall interpretation. The lack of faith in the 'one good indicator' is a reflection of the real uncertainty and lack of understanding there is for marine resources and systems – even the extensively studies ones. There is no faith in the ability to pick the one good indicator reliably. So effort should go into developing the suite of easily and cheaply measured diffuse indicators, rather than on the search for the 'silver bullet'.
- In a practical sense there are 2 kinds of used in fisheries.
  - Trend indicators that are essentially the raw data. For example CPUE or size composition of catch. These are simple, cheap, and usually used in the early stages of a fishery when pressures on resource low. This is the approach taken to both developing and small value fisheries, and in NT is backed up by conservative decision making.

- Point indicators that are usually model derived and more complex. For example exploitation rates or MSY. This approach is taken as the demands on the resource intensify and the management questions become more complex.

It would be useful to get a better idea of the cost-benefit and risks associated with these 2 kinds of indicators (recognising that there is a gradient). Where is the simpler approach OK? Are there circumstances where it is robust?

- Are there circumstances where the biological state of the resource can be assumed to be OK because economic failure will occur before biological collapse or damage occurs? It is recognised that if economic failure always occurred first then we would not have any collapsed fishery stocks. But are there identifiable circumstances (e.g. price, capture cost, fishery dependency on target stock, no significant other or unmanaged users) in which economics provide adequate biological protection. If so indicators could focus on tracking those circumstances to ensure that the conditions for economic protection of the resource persisted, supported by only simple/cheap indicators of stock condition.
  - Economic models/analysis must involve industry for reality and ownership. This can sometimes be difficult because of commercial confidentiality or conflict of interest, but without it the analyses are of little use – and often damagingly wrong. This needs to be kept in mind when considering the development and use of economic indicators.
- Single species biological indicators have a long history of experience (although that experience is scattered and needs to be consolidated, even within Australia). The major biological problem is finding sensible indicators for ecosystem condition. The ecosystem is the basis of production, is explicitly part of the ESD objectives, but there are no generally agreed indicators in use for things like biodiversity and food-chain dependencies. Some development of habitat indicators, and indicators relating to endangered species (single species again) and general by-catch, but these generally developed in isolation from the broader ecosystem health question.
  - What is the international experience with ecosystem indicators?
  - There have been some limited efforts to broaden the focus in fisheries management from the target species. However this is usually a reaction to deal with a perceived threat to continued fishing as a result of public or international concern (e.g. by-catch, turtles, seabirds) or protecting the ecological basis of fishery production (e.g. habitats), rather than an initiative of the fishery managers or industry to implement the broader principles of ESD.
  - Ecosystem indicators difficult to develop and get agreement even in a scientific sense, and very difficult politically and practically. Governments have demonstrated that they are not prepared to fund this sort of work as a specific ‘public good’ exercise, and it is left to industry sectors.
- Multispecies fisheries have difficulty even with specifying definitions and indicators of over fishing even just when considering the group of main target species. For example a definition and indicators for over fishing could be provided for each species separately, but what of the group of target species. If for example there are 10 main commercial species, is it acceptable to have 0,1,2... of them individually over fished for some broader

objective, or is it acceptable to over fish all 10 so long as other species are added to the commercial list to replace those that are over fished. What are appropriate objectives and indicators for 'fishing down the food chain' or taking advantage of fishing induced changes in the ecosystem that have some species increase and others decrease in abundance – against a background of natural change in ecosystems. Another difficult issue but one with real 'on the ground' impact that must be addressed.

- There is a need to put the use of indicators in a risk context, where risk relates to the objectives of management. What are the risks or what are the general kinds of risk (i.e. hazards or consequences) associated with the different indicators in different situations. Can this be put in relatively simple (word and relative) terms? As simple to understand table that could be used as a starting position when trying to chose indicators for a given situation (especially situations with little background information).
- Are there some indicators that can be defended on general and qualitative risk terms? Can this defence be sufficient to support choice of indicators in discussions with other Depts and non-fisheries interest groups? (often their own indicators are not well justified anyway, so fisheries should be able to provide something better).
- Management decisions are intentionally conservative when little information is available. Do not believe a 'recipe book' of formulaic answers applicable to every situation would succeed – appropriate indicators must relate to the specific management objectives (ecological, economic and social) and so must be developed

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- Cost recovery is a major impediment to development and use of ecosystem indicators in fisheries.
  - Some user groups pay and some don't, and wider ecosystem interest groups in particular don't.
  - Cost recovery, especially combined with strong industry participation in decision making, leads attention first to the target species and issues very close to the commercial interests of fishing operators.
  - There will always be important questions relating to the issues of direct relevance to the fishery and its operation that can be put up for funding in competition with questions relating to the broader ecosystem. Under these circumstances it is virtually impossible to take an ecosystems view.

#### *F. Experience Elsewhere SWOT*

- What guidelines and experience can be provided from the history of experience, in Australia and elsewhere, about the strengths and weaknesses indicators and their use in management for ESD? One of the best practical outcomes in the short term, of direct benefit to the day-to-day managers, would be to pull together this experience and provide

guidance about strengths and weaknesses of different approaches, and the circumstances in which some indicators would be good/bad. This could provide practical advice about what to do in the absence of detailed information and research (and recognising that both are in increasingly short supply).

- Build on the Fisheries Ecosystem Management (FEM) experience of a few years ago and learn from those mistakes.
  - The FEM was attempting to sell a concept that was OK in principle but that was not seen to be practical or believable.
  - There was no notion of just how the concepts would be connected with practical management.
  - It required cross-jurisdictional agreement without having elements that related to the day-to-day operations of those jurisdictions.
  - We need to be practical in the outcomes and approach. Good way to start on that is to try to harmonise the ESD interpretations and use of indicators across the jurisdictions, but working from what is already there and agreed rather than trying to start a whole new concept.

#### *G. State of Environment Reporting*

- There is a need for fisheries to play a much more active, and leadership, role in the State of Environment Reporting. The recent SOE Core Indicators draft report makes this need very clear. The SOE Core Indicators are very ‘high level’ and still far from pointing to practical measures. Some measures suggested (e.g. total catch) are dangerously oversimplistic; the key missing step is what exactly are the measures being used to indicate and how would changes be interpreted.
- Fisheries assessment and management is far ahead of the SOE thinking in terms of the use of indicators. Fisheries indicators should be used as part of SEO reporting, and this will mean getting broader acceptance of the credibility of fisheries indicators. There should be cost sharing of reporting of these indicators between fisheries and environmental Depts. Fisheries should be driving the development of SEO reporting indicators for aspects of the marine environment that fisheries managers deal with – not having the agenda driven from the environmental dept as at present.

### **3. Development and future directions**

- Will develop indicators as information is accumulated. Indicators will include spawning biomass, catch rate, recruitment, economic return and user satisfaction.

### **4. Implications R&D**

## QUEENSLAND

### 1. Status and Current Use of Indicators

- Management plans structured to explicitly provide objectives, indicators, targets, and triggered management actions. See this as simply meeting modern management standards and practices. Plans are developed by MACs, and QFMA provides general guidelines as to how to structure the plan and use the various components (objectives, targets etc). Strong emphasis on quantifiable performance measures; even if the indicators are approximate they should be specified and the interpreted targets/triggers identified.
- Fishery independent measures have been introduced for spanner crabs (because of ITQ introduction) and taylor (because fishery targets a very limited age range and CPUE does not reflect what is needed for stock assessment).
  
- Socio-economic indicators are useful, and have been used in management decision making. Examples are the decision to introduce a buy-back scheme to set TACs.
  
- Considerable reliance on CPUE. Methods are being developed for detecting and defining trends, including 'technology creep' and it is hoped that these methods will bring some uniformity to interpretation and use of CPUE.
  
- Incorporating explicit objectives, indicators, performance measures and management triggers into management plans. This being done very intentionally and with over-arching guidance for the structure and content of plans.
  - The guidelines call for quantifiable indicators and measures of performance. They may be approximate or general in the first instance, but they need to be included. They can be improved in later iterations of the management plans.
  - The triggered action may 'just' be to generally review the situation, or it might be a specific and proscribed management measure.
  - Proscribed management measures need a strong level of industry and political support, but with that support they don't necessarily need to relate to highly accurate indicators (so long as they are measurable and the interpretation that is applied is clear). For example, the scallop fishery has strong management actions triggered by a CPUE indicator; if CPUE drops to 70% of a base level ¼ of the area of the fishery will be closed, and if it drops to 60% then ¾ will be closed.
  - Indicators and performance measures are used to focus research effort onto relevant measurements.
  
- At present there are no biodiversity indicators used. There is a need for practical indicators and performance measures for this. The pressure from industry for these types of indicators is increasing. There is increasing pressure from the wider community for such indicators.

- Bag limits on trawl bycatch species (i.e. total possession limits) are being introduced to help minimise by-catch and protect biodiversity etc, but there is no indicator for whether this is actually protecting biodiversity or whether there is more dumping of bycatch.
- Indicators used. In terms of appendix 3 of our handout, most fisheries are using target species indicators of type 1 and 2; some use 4, several 5, and snapper uses 7 (based on a dynamic pool model). MSY is used to set a maximum, not a target, catch. Economic indicators of type 4 and 5 are used, especially the use of surveys. QDPI is developing economic indicators for commercial fisheries. Social indicators tend to be things like the community, industry and political support for the management actions.
- The fishing industry is very supportive of the increased development and use of very specific indicators and performance measures, related to management objectives. The industry uses, and wants to increasingly use, these to identify what is really necessary to achieve the agreed management plan and what is not. It wants to use them to stop 'open-ended' or 'arbitrary' demand for management, monitoring and research. They are happy to support what is needed, but want to be sure what is needed. Being explicit about objectives, indicators and performance measures has been found to be a useful way to achieve this.

## 2. Issues

### A. *National Approach*

- The ESD initiative needs a 'good kick along' aimed at improving implementation and making it 'real'. There is a real role for national initiatives in this. The individual jurisdictions are limited in the resources and skills they can bring to bear on the problem; learn from other experiences; develop some uniformity across MACs and jurisdictions.
  - need benchmarking (uniform, consistent, success in usage) approaches across MACs, and for comparison across jurisdictions. Part of the process of learning what works (i.e. need clarity on what done, and what constitutes success and failure to effectively learn).
- SCFA and its processes could be useful when it came to implementing and agreeing to national standards.
- National support for the further development of guidelines for the use of indicators, targets etc would be extremely useful. Focus on what could be included in management plans, and consistency of application – across fisheries within a jurisdiction and across jurisdictions.
- National leadership needed, with input and participation from jurisdictions. Otherwise will get duplication, soft approaches, and distortion of principles by local events.



- The national guidelines should not be too prescriptive, recognising different local conditions. They could be detailed (in that they provide specific suggestions) but those suggestions should not be required to be followed in all cases. There is use in national guidelines; while local events and circumstances are important, everything is not determined locally. Not everything about each fishery is unique. The national approach could suggest
  - What methodology should be used
  - What common patterns of responses are seen (biologically)
  - What indicators have been tried; what has worked and not worked, and why; what has been the experience in other sectors (especially forestry) and overseas?

### *B. Terms and Definitions*

- 1<sup>st</sup> dot point under guiding principles (ie processes to integrate long and short term economic, environmental, social and equity considerations) is extremely important. But note that the level of difficulty is high. The practical question of ‘what would be useful indicators against this principle for the taylor fishery that is shared between the commercial and recreational fisheries’ gave a discussion that focused initially on suitable indicators of process, then recognised that the indicators needed to relate to outcomes as well, and ultimately stopped on the conclusion ‘its difficult isn’t it’.

### *C. Indicators (biological, economic, social and others) and Broader Issues*

- There is increased use of area based management, and there is a need to develop indicators that measure the performance of area based management with respect to the stated objectives of the area based management. Examples of area based management and their objectives are
  - Protection of endangered species
  - Protection of key habitats
  - Protection of spawning stock (e.g. taylor and scallops)
  - MPAs for protecting biodiversity
- Industry is increasingly supportive of area based management, so long as the objectives are clear and performance can be reviewed. Development of improved indicators for this is very important. The existing indicators tend to be weak. The key point is that there need to be clear statements of objectives (e.g. conservation, social, economic) and performance measures for each objective.
- Broader ecological management is very fractionated across state departments, making ecosystem management difficult. QDPI manages habitats and fishery compliance. Dept of Environment and Heritage manages marine parks and threatened/endangered species. Dept of Natural Resources manages freshwater water quality. QFMA manages fisheries in marine and freshwater. Development of guidelines for the identification and use of

indicators and performance measures would help communication and coherent management of the marine and freshwater ecosystems and fisheries.

- Need to focus holistically. Specifically to include social and economic issues as well as ecological. There is a need for statements of broad and high level objectives for each of the 3 outcome areas, as well as more specific suggestions as to potentially useful indicators and performance measures. Need to move away from ‘waffly’ word that cannot be turned into measurable objectives and performance indicators. Process and outcome benchmarking essential.
- Need to recognise that ESD transcends industry sectors, and that ESD interpretations should be consistent across sectors. This is not the case at present (probably because the NSESD was developed on a sector by sector basis and that jurisdictional differences in interpretation and emphasis were subsequently overlaid on these sectoral differences. There should be some indicators and performance measures for ESD that cross sectors (especially very closely related sectors such as recreational and commercial fishing, but also for sectors such as fisheries and aquaculture).
  - Properly developed and agreed these interpretations, indicators and performance measures could provide the common language across sectors that is presently absent (or at least very weak) when disputes erupt or there is need to negotiate agreed outcomes.

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- What indicators are useful where data is limited – eg recreational fishing and low value fisheries. What use can be made of fishery independent surveys (eg of recreational fishing)
- Most jurisdictions make extensive use of CPUE, sometimes additional information to supporting interpretation.
  - what is robust and reliable
  - when is it necessary to use fishery independent methods (Queensland's approach is when fisheries move to ITQ or when there is a major change in markets).
  - In some cases the recreational fishery can provide a more stable and interpretable CPUE than the commercial fishery, particularly if the recreational sector provides the greater catch. So in some cases it is useful to monitor the recreational fishery rather than the commercial fishery to avoid the effects of changes in product price and some of the fast changes in technology?
  - How to deal with technology creep and its effects on CPUE. What can be quantified? What should be monitored? What is the risk?

- Indicators are management tools. They must be understandable to managers and industry. They must be practical within the management system.
- There is a need to benchmark (both the process and ‘on the ground’ outcomes).
- It would be very useful to have a standard software package to do basic information processing (e.g. CPUE) and to suggest/test various common indicators or performance measures. The software should include tests for robustness against commonly considered concerns (e.g. climate change, technology creep). The results could be used as a first step, to begin discussion and selection of indicators, targets and performance measures. The jurisdictions could use them if they met jurisdictional needs. The output of the software package would be input to MAC and other management decision processes. A key point in this is that the software would link specifically to the data from the fishery and look at measurable indicators – not like the qualitative ‘tick the box’ report card approach. The software package would be used mainly to start and help build constructive debate. It would not provide an assessment, an evaluation of actual management performance or proscribed indicators/actions. A high level of detail would be required in the prospective indicators/performance measures to be useful in development of management plan (i.e. they have to be specific indicators and measures, not generalities. But at the same time these must be seen as some options to consider, and perhaps chose from, rather than prescriptions.
  - The software package would also be of potential use in tertiary and other training for fisheries scientists and managers, and so contribute to a longer term increase in the quality of Australian fisheries management.
- There was strong support for the precautionary principle as stated in the IGAE, especially as applied through an assessment of the ‘risk weighted consequences of all options’. This should be emphasised in the use of indicators and performance measures in decision making.

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- There is a ‘community service obligation’ (= public good obligation) for governments to fund assessment activities relating to the interests of groups other than commercial fisheries groups where these other interests cannot effectively be levied (e.g. recreational fishing, tourism, some conservation interests). Without that support it will be extremely difficult or impossible to develop and apply sustainability criteria and performance measures for many low valued and recreational/tourism uses of marine resources.

#### *F. Experience Elsewhere SWOT*

#### *G. State of Environment Reporting*

- Want consistency and transparency in National State of the Environment Reporting. Fisheries indicators should be used and valued in this reporting.

**3. Development and future directions****4. Implications R&D**

## NEW SOUTH WALES

### 1. Status and Current Use of Indicators

- The NSW legislation sets a need to be aware of the economic viability of fisheries. Simple indicators could be developed and used (e.g. volume, value of the catch and cost of the catch, license price). Most of these things are measured in some way now, but not used in any formal indices. There is scope to develop these indicators, and the cost of implementation would be relatively little because the information is already collected. But there is definitely a need for indicators relating to economic viability and performance. Industry is concerned that any such development might result in additional resource rental and other costs.
- NSW has no specific need or interest in a measure of economic efficiency, and in fact takes a broader view of economic issues.
- Employment and regional development is important, but it is lower in the hierarchy of indicators than the conservation and economic viability issues. Ultimately this is dealt with through the political process, and so there is no emphasis on the development of indicators. Regional employment and development are extremely important at the political/policy level, rather than at the management level.
- NSW is starting to monitor habitats through the use of surveys. This is intended to be to measure long term changes, and the surveys may only be repeated on 5-10y intervals.
  - Range of indicators used depending on state of knowledge – catch stability, CPUE trends, standardised CPUE trends, size/age composition, fishery independent CPUE, changes in estimated stock size, estimated probability of change in abundance under different management strategies.

### 2. Issues

#### A. National Approach

- It would be extremely useful to have a defining set of reasonable standards, that SCFA could agree to, and that would set out what it is reasonable to expect of ESD in a fisheries management context. This would need to contain sufficient options and flexibility to cover the widely differing situations and fisheries both between and within jurisdictions. But it would be useful to have something that helped limit the ‘open ended’ nature of ESD and provided guidance to MACs as to what were reasonable standards and measures. The value of such indicators and standards in public debate is very great. At present many of the selections are arbitrary and not particularly defensible. NSESD and IGAE set out broad ESD goals, but these need interpretation in a practical management plan and consultation group context.

- Supportive of access to a useful set of ‘standard performance measures’ that the jurisdiction can choose from. What is needed is a basic toolbox to support the management consultation groups (i.e. MACs). This should include:
  - A list of all the indicators used, or that could be used.
  - Descriptions and suggestions of indicators, targets and management trigger points relating to ESD objectives. This should be provided in a form that is useful for MACs in working out what to put into the various ‘boxes’ in a management plan.
  - When and why particular indicators should, or should not, be used. What information is needed to use them.
  - What are the reasonable interpretations for the broader ESD objectives and what are appropriate indicators (i.e. what is it reasonable to include beyond the target species – the ecosystem, social and economic objectives in particular).

### *B. Terms and Definitions*

- The definitions of ESD provided by NSESD are dated. For example the second dot point in the guiding principles relates to micro-economic reform – this is no longer thought highly of and should be deleted. Also there is no mention of several initiatives that have become important in recent years, such as regulatory reform, national competition policy and the emphasis on education/consultation to achieve desired outcomes.
- The definitions of indicators provided match the use of the terms in NSW

### *C. Indicators (biological, economic, social and others) and Broader Issues*

- There is a need to make it clear that ESD is the big picture. It is more than just the target species. It included impacts and effects on non-target species, but with this comes the need to be clear just what is meant by this, what should be measured, and what use would the measurements be put to? There is a great need to develop indicators relating to the broader ecosystem.
- ESD should not be limited to just a fisheries context. ESD goes well beyond fisheries management and targets/indicators looked at only in a fisheries context alone may not achieve ESD. But many things are beyond fishery management control and perhaps even human control. ESD and Sustainability indicators must have some way of dealing with this potential lack of control and natural variability – the impact of non-fisheries human activities and natural environmental changes. Perhaps some clear statements about the limits of the indicators and management could deal with this. In any event, we do need to approach the problem, and these difficulties can not be used to stop the development and use of Sustainability indicators.

- There is a need to have indicators for environmental conditions, even if they are not within the power of fishery managers to control them. They are useful in lobbying other users of the marine environment and so protecting the interests of fisheries. Also they are useful to ensure that management actions are not unnecessarily triggered by environmental fluctuations (e.g. CPUE declines because water body moves fish offshore and beyond the reach of fishing).
- There needs to be a greater consistency in the use of ESD across industry sectors.
- There is essential conflict, or at least tension, between conservation and use/development. There is a balance or trade-off between these objectives. For example the IGAE emphasises that management reactions need to be appropriate and affordable. The idea of continuous improvement is not necessary is not necessarily right – in some cases maintenance of the status quo is the objective. The emphasis on improvement in the ESD definition is not appropriate.
- The simple ‘mantra’ of sustainability is not enough. The idea of maximum sustainable yield may be out of favour but there is a need to say something about the level at which sustainability is achieved. A fishery can be sustainable at very low population levels of the target species. What is desirable? What is appropriate in a multispecies fishery or in a sequential fishdown? The balance of species may change, but what is acceptable? There is a need to address the issue of level.
  - Practical fisheries management experience indicates that indicators for mixed species must be able to accept significant localised over-exploitation of some species. This is what is done. Fishing a community is not limited by the least productive species. Perhaps there is a need for guidelines to ensure that the situation is reviewed more broadly that the localised area – is the species still OK in some other locations? Is this where MPAs fit in? Indicators could and should be developed.
- How do the Sustainability indicators etc relate to the definitions and indicators for other important decision processes – especially endangered/threatened species criteria and definitions of over fishing? Where do these reference points cross over, and how do they relate to one another. The development of a reasonable approach to ESD in fisheries should fit in with these other existing definitions and methods, and ideally would provide an overarching framework where the hierarchy all fitted together.

#### *D. Use and Selection*

##### *Reliability/Uncertainty/Expectations*

- There are some big ‘buts’ in all of this. Two major potential problems are (1) the cost of implementation could be very high if lots of things need monitoring and analysing, and (2) the standards could be unattainably high. There is a possibility that ESD standards could raise the level of expectation as to what managers and the industry will provide and achieve, and that these standards will just serve to provide the public and conservation

groups with more ammunition to use in their attacks on fisheries. The standards need to be practical.

#### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Past approaches related to ES-like topics (e.g. Large Marine Ecosystems, Fisheries Ecosystem Management, the SCFA indicators review, the SCFA report card) have not generated very useful outcomes. Not necessarily a reason to be negative. It is an evolutionary process. And the time is right now for some movement – particularly because of the increasing frequency of questions (from the general public, interest groups, Government Departments, and legal challenges) that relate to how performance is measured.
  - Earlier approaches were either more ‘visionary generality’ (eg FEM) or very superficial (e.g. the report card).
  - The toolbox needs to relate specifically to what goes into management plans.
  - The toolbox should be useable in management.
  - The toolbox should be useable in research planning processes and funding allocation (including by FRDC) by indicating what is needed to support the use of the indicators selected for use in the management plan.
- Practical take-up is a key issue. What is workable? What are the tools that would make particular approaches (i.e. indicators, targets and trigger points) workable? The toolbox must go beyond just the concepts, and go to what would actually be used. There is a need to be able to explain simply and clearly why a particular cost is justified. The indicators must be able to pass the triple test any MAC will apply - ‘is this value for money’, is it understandable, it is acceptable to industry.
- The linkage and balance between the information base available for development of indicators and the application of precaution in decision making needs to be emphasised. Use of the lowest common denominator, ‘poor mans indicator’, needs to be balanced by use of precautionary management decisions/triggers.
- There is a need to ensure that it is clear that while indicators can perhaps be developed and dealt with outside the fishery management process, identification of targets and trigger points are management decisions.
- It could be useful to try to develop the hierarchy of objectives. This in practice exists, but is not explicit. What are the over-riding objectives? There is a biological bottom line in fishery decision making. Conservation is the key thing in the end, and will over-ride economic and social issues under specific circumstances. This is well understood (although not explicit) when dealing with the target species. What would be the parallel situation for broader ESD objectives? What is the hierarchy of objectives for them?
- Indicators important for accountability and transparency in decision making. Need real practical outcomes that can be understood and implemented without ambiguity.



Emphasise that useful indicators are objective specific, so not likely that one indicator will serve all. Need for industry and management agreement to ensure that trigger points related to use of indicators are acted upon appropriately (rather than just calling into question the validity of the indicator or trigger point). Recognise the importance of use of indicators, but also the high cost of their abuse and inappropriate use.

*E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- The sorts of indicators used will depend on the value of the fishery. What are the ‘poor mans’ versions of the indicators? When and how should they be used? What would be gained from moving to intermediate or high cost indicators?

*F. Experience Elsewhere SWOT*

- What has the NZ experience been? They have had a focus on indicators and ecosystem objectives for some time – it does not seem to have hurt the industry there, but is it achieving anything for the ecosystems etc? What has been the US experience with the use of over fishing definitions.

*G. State of Environment Reporting*

### **3. Development and future directions**

- Embarking on management plans for main commercial species and endangered species. Developing indicators for carrying capacity and food web supporting fisheries and aquaculture. Developing indicators based on size of spawning stock compared to unfished level. Developing an index of biotic diversity for application to freshwater systems.
- Need for a compilation of all reasonable indicators, their information requirements and the circumstances where they are appropriate/inappropriate; what indicators used in collapsed fisheries, and why did they failed; what indicators used in sustained fisheries, and why successful. Need for indicators for impacts of trawling, food-webs and non-target/non-retained species (incl. Benthic invertebrates).

### **4. Implications R&D**

## VICTORIA

### 1. Status and Current Use of Indicators

- The science-management-industry interface is being improved, and that is a key step in the development of meaningful indicators. Fisheries Acts are being redeveloped in ways that greatly help setting targets and using indicators/triggers. The Acts have gone from ‘industry can do anything except when told to stop’ to ‘industry can do nothing except what is explicitly allowed’ to the setting of objectives, targets and performance measures and use of these to judge all management measures. Specific management plans are now the key tool for management, and Acts are increasingly in plain English and prescriptive about the need for plans to contain objectives, indicators and decision rules.
- Social and economic indicators
  - a data base of economic performance is being developed
  - industry is prepared to deal with biological indicators, but does not want economics looked at. There are too many conflicts of interest and risks with the taxation office or other government departments.
  - But economic performance is important, and there is a need to know what it is.
  - Economic/social indicators should be more useful to industry in dealing with other sectors (e.g. commercial vs recreational fishing) than they are. In part this is because the indicators are so weak and unrealistic.
  - Transfer or good-will prices on licenses are a useful economic indicator. Also % contribution to a regional economy or employment.
- Objectives, targets and indicators in management plans have helped to get stock assessment groups to focus better, and to provide better reports.
- Previous efforts at Fisheries Ecosystem Management, fisheries report cards etc failed, mainly because there was no general ownership. A few devotees were in evidence, but nothing beyond that. These approaches did not address, or relate to, practical use and implementation.
  - The present approach is being built from the bottom up, and that is essential for success and pick-up.
  - Support from SCFA is not itself sufficient for success (FEM and the report card approach was agreed by SCFA). What is needed is support, understanding and ownership at the grass roots level (i.e. the practical level of management). The approach needs to meaningfully link to the construction of fishery management plans.
- Dealing sequentially with more important resources, where indicators are being developed by the stock assessment groups. Reports on 16 fisheries groups, and from a separate habitat assessment group.

## 2. Issues

### A. *National Approach*

- Want a summary of what is done across jurisdictions and across fisheries within jurisdictions, so as to avoid duplication and get consistency. Is there a small set of high level principles and indicators that can be identified as being useful/appropriate for fisheries of various categories (e.g. fish, gastropod, crustaceans – in fact what are the useful categories?). Can we use this to start to develop a common approach.

### B. *Terms and Definitions*

- Want definitions of terms and synonyms, and how they should be used. The use should include how they should fit into the management plans and strategies.

### C. *Indicators (biological, economic, social and others) and Broader Issues*

- Fisheries Victoria does not control habitats, but still wish to develop indicators for habitat so that FV can act as an advocate for healthy habitats (e.g. the biggest threat to many freshwater fish populations is the dairy industry). This also applies to ocean outfalls and water quality.
- Most fish stocks are very resilient to withdrawals (harvest) from the population. Habitat destruction or pollution usually does the serious damage. This needs to be dealt with specifically. There is a need for development of environmental indicators for these issues. For example, how much habitat is enough (1) for the species, (2) for fisheries production, (3) for the ecosystem/biodiversity.
- Spatial management is an area where indicators should be better developed.
  - The whole coast should be an MPA underpinned by a management plan with appropriate objectives, indicators and performance measures. Fisheries should ensure that it has appropriate measures developed to allow continued sustainable catching.
  - The present approach is inconsistent, in that it adds MPAs across the top of fisheries that are legislatively required to be sustainable. The assumption is that the management is so poor that the MPA insurance is needed. There are two issues, the target species and other species, and indicators capable of demonstrating that these are OK should be developed.
  - There is a need for pristine areas, but objectives and indicators should also be developed for them and their performance assessed.
  - Fisheries should use MPAs constructively to learn about how better to sustainably manage fisheries and the impacts of non-fisheries uses.

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

- There needs to be some common sense in the use of indicators. We do not fully understand fisheries or their resources, and so the indicators are not always going to be the right ones. We need to be prepared for the situation in which the indicators are all fine but the industry is going broke, or in which the indicators are poor but the industry sees no problem. The ‘maximum sustainable whinge’ as an indicator would be a useful one.
- The lack of real understanding about how ecosystems and populations ‘work’ needs to be put up-front in any guidelines sustainability indicators and their use. Development will be by evolution. Expectations in the short term need to be realistic.

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Want some useful guidance for conservation and environmental indicators (ie more than just the target stock). And these indicators need to be quantitative. Indicators for habitat and environmental quality are particular needs.
- What is the ‘power’ of various approaches to indicators?
  - Should there be one or many; what is the trade-off?
  - Where do ‘simplistic’ or ‘easy way out’ indicators fit into the scheme? That is indicators that are easy, tempting, but weak (eg CPUE)
  - There is a need for understanding to reliably identify indicators; we should not just guess at them. But what can be done while that understanding is being obtained, or where it will probably never be achieved because of the limited scientific effort available.
- Indicators and triggers can be based on limited data, and even just common sense. This can still be useful, and the formal identification of these indicators does improve transparency, help support monitoring, and helps ensure that at least change is noticed.
- Industry has major concerns to ensure that triggers are reasonable (=understandable and justifiable). Industry is prepared to work with triggers, but needs to understand what they are for and be convinced they will work and not cause unnecessary pain.
- Indicators need to be scaled to the available data – complex/confident indicators where there is good data, and otherwise simple/uncertain indicators. Indicators are a management tool, and guidelines for their use should reflect this. The management context is part of the puzzle. If simple/uncertain indicators are used they should be linked to precautionary management. Indicators and trigger points can and should be reviewed.
  - Limit reference points should be set at some biological ‘bottom line’, and should not be changed much.
  - Triggers do need to trigger a response, and this should be explicit. The response need not be draconian, and it may be slow or staged, but it needs to be identified. (eg the

Victorian rock lobster is below the target of 25% virgin spawning stock, the recovery strategy may take 10y, but the triggered action was to develop and track a recovery strategy.) There is definitely a need for goal and performance measures.

- Fishing Acts are being reviewed to meet national competition policy. This will require demonstration of the benefits of every regulation, and demonstration that every regulation is not anti-competitive.
  - This will place great emphasis on the appropriate use of indicators and targets that encapsulate the objectives fully.
  - This will require explicit environmental indicators to allow the use of gear restrictions (eg restriction on the use of dynamite fishing), and the case will have to be made against those indicators.
- Stocks are sustainable at many levels, including some very low levels. What is the target and why?
    - This is a management decision.
    - Perhaps the Minimum Biologically Acceptable Level (MBAL) approach should be used, and above that level leave to economics.
    - What are the bounds of resilience, beyond which systems/stocks are permanently changed or very slow to alter?
  - Indicators must be affordable, achievable and agreeable in the context of fisheries management (i.e. industry + managers + scientists) to succeed. Otherwise they will be ignored.
  - Indicators are used to indicate a change in state. Need good understanding of resource dynamics before indicators can be reliably used. A wide spectrum of indicators are available for use – from simple data to the outputs of risk assessments. Economic and biological indicators are needed.

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

#### *F. Experience Elsewhere SWOT*

- Want to know what has been the experience elsewhere with indicators and reference points. For example CPUE in the Victorian abalone fishery is a poor stock indicator because divers stop work at a lower density threshold. What has worked/not worked, and why, for:
  - Target stocks
  - Non-target species
  - Broader environmental issues
  - Habitats

### *G. State of Environment Reporting*

#### **3. Development and future directions**

- Stock assessments being improved.
- Need intensive development of indicators on selected species, where detailed information is available, in the hope that outputs can be extrapolated to other similar resources.

#### **4. Implications R&D**

## TASMANIA

### 1. Status and Current Use of Indicators

- Use of performance measures and triggers in management plans
  - Use of triggers and performance indicators has been very useful in focusing debate on key management objectives and issues. For example there have been assessments available for school shark since 1985, but there was no agreement and little progress in management. The recent focus on targets, thresholds and harvest strategies has resulted in significant progress. There is now agreement to rebuild the stock to a specific level over a given time frame with a certain probability, measured in an agreed way. This has helped clarify and formalize management objectives and strategies.
  - Important to clarify what performance indicators can and can't tell you. For example CPUE might be a poor index of abundance even if the data themselves are accurate. There is also some danger in the current public service fascination with performance measurement, if indicators are chosen without considering what they really indicate. It was noted that performance indicators are used routinely in the commercial world, but generally for well defined and easily measured quantities such as profit. Can robust indicators be found for sustainability?
  - In some ways, the need for performance indicators was driving the clarification of management objectives, rather than the other way around. This was seen as a good thing as it allowed grass roots debate about concepts, which were more easily understood.
  
- Reference to the "hierarchy" of indicators in the appendix supplied prior to the interview.
  - Lobsters are at level 7 (ie risk assessment)
  - Abalone are at level 5
  - Scalefish are at levels 1 and 2
  - Level depends on information and value of the fishery. An incremental approach is being adopted.
  - Move to minimal level of monitoring for all fisheries.
  - Generally insufficient funds to ensure that even catch monitoring is done well.
  
- Precautionary approach
  - Scalefish plan is precautionary given lack of information (limit entry).
  - Question raised about inverting the precautionary approach: if a fishery is small and not of high value, a threat to the stocks is unlikely?
  
- Socio-economic indicators
  - Need to recognise community needs such as regional employment. The level of exploitation might increase with higher unemployment.
  - A formal socioeconomic survey has been undertaken for rock lobster. Concluded that you can't even detect large changes.
  - There have been attempts to measure profitability for lobsters and abalone. In the latter case this was with the aim of collecting resource rents. It is expensive to get the

information and there are insufficient contrasts in the data. Also influenced by changes in exchange rates. Have concluded it is difficult to measure socio-economic performance.

## 2. Issues

### A. *National Approach*

- Need to take note of previous work in this area
- Noted the SCFA paper on sustainability indicators, and that SC were keen to follow up to develop some standardization across jurisdictions. There was clearly a need for common language and definitions, but there were difficulties with standardized reporting and measures.
  
- Need to take account of local issues and needs
  - The evolution of the use of trigger points, targets and performance indicators has been driven largely by local needs, rather than by the desire to report at a national level. However it was recognized that jurisdictions were having some difficulties in developing and applying these concepts, even for target species let alone broader ESD issues.
  - There were doubts expressed about the (political) will to develop national consistency in this area.
  - There is a lack of experience and expertise at the local level, particularly at the advisory committee level, but also among some managers.
  - There was agreement on the need for an “easy read” document which outlines the concepts (without resort to mathematics!), and discusses such issues as data requirements, what certain indicators can and can’t tell you, pitfalls, and specific issues such as interpretation and use of CPUE.

### B. *Terms and Definitions*

- Definitions
  - Concern was expressed about the Australian definition of ESD, which includes reference to improving the quality of life. This was seen to be value laden.
  - Similar reservations were expressed about the term “equity”.
  - There were also reservations about expressions like “maintenance of essential ecological processes”. What did this mean, how could it be measured, what sorts of temporal and spatial scales were involved?
  - The definition of sustainability indicator does not refer to sustainability.
  - Need to include definition and description of “trigger point”.
  - To the section on guiding principles, it should be added that some guiding principles may be mutually inconsistent, and that judgment and interpretation were needed. There was concern about slavish adherence to one or another aspect.



- The FAO guidelines on the precautionary approach were noted. This calls for “sensible exploitation”.

### *C. Indicators (biological, economic, social and others) and Broader Issues*

- Attempts to monitor habitat and non-target species
  - Have used monitoring within reserves and contrasts inside and outside reserves. There is a cooperative approach between TAFI, Fisheries and Environment. The use of spatial contrast is seen as preferable to temporal contrasts which are much harder to interpret. However the cost of collecting the data is still an issue, and there is no current strategy for responding to the data collected.
- There is a need to monitor predators on the resources, such as seals, killer whales, and sharks. Their effects on the resource may be more significant than the fishery. A sustainability indicator for the fish resources may be population levels of key predators. This may be a good example for cross-sectoral interpretations of ESD.
- Need to focus on sustainability of fishermen as well as fish.
  - Useful to have basic information on price and quantity over time. Cost information harder to get and less important.
- Plea for “realistic” approach in terms of information available and cost of getting it.
- From FRAB point of view, indicators for assessing and evaluating why proposals are needed would be useful.

### *D. Use and Selection*

#### Reliability/Uncertainty/Expectations

- Need for realistic expectations
  - Concern was expressed about unrealistic expectations arising from initiatives like fisheries ecosystem management (FEM). There are people in EA and the conservation movement who expect full implementation, with reporting on performance indicators. There are some indicators available for some things but they fall far short of FEM objectives. Most current indicators are stock specific, and even these are constrained by data and interpretation.
- One promising area for development outside the target species focus is in the area of marine reserves. There is some basis for development of indicators in this area, but they will still fall far short of FEM. One of the primary objectives for MPAs was to understand the functioning of the system without intervention, not to save fisheries.

- There was concern about misuse of indicators by industry detractors. Some indicators were more robust than others, but it was difficult for “non-technical” people to know the difference.
- It was also noted that there was a considerable level of scepticism in industry about information from Government on stock levels. There is an education and communication task to convince people that indicators are appropriate, accurate and relevant. Even for Tasmanian rock lobster, where there was arguably a very sound and thorough assessment on the basis of fairly comprehensive data, industry took a lot of convincing. The problem in going beyond the single species focus would likely be much worse.
- Concern that ESD was enshrined in legislation without the technical ability to back it up. This left the management process wide open to legal challenges.

#### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Sustainability indicators
  - The notion of a single robust indicator for sustainability does not seem feasible. We can only really measure some components of it. It will be a long time before we can even deal with interactions between species.
  - There are many judgments that have to be made in interpreting indicators. For example catches or abundance indices can decline for reasons other than over fishing. There are examples of major changes in species abundance or species composition in pelagic systems that are clearly unrelated to fishing.
  - It was noted that the inter governmental agreement on the environment (IGAE), and most recent fisheries acts, provide the scope to move management plans and associated indicators in the direction of wider ecological concerns.
  - For multispecies fisheries (such as scalefish), looking at indicators of ratios of species in catch. Possible trigger points if species disappear entirely from the catch.
  - For rock lobster, there was good data and clear targets at the species level. The next step might be to look at sea urchins or habitat quality.
  - While there was support for use of indicators, there were reservations about use of reference points such as  $F_{0.1}$ ,  $20\%B_0$ ,  $10\%$  MPA etc.

#### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

#### *F. Experience Elsewhere SWOT*

- Sharing information and experience
  - Fairly extensive already through SCFA, fishery managers meetings, and special events like the FAO meeting next year.
  - The need is to get the people at the coal face – MAC members and decision makers – together with those who are already implementing these approaches and who have

the practical experience. Need to get down to the level of; what is an appropriate target or threshold for egg production; what is an appropriate threshold for %B<sub>0</sub>; is it the same for prawns and orange roughy?

- Useful experience from other jurisdictions or overseas on broader indicators for socioeconomic and ecosystem aspects of ESD.
- Analysis of why the SCFA “report card” approach did not work.

#### *G. State of Environment Reporting*

- More concerned with operational aspects at management plan level than for national reporting.

### **3. Development and future directions**

### **4. Implications R&D**

## COMMONWEALTH

### 1. Status and Current Use of Indicators

- AFMA management plans contain the scope for specifying performance criteria, indicators and measures. So the process is already in place to encompass Sustainability indicators. All plans at least specify performance criteria. A few define how performance against them will be measured. Also annual reports that provide these measures are produced for each fishery. All this is already provided, but an issue seems to be who does the measuring – AFMA, DPIE, ANAO?
- ANAO and others are measuring fishery management performance using their interpretations of what ESD and other policy/legislative objectives mean. There is a need for ‘bottom up’ development of a set of agreed interpretations and indicators for use in reporting and to lead the interpretations of other groups.
- Explicit sustainability indicators applied to some species (SBT, orange roughy, southern shark, eastern gemfish), usually based on reference points (such as the proportion of the initial spawning biomass) and linked to management actions such as change in the TAC or fishing effort. Other indicators use catch rate and size/age of the catch. Paper to SCFA on general present approaches, including the Pressure/State/Response model.
- Management subcommittee of SCFA agreement to include sustainability indicators in management plans, but no common approach given different legislative approaches and objectives (indicators need to relate to objectives). Lack of agreement on terminology, what indicators are, and how they should be measured. SCFA paper on sustainability indicators provided to assist common understanding.

### 2. Issues

#### A. National Approach

- There is a need for national agreement on the definitions and usage of terms related to Sustainability indicators and performance measures etc.
- The definitions provided are OK, except for
  - The term sustainability indicator is confusing. Where does sustainability fit in? Is it just an indicator (i.e. something measured), is it something measured that might be useful in evaluating sustainability, or is it a performance measure (i.e. a measure that comes from how well a target or objective is being achieved)
- SCFA has produced several agreed approaches to ESD reporting and achievement (i.e. the ESD report card, the paper on use of sustainability indicators and Fisheries Ecosystem

Management), but they have not really been used by anybody despite their national development and agreement. The problems were:

- The previous attempts were based on performance measures and indicators that were too qualitative. The assessments given under them were very subjective and basically a matter of opinion, and so they had no value in conflict situations or broad credibility. There is a need for quantitative and measurable performance measures and indicators.
  - The questions/indicators were too high level and general, and so it was too easy to provide answers that were also very high level and general but that were not useful.
  - The approaches in general were too academic/theoretical and not practical. They were top-down driven rather than bottom-up. They did not connect with the practical level of decision making and management planning.
- There is interest and desire for national standard approaches and to have these link to practical management plans and decision making. But the practical level is very strongly driven by the details of the specific fishery. How then can a general approach be developed? What, if anything, can be usefully developed that is both generic and practical/realistic in particular cases? That is the challenge and still an open question.
  - It would be useful to develop national standards for sustainability indicators, but all of the jurisdictions would need to agree and to get beyond their petty sniping. There is a need for ownership, and enough control that there is little fear of the process giving unreasonable outcomes.
    - What is driving the ESD policy and push in each jurisdiction, and how does that link to the development of national standards?
    - Different jurisdictions emphasise different aspects of ESD and have different information bases. What is the common thread to underpin national standards?
    - The issue is too important for progress to be overcome by petty divisions and ‘having a dig’ at one another whenever the opportunity arises.

## *B. Terms and Definitions*

## *C. Indicators (biological, economic, social and others) and Broader Issues*

- ESD is a huge concept and no one agency has the control needed to achieve all of its facets. ESD is all encompassing at the level of national policy and cross-sectoral decision making. We need to be clear on what constitute reasonable boundaries for fisheries.
  - It may be useful to have indicators for aspects of ESD that are not fully (or even partially) controlled by fisheries management, but these are ‘non-core’ and would need careful justification of their use and value to pass the cost-benefit test.
  - The AFMA Act focuses on ESD and economic efficiency (among other things). A recent High Court judgement has interpreted ESD in this context as relating only to ecological aspects (i.e. excluding social and economic issues), but this is thought to be an interpretation that misses the spirit of ESD and so social and economic issues are still recognised by AFMA.

- Social issues and their importance/impact are a fact of life, and they cannot be ignored. The political mechanism (including ministerial directive) is always there to allow the expression of these issues if the management procedure fails to address them adequately or major irreconcilable differences emerge. (eg The dispute over the quota level for jack mackerel, which hinged on whether to give priority to regional employment or scientific estimates of sustainable fishing levels, and the dispute between commercial and recreational/charter sectors over access to striped marlin catches.)
- AFMA takes a staged or hierarchical view of ESD. By and large:
  - The first stage is stock assessments and measuring the effects of fishing on the target species. This is a key need, as failure in this would be regarded as a failure in core business.
  - Then come economic effects.
  - Then come other effects.
  - This is not totally fixed as a priority list, and alterations are made according to the management/policy issues that arise. Non-target species, habitats ecosystem and by-catch issues will be included on a priority basis as they become significantly important management/policy issues. The level of effort is based on the perceived risk and cost/benefit.
- Ecosystem indicators should include things that impact on fisheries (e.g. oceanographic environment, the size of seal populations etc). These could be useful in supporting fishery assessments and decision making (e.g. the effects of oceanographic conditions on recruitment or catch rate) and/or in helping sensible decision making at cross-sectoral levels (e.g. the allocation of fish catch between the fishery and the charismatic megafauna).
- There is considerable concern, and lack of support, in parts of industry for the extension of indicators to cover broad concepts such as ecosystem integrity' because of the considerable potential for these indicators to reflect negatively on the industry and for the indicators to be misinterpreted. Outside of fisheries management agencies, where the level of understanding about fisheries matters and the indicators themselves is high, indicators may hinder rather than help. This view is essentially that 'the environmental argument is not a rational one and you can't win even if your indicators are good'. However, different parts of the industry hold different views on this matter, and in particular find indicators useful in identifying and attributing environmental damage done to the marine environment by other sectors, in projecting a 'clean green' product image, in educating the public about fisheries, and to identify and manage threats to sustainability of fishing operations.
- Key questions are what are useful indicators; what interpretation should be placed on them; how exactly would they be used (including in education)?
- Sustainable fisheries need sound policy (ie an Oceans Policy), sound decisions, and sound process. The impediments are knowledge, money and time. Cost recovery per se is not a major impediment; the AFMA MAC process is providing balanced decisions on the

allocation of resources between target and non-target species, with considerable expenditure on non-target species.

#### *D. Use and Selection*

##### Reliability/Uncertainty/Expectations

- There is a need to develop methods and indicators that will work in situations where information is lacking. What is a reasonable lowest common denominator? What are reasonable but simple/easy indicators of ecosystem integrity?
  - Is there value in monitoring prey species via the fisheries that take them either as target or bycatch?
  - Is there value in monitoring water quality?
- There is a need to get some sensible debate and guidelines on the acceptable level of change to ecosystems. Agriculture only exists because of the clearing of forests, and at some level a similar concept should apply to fisheries. Some clear guidelines, and associated indicators, would allow fisheries to report on their impact in a context of acceptable change rather than an expectation of no impact. This would be very useful both for decision making within fishery management and for influencing outside groups. AFMA wants to be, and be seen to be, a responsible manager; similarly the industry wants to be, and be seen to be, a responsible industry.

##### Selection/Use/Risks/One vs Multiple Indicators /Simple and Effective

- Who are these sustainability measures and indicators really for? And linked to that is who will/should fund the development and measurement of indicators? Overall, indicators are a tool for measurement of progress toward management goals. Two categories of use were recognised:
  - Use internal to the fisheries agencies
  - External reporting, 3<sup>rd</sup> party audits, and influencing other decision makers. In the latter case there is a need to be careful that the indicators are understood by those other users and that are not open to misinterpretation/misuse. Use of indicators in the latter case requires an associated effort in education/explanation.
- The BRS has done work on a framework for assessment of ESD. How do sustainability indicators fit into this framework? What extra, if anything, is needed and how would it be used?
- Given uncertainty it is risky to rely on a single indicator; would like to see development of a broad range of indicators. Use of a broad range of indicators is likely to give more robust management even if the measurement of some individual indicators are not precise (use of several imprecise indicators will be more robust than use of a single precise indicator).

### *E. Cost Recovery/Target and Non-target Fishery/Rich and Poor Fishery*

- A major constraint from the real world is that the resources available for management are limited, and so it is not possible to do everything that might be desirable and it is necessary to prioritise where the available effort goes. The first priority is to assess and manage the target species of fisheries, and management consequently places highest research priority on support for stock assessments. There are too few resources to place major emphasis on non-target species. And any effort on the non-target species or environment must pass the cost-benefit test (as does any effort allocated to the target species). What really are the benefits for the cost, and how do they compare to the benefits from allocation of the research effort elsewhere. Effort into the development and use of Sustainability indicators must be justifiable in these terms.
- It is recognised that it is desirable to take a pro-active approach to the non-target issues, and that ignoring the non-target species is not acceptable policy. But the range of potential issues relating to the ecosystem and non-target species is huge and effective methods to deal with them in this context are still being developed. There is a need for practical (cost effective) methods for this pro-active monitoring and management.
- Environment Australia is developing indicators to be used for State of Environment reporting. AFMA is keen to support this, but there needs to be EA funding support to make this achievable.
  - There is need for development of guidance on what can be done in a practical sense.
  - There is need for development of better ways of using information that is already collected, or that could be collected at very little extra cost by existing monitoring programs.

### *F. Experience Elsewhere SWOT*

- Concern from industry that the use of quantitative indicators, especially ecosystem indicators, did not appear to be useful in the case of the forestry debate – either in helping decision making within the negotiation processes or in the broader public debate. Perhaps they have been useful in reporting against national and international obligations. What has been the experience in the forestry case? What lessons can we learn about the strengths and limitations of the use of quantitative indicators, and about their overall usefulness? We need to be able to make a clear case for the usefulness of quantitative indicators before going down this path.
- Recognised that indicators are needed to be able to measure progress toward actual ‘on the ground’ outcomes; There may be a high quality of management and decision processes in place, but there is a need to track the actual outcomes. The question that needs to be answered is what are the best indicators or measures of these outcomes?



- What has been the experience with sustainability indicators elsewhere (nationally and internationally)? It would be useful to provide a review, but more than that is needed. For standards to be adopted nationally the different jurisdictions must develop ownership, and that will require real bottom-up development as well as support from high level policy.

### *G. State of Environment Reporting*

- There is a need for consistent indicators around the country for both fisheries and environmental reporting.
- The AFMA Board is currently developing its interpretation of its legislative objectives with (including ESD and economic efficiency), and will have these interpretations developed by February 1999.
- There is a recognition that linking fisheries indicators and State of Environment indicators could help build credibility and trust, but AMFA being outside the Departmental structure (IDCs etc) and represented through DPIE limits AFMAs ability to be involved in decision making as a full participant.

### **3. Development and future directions**

- Progressively moving to develop indicators for all major target and by-catch species. Progressive move toward development of environmental indicators. Framework for assessing fishery management performance.
- Want fishery specific and ecosystem indicators that are practical (for stakeholders), reliable, and cost effective. Intent to apply the framework for assessing management performance to major Commonwealth fisheries, and the need for detailed analysis to support application of the overall framework.
- The Research subcommittee of SCFA identified sustainability indicators as a key research area in their review of national research priorities.
- Need to develop defined, measurable and auditable sustainability indicators; standard terminology and what to measure.

### **4. Implications R&D**