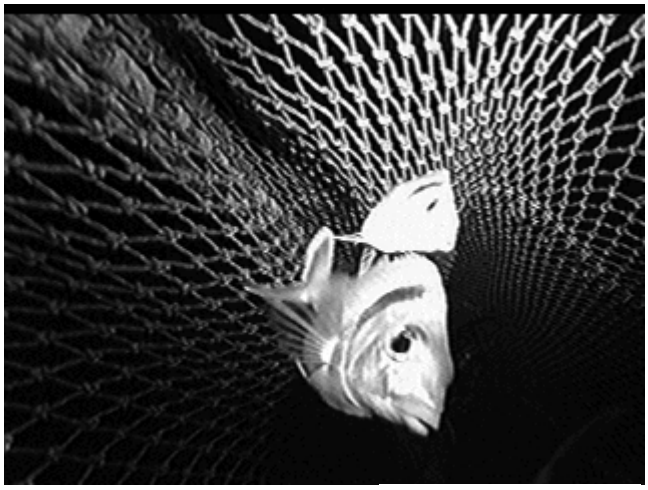
EXCELLENCE IN MARITIME TRAINING CONSULTANCY & RESEARCH

A subsidiary of the Australian Maritime College

RESEARCH and DEVELOPMENT: A review of its application in the South East Trawl Fishery



SETFIA

FISHERIES RESEARCH & DEVELOPMENT CORPORATION

Paul McShane

March, 2002

Cover Photograph

Fish entering trawl net, 300 m depth in Bass Strait, as photographed with underwater video by Matt Piasente (Australian Maritime College). Part of FRDC funded study 98/204 "Maximising yield and reducing discards in the South East Trawl Fishery through gear development and evaluation"

TABLE OF CONTENTS

LIST OF ACRONYMS

ABARE	Australian Bureau of Agricultural and Resource Economics
AFMA	Australian Fisheries Management Authority
AFFA	Agriculture, Fisheries, Forestry, Australia
BRS	Bureau of Rural Sciences
EA	Environment Australia
EPBC Act	*Environment Protection and Biodiversity Conservation* Act (1999)
ESD	Ecological Sustainable Development
FAG	Fishery Assessment Group
FRDC	Fisheries Research and Development Corporation
GAB	Great Australian Bight
ISMP	Integrated Scientific Monitoring Program
ITQ	Individual Transferable Quota
MAC	Management Advisory Committee
MAFRI	Marine and Freshwater Research Institute
NGO	Non-government Organisation
NOO	National Oceans Office
SED	Seal Exclusion Device
SEF	South East Fishery
SEFAG	South East Fishery Assessment Group
SETF	South East Trawl Fishery
SETFEAG	South East Trawl Fishery Ecological Assessment Group
SETMAC	South East Trawl Management Advisory Committee
SENTMAC	South East Non-Trawl Management Advisory Committee
SENTF	South East Non-trawl fishery
SSF	Southern Shark fishery
TAC	Total Allowable Catch
WWF	Worldwide Fund for Nature

EXECUTIVE SUMMARY

A review of current research and development (R & D) and its application to the South East Fishery (SEF) was commissioned by the South East Trawl Fishery Industry Association (SETFIA). The review focused on:

- the consultative process linking research to management;
- the link between the current strategic research plan and Industry needs;
- gaps in the current research strategic plan, particularly relating to the requirement of Industry to undertake a strategic ecological assessment of the SEF;
- opportunities to engage Industry more effectively in SEF research.

Consultation was undertaken with Industry sector representatives, government agencies, and other stakeholders (including non-government organisations). Such consultation revealed a plethora of linked (some only vaguely) committees, sub-committees, and other representative groups with an interest (direct or indirect) in the SEF. This complexity appears to have introduced much bureaucratic inertia in the co-management process and presents as a strong demotivator, and a major disincentive to Industry participation.

There are legitimate industry concerns relating to new environmental legislation and policy. **The increasing emphasis on ecosystem management must shift research priorities from species assessment to ecosystem assessment.** Such change in emphasis impacts on the current Total Allowable Catch (TAC) setting process which understandably focuses on the 18 SEF quota species. Inevitably, spatial management will be considered and perhaps introduced. Industry must be prepared to defend existing access rights with scientifically robust information. The SEF must also develop capacity within existing resource constraints to address the Environment Australia (EA) strategic assessment (under the provision of the *Environment Protection and Biodiversity Conservation* Act (1999)) while improving the current assessment/management applicable to the main quota species.

Industry participation in the Fisheries Assessment Groups (FAGs) has greatly improved the quality (and acceptance) of stock assessments in the SEF. However, there is a need for a more transparent and less cumbersome/costly process to deal with issues of Ecological Sustainable Development (ESD) in a consultative manner. Thus, issues of stock assessment for individual fisheries, for which there is an obvious relevance to fisheries management, could be dealt with separately from the wider issues of ecosystem governance.

It is suggested that the Management Advisory Committees (MACs) assume the role of the TAC subcommittee to more demonstrably separate TAC setting from the wider research needs (particularly ESD).

An alternative model whereby fisheries assessment is arbitrated in a wider representative group (a Plenary) is attractive in capturing the benefits of broader consultation (researchers and Industry) and providing an opportunity to evaluate fisheries in a wider ecosystem context (as required

by EA). Thus, new assessment methods developed for one species may have applicability and relevance to others. In addition to this, there is substantial overlap in considering environmental or ecological issues across the various stakeholder groups including the South East Fishery Assessment Group (SEFAG), the TAC setting subcommittee, the SEF Research Subcommittee, and the various Fisheries Assessment Groups.

It is proposed that the current SEFAG be expanded to embrace the current Research subcommittee and to provide for ecological assessment of other regional fisheries: the Southern Shark Fishery (SSF), the Great Australian Bight (GAB) trawl fishery, Squid, Bass Strait Scallops. This aligns with the Australian Fisheries Management Authority's (AFMA) plans for a common management plan of the Southeast Trawl Fishery (SETF), the Southeast non-Trawl Fishery (SENTF), SSF and GAB trawl. **The role of the Fisheries Assessment Groups should be reinforced by a more transparent consideration of fishery performance linked to performance indicators for the target species and decision rules influencing changes to management.** In any case the input and time spent by Industry participants would be substantially reduced.

It is proposed that a Plenary evaluate outstanding issues relating to species assessment (as identified by the FAGs), ESD strategic assessments, and other more general issues applicable to the SE region (as identified by the expanded SEFAG). A Plenary provides a transparent and consultative forum for identification of gaps and needs in providing management advice**.** In addition, there would be greater rigour and incentives for researchers to apply the most robust methods in assessment as **the Plenary could also provide for contested assessments (as successfully practiced in New Zealand). The Plenary will consider assessments provided by the various Fishery Assessment Groups when such assessments trigger an indicative need to change management.**

Similarly, the broader environmental issues and attendant research needs should be addressed in a wider forum than is presently provided. Thus, **the expanded SEFAG (embracing the Research Subcommittees of the various fisheries operating in South East coastal waters) would consider systemic issues applicable to the region (e.g. coastal oceanography and sea-surface temperature anomalies, interactions of fisheries particularly relating to discards, demersal trawling impacts, development of SE ecosystem models).** Such a group could provide forceful representation in research prioritisation and funding application. The group would also provide a forum for capturing the experiential knowledge of fishermen and for using such knowledge to frame hypotheses for multi-disciplinary studies of the SE ecosystem. Industry would also benefit from a direct examination of the sustainability issues required by EA in its Strategic Assessment of Commonwealth Fisheries. **As research resources are clearly limited, there should be sharing of common needs in environmental/ecological assessment and management across participating fisheries in the SE region (e.g. SSF, Squid, Scallops, Tuna & Billfish).**

The TAC setting process can be improved by providing for greater transparency in decisions relating to individual species. Current issues

include a generally poor relationship between catch rates of quota species and the stock status of those species. Industry participants claim environmental factors are significant drivers of fisheries performance and can explain year-to-year variation in catches or catch rates. Furthermore, changes in targeting and improvements in gear can also influence catch rates. A more explicit process involving agreed performance indicators linked to a decision rule framework would provide more transparency to stakeholders in TAC setting and review.

With a more effective use of the time of Industry participants, there will be enhanced opportunities for partnerships between research and development agencies, and the Fishing Industry. Already, the SEF Industry Development Subprogram is yielding demonstrable outcomes to Industry and aligning Industry, management, and research needs. More can be done to capture the emerging good will from such collaborative programs including leveraging Industry input for external funds (including new AFFA funding programs such as Farm innovation, Farmbis). Opportunities for Industry proactivity in environmental management include grants programs administered by EA and the National Oceans Office (NOO).

The current Strategic Research Plan applicable to the SEF revealed several gaps in addressing the EA Strategic Assessment of Commonwealth fisheries. **In particular, there is an opportunity to harness Industry capacity more effectively by extending the current Integrated Scientific Monitoring Program (ISMP) more effectively.** Recommendations arising from an evaluation of the current Research plan include:

- Harness Industry capacity more effectively, particularly in extending the ISMP to provide for fishery independent surveys and utilization of electronic data collection capacity;

- Harness Industry capacity more effectively to develop onboard data collection capacity for environmental data (e.g. sea-surface temperature);

- Improve utilization of Industry data (and the SEF data base) to identify targeting practices (e.g. fill out “target” field in logbook record);

- Improve utilization and reliability of Industry data by validating SEF 1 (estimates of catch from quota records) against SEF 2 (estimates of catch from logbooks);

- Improve understanding of the relationship between catch/catch rates and stock abundance by undertaking fishery independent assessment (through extension of the ISMP), analysis of targeting practices (as above), and correlating with environmental data such as sea-surface temperature;

- Address gaps in the EA requirement for strategic assessment particularly relating to ecological risk assessment;

- Address gaps in the EA requirement for vulnerability assessment of endangered/protected species (particularly seahorses, and deep water sharks);

- Link environmental programs in other fisheries (e.g. Southern Shark Fishery fixed station research) to the SEF;

- Improve utilization and robustness of ISMP data in evaluation of by-catch, discards, and vulnerable species, by evaluating and allowing for operator variation in estimation procedures;

- Extend results of Industry programs and encourage greater participation in collaborative Industry research, particularly the ISMP and the SE Industry Development Subprogram, by the "grass roots" through port visits and presentations;

- Promote targeted training programs to develop awareness of the 'big picture' issues facing industry (e.g. ecosystem management, ESD, supply-chain management, access right security, public relations).

Funding sources to support the needs identified above include:

- AFMA, particularly in extending the Ecological Risk Assessment to the SEF;
- Fisheries Research and Development Corporation (FRDC), in supporting focused studies arising from the Ecological Risk Assessment;
- FRDC in supporting and extending Industry development programs including the e-boat project particularly in developing greater capacity for Industry data collection;
- AusIndustry through its R & D Start program;
- Agriculture, Fisheries, Forestry – Australia (AFFA) through Farmbis in supporting and applying training programs focused to Industry needs;
- AFFA through Farm Innovation providing support for innovative programs such as the e-boat project and electronic collection and archival of environmental data;
- EA (through Coasts and Oceans Grant programs including coastal monitoring, marine species protection, cleaning our waterways Industry Partnership program);
- NOO (Coastal and Marine Planning grants).

Introduction

The South East Fishery is the nation's most complex fishery representing multiple jurisdictions (Commonwealth and State), methods (trawl and non-trawl), species (18 quota species), and associated research and management agencies. The complexity includes the administrative burden of an Individual Transferable Quota (ITQ) system. The investment of industry stakeholders in research and management is substantial and measurable in the time spent in attending and preparing for meetings of the many consultative groups with direct or indirect interest in the SEF.

It is intended that the formation of stakeholder representative groups encourage constructive and productive partnerships between researchers, managers, and Industry participants. There are some outstanding examples of successful such partnerships in the SEF. However, this review has been prompted by concerns that the interaction of Industry with researchers and managers may not be achieving its full potential. Opportunities arising from an improved research/management process include:

- Managing the current emphasis on ecosystem management and the change in focus on species management within the SEF;
- greater Industry input and enhanced collaborative effort during the development and conduct of projects particularly via the Integrated Scientific Monitoring Program (ISMP) and SE Industry Development Subprogram . This could result in improved and more cost-effective outcomes for Industry and reinforce existing Industry researcher partnerships;
- Greater participation at the "grass roots" level of the fishing Industry and enhanced support for research and development;
- Increased awareness by Industry of the strengths and weaknesses of fisheries assessments leading to a shared commitment of Industry and government stakeholders to improved management of the SEF.

Already there are attitudinal differences emerging among researchers with several scientists active in the SEF choosing to work very closely with Industry. These individuals have helped rebuild a constructive working relationship between researchers and Industry and important mutually beneficial initiatives have recently emerged[1]. In particular, the South East Fishery Industry Development subprogram has been enthusiastically embraced by Industry and is delivering some innovative and relevant results.

There are clearly limited resources and associated opportunities for research in the SEF. The total landed value of the fishery is about $70 million annually. The complexity of the fishery and its geographical range further limit the capacity to conduct assessments of the eighteen quota species, let alone the other species caught in the fishery. Further to this is the emergence of ecosystem management, and the need for information to address community concerns relating to commercial fishing and its effect on the environment. This has prompted strategic assessments of fisheries under new Commonwealth Environmental legislation. It is therefore essential that the available resources be used sensibly and transparently (to

[1] As summarized in the first edition of South-East Trawl Fishery Industry Association News (September 2001)

stakeholders) in a way that captures maximum benefit measurable in satisfying management objectives and legislative requirements in the SEF.

The current review of the application of research and development in the SEF aims to realign fishing Industry needs with research provider capacity by developing and presenting a strategic research plan. It identifies gaps in current research programs particularly those relevant to emerging and potent environmental legislation/policy.

Terms of Reference

The terms of reference of the review were to:

1. *Review the current research planning and selection processes for the SETF; assess the effectiveness of the Industry input to these processes and, if necessary, recommend changes to achieve more effective Industry involvement.*

2. *Review the current SEF Research Plan (from an Industry perspective) and suggest future Industry research requirements based on discussions with Industry, fishery managers, researchers, Environment Australia, relevant NGOs and funding agencies. In particular, this assessment should identify emerging environmental issues, requiring strategic research and research that may be required to assist the fishery in gaining environmental accreditation.*

3. *In light of increasing demands for research, recommend appropriate funding sources and strategies with a view to assisting the Industry to gain maximum leverage from its research expenditure.*

This review has been structured to directly address these terms of reference.

Preliminary consultation with sector groups and other information sources

Individual Sector representatives were consulted to identify current research and development priorities. Consultation included:

- SETFIA members and secretariat;
- AFMA managers (Geoff Richardson, Ian Towers, Brad Norman);
- AFFA managers (John Talbot, John Barrington, James Lee, Victoria Anderson);
- ABARE SEFAG representative (Debby Brown);
- FRDC managers (Patrick Hone, Alex Wells);
- EA (Mark Flanagan);
- National Oceans Office (Sean Sullivan);
- SE Industry Development Subprogram (Ian Knuckey);
- Research Agencies (MAFRI, CSIRO) (Ian Knuckey, Tony Smith);
- World Wide Fund for Nature (Katherine Short).

Information expressed in this review reflects the opinions and views of the individuals consulted above. Relevant reports or papers are cited as footnotes.

1. Review of the current research planning and selection process

1.1. The stakeholder consultation process

Reflecting its inherent complexity, the SEF has many inputs to the research management process as shown below. At the higher end, day-to-day management of the SEF is the responsibility of the AFMA board and development of fisheries policy is the responsibility of AFFA.

Although AFMA and AFFA have an interest in fisheries research and its application to the SEF, the main fora for research and its integration with the Fishing Industry is via the Southeast Fishery Assessment Group (SEFAG), the Research Subcommittee, and the various Species Assessment Groups shown below.

The Bureau of Rural Sciences (BRS) has taken a particular responsibility for the evaluation of Ecological Sustainable Development (ESD) in fisheries policy and management reflected in economic and sociological studies. Similarly, the Australian Bureau of Agricultural and Rural Economics (ABARE) has interests and capacity in economic assessment. Representatives of ABARE and BRS participate in the various stakeholder groups including the Research Subcommittee. They also provide advice to SEFAG and to the AFMA board.

1.1.1 Research Subcommittee

The terms of reference for the Research Subcommittee include:

- identification and documentation of fishery research gaps, needs and priorities;
- provision of a forum for expert consideration of scientific issues referred by the MACs;
- provision of a forum for detailed consideration of scientific issues raised by fishery stakeholders (i.e. Industry and non-government organizations, (NGOs)).

Among its various functions the Research Subcommittee considers:

- research gaps;
- research priorities;
- research proposals (solicitation and evaluation);
- development and update of strategic research plans (the most recent of which was submitted in 2000);
- advice to the MACs.

Industry has experienced some difficulty in actively contributing to the evaluation of research projects as Industry participants lack technical expertise in fisheries science. However, Industry participants have assisted in the development of realistic hypotheses on the dynamics of SEF stocks for testing of population models, among other useful inputs. Furthermore, the collective experience of Industry representatives can assist in the development and application of research projects. This is already happening particularly with the advent of the ISMP.

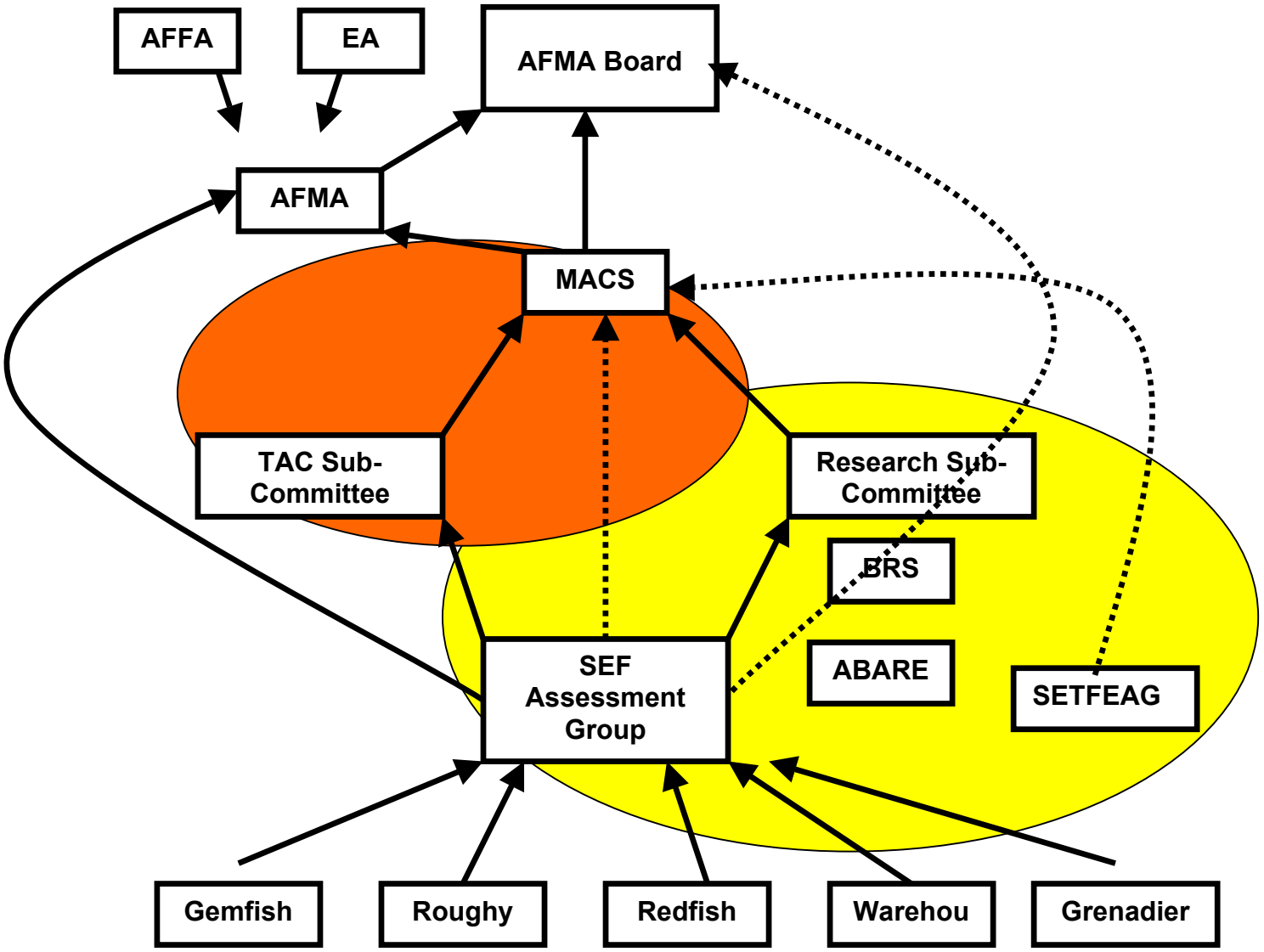
1.1.2 South East Fishery Assessment Group (SEFAG)

Industry representatives are members of SEFAG providing practical insights into trends in catch rates of individual species and environmental conditions (e.g. variation in sea-surface temperature). Scientists provide advice reflecting the need to establish TACs for the 18 quota species under the output controlled management regime. Functions of SEFAG include:

- fishery assessment and reporting;
- identification of information needs and deficiencies for fishery assessments;

- contributing to MAC identification of research gaps and needs;
- advising MACs on biological, ecological, and economic implications of stock assessments;
- evaluation of alternative harvest strategies;
- risk assessment for alternative TAC settings;
- development of sustainability indicators;
- peer review of alternative independent assessments.

Again, there is an opportunity for scientists and Industry participants to work more closely together aligning the experiential knowledge of the Industry with the technical capacity of researchers. However, there is substantial overlap with the Fishery Assessment Groups, the Research Subcommittee and the TAC subcommittee.



Fishery Assessment Groups

Exhibit 1
Current SETF consultative and management groups with proposed groupings of committees with obvious areas of overlap (coloured shading).

1.1.3 Fishery Assessment Groups

Fishery Assessment Groups (FAGs) followed the establishment of one for Eastern Gemfish in 1996 reflecting the particular needs (and status) of that fishery. Since then, others have been established for Warehou (blue and spotted), Orange Roughy, Blue Grenadier, and Redfish. The assessment groups usually meet twice each year and address issues of particular importance to the fisheries including identification of research and monitoring necessary to improve the stock assessments. Industry is represented on the FAGs. However, the FAGs clearly share consideration of fisheries research (with an understandable emphasis on stock assessment) with SEFAG and the Research Subcommittee.

The establishment of a South East Trawl Fishery Ecological Assessment Group (SETFEAG) is an obvious vehicle for Environment Australia (EA) participation in the stakeholder representative process applicable to the SEF. Consideration of ecosystem management rather than species management is more consistent with the management ethos of EA and reflects their emphasis on Ecological Sustainable Development (ESD).

Advantages of ecosystem management include:
- bridging the gap between species level and community level effects;
- being able to establish a precautionary approach to ecosystem management;
- spatial management of fisheries in a region prioritized under Australia's National Oceans Policy (the South East Region);
- aligned to EA requirements for ESD management of Commonwealth fisheries.

Disadvantages include:
- a generally poor understanding of ecosystem processes and their influence on individual fisheries (and vice versa);
- administrative complexity in managing multi-species fisheries;
- adapting a quota management system to provide for spatial rather than species management

In reality, few fisheries are able to address all of the requirements specified under EA's guidelines for sustainable fisheries. There is a huge gap between current environmental policy/management and the capacity to evaluate its effectiveness (or otherwise). These issues are addressed in some detail below.

1.1.4 TAC Subcommittee

This subcommittee considers information applicable to the TAC setting process but it presents as an additional layer of administrative complexity with overlap in functions of the MAC and SEFAG. Current issues for industry include:
- the uncertain (or poor) relationship between catch trends and stock status;
- external factors (environmental, targeting) influencing trends in catch rates;
- the use of catch rates, or total catches in setting TACs for SEF species;
- cross sector (trawl/non-trawl) quota transferability;
- external peer review to ensure rigour and transparency in the assessment process leading to TAC decisions;
- quota asset values reflecting uncertainty in the TAC setting process.

1.2 Limitations of the current process

1.2.1 Too many costly meetings

Each species assessment group meets at least twice a year, SEFAG and the SEF Research sub-committee meet at least twice each year and there are also several workshops each year. Generally, and similar to other stakeholder representative

groups in other jurisdictions and other fisheries, the same Industry representatives attend these meetings. This places a substantial burden in participation which is essentially a voluntary task at the expense of the Industry participant's day to day business. Unlike the scientist, manager, or NGO representatives, Industry participants are not paid to attend meetings. Industry participation is at the expense of growing cynicism about the consultative process and participants wearying of the time spent in meetings.

Not surprisingly, Industry representatives want fewer meetings. Maintenance of the motivation of Industry participants is a current problem. The Industry needs effective participants in the stakeholder consultative process but the current system is geared demonstrably against this aim.

The cost of running the SEF assessment process (meetings and reports only) is about $360K annually. The total cost of managing the SEF is about 4% of the GVP of the fishery[2].

1.2.2 Overlap of issues with other fisheries

Many SEF operators have endorsements in other AFMA managed fisheries such as the Southern Shark Fishery (SSF), the Great Australian Bight (GAB) Trawl Fishery, Bass Strait Scallops, the Eastern Tuna and Billfish Fishery, and the Southern Squid Jig fishery. As these fisheries operate in the same coastal regions of South East Australia, there are clearly interactions and common issues. Common issues include ecosystem management (and increasing influence of EA), assessment techniques, environmental influences (e.g. sea surface temperature anomalies), and adverse community perception of commercial fisheries.

From a research perspective, ecosystem level influences (including predator prey interactions affected by declines or increases in species abundance, climatic effects, and general ecosystem function) are relevant to all fisheries in the region. Particularly relevant to general ecosystem function is the status/vulnerability of non-quota species which, in general, have received little scientific attention. The interactions with other species from other fisheries such as the Southern Shark Fishery can be an issue particularly with the relaxing of input controls in the Shark Fishery potentially enhancing by-catch and adverse environmental impacts in that fishery. Endangered/Protected species such as seahorses, deep-water sharks, and seals present as a major issue for the SEF (because of their increasing public profile and concerns by NGOs) and information requirements would best be handled collectively across other fisheries which may impact on such species.

With the emerging importance of environmental issues in fisheries management, there is considerable overlap among the various representative groups in considering research issues. For example, effects of fishing on the ecosystem generally (under Principle 2 in EA's Principles of Sustainable Fishing) are relevant to the Southern Shark Fishery, the GAB Trawl Fishery, the Bass Strait Central Scallop Fishery, the Southern Squid Jig Fishery, the Tuna and Billfish Fishery all of which interact with the SEF. Thus food chain linkages, fates of discards, effects of trawling on the ecological communities of southeastern waters, influence of changes in coastal oceanography, could all be considered in a collective forum aimed at identifying research needs and priorities.

Uncertainty in assessments of fisheries, application of new assessment techniques, performance indicators, decision rules, other issues relevant to the TAC setting

[2] from ABARE data 1998/99

process, ecosystem management (and strategic assessment of fisheries) could also be considered across fisheries in a collective forum as currently practiced with some success in New Zealand.

1.3 Improving the process

AFMA does not have a fisheries-wide assessment and management forum such as practiced in New Zealand (which has a similar stakeholder consultative process driving its ITQ management of its fisheries). Moreover, AFMA is required under the Fisheries Management Act (1991) to ensure fisheries are conducted "*in a manner consistent with ESD 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*".[3] There is therefore a need (and increasingly, a requirement) to consider management of individual fisheries in the wider ecosystem context.

Advantages of a broader consultative process include:

- examination of stock assessment methods and novel approaches with mutual benefit to the SEF and other fisheries in the region;
- examination of broader environmental issues such as climatic effects, oceanographic processes, and ecological interactions applicable to all fisheries in the region (South East Australia);
- less impost on industry participants as many of the issues applicable to individual species (in the Species Assessment Groups), fisheries (in the SEFAG, and Research Sub-Committee) coalesce in consideration in a wider consultative forum;
- an opportunity to align a management plan incorporating the SETF, SENTF, the Southern Shark Fishery, and the Great Australian Bight Trawl Fishery, with a common consultative forum addressing research and ESD strategic assessment.

Disadvantages include:

- uncertainty among Industry participants of the process;
- yet another change to an already complicated and cumbersome process;
- potential to lose focus on SEF issues;
- the cost to Industry, under a contested assessment regime, for increased scientific representation.

AFMA's charter necessitates consideration of fisheries on a fishery-by-fishery basis and consultative groups such as the SEFAG are demonstrably important in the TAC setting process. The non-trawl ITQ system now covers the remaining 13 trawl quota species[4]. Furthermore, a management plan incorporating the South east trawl fishery, the South east non-trawl fishery, the Southern Shark fishery and the GAB trawl fishery is to be finalized by the end of 2002. This would be a good opportunity to introduce the proposed changes in consultative groups.

The inclusion of Stock Assessment in overall research management and delivery is complicated by its pivotal role in the TAC setting process in the SEF (as considered in the Research Subcommittee, SEFAG, and the TAC subcommittee). As much of the proposed research is either methodological (new approaches, models and so on) or simply conducting assessments of individual quota species, stock assessment should be separated from the general research planning process.

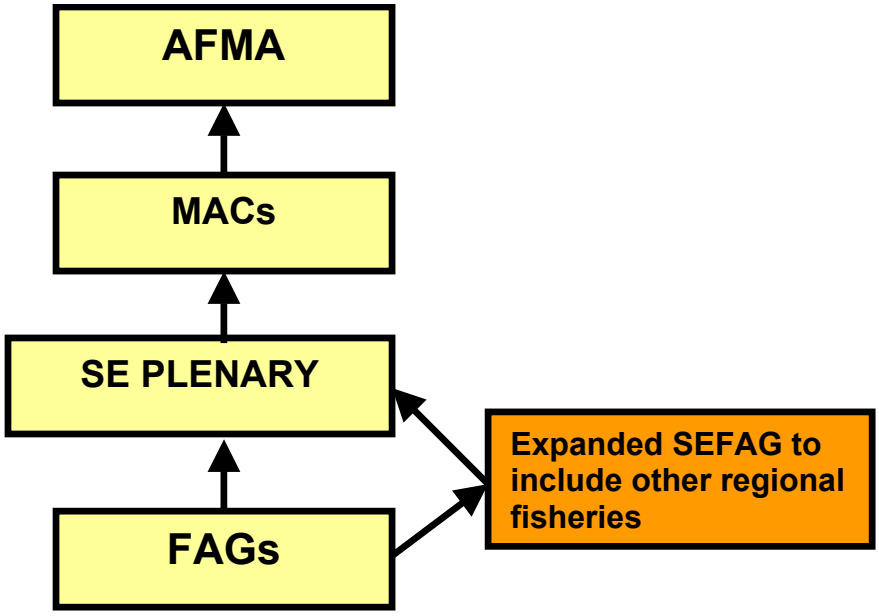
[3] AFMA has five legislative objectives under the *Fisheries Management Act* 1991 (see www.afma.gov.au).

[4] Grieve, C. and Richardson, G. (2001). Recent history of Australia's South East Fishery: a manager's perspective. *Marine and Freshwater Research* 52, 377–386.

The plethora of stock assessment methods applicable to fishery data presents an additional difficulty in aligning management, research and Industry. Not surprisingly, Industry participants in the stakeholder consultative process find mathematically intensive treatments of fishery data impenetrable in most cases. Thus, Industry is reliant on the advice of those few scientists with the capacity to undertake quantitative assessments of SEF species. Fortunately, there appears to be a good working relationship between those scientists and Industry participants in the assessment process, particularly in the Fishery Assessment Groups.

The astonishing increase in computational power over the past two decades means that simulation modeling is now a routine tool in fisheries assessment and risk-based assessments are far more tractable than in the past. Even so, assessments are vulnerable to process error in the absence of accurate input data. Industry and Scientists have acknowledged that performance indicators based on trends in catch and catch rate are inadequate because of uncertainty about the relationship between catch rate and fish abundance. Although there is clearly a need to provide greater scientific defensibility in relation to the TAC setting process, the emphasis on species-specific assessments is at the expense of a more holistic treatment of the ecosystem and the interaction between component species. This is perhaps not surprising given the limited resources available.

Exhibit 2: Alternative research/management consultative process



The alternative model (Exhibit 2) reflects the need for a more cost-effective (time and money) approach to stakeholder participation in research. It provides for a more streamlined process allowing for collective consideration (including other fisheries in south east Australia) of stock assessment and general research. It is less burdensome on the time of Industry participants: the Plenary would meet once a year for five days and would provide a transparent basis for the consideration of proposed changes to management i.e. TAC, EA strategic assessment. The existing SE Plenary would be integrated into the regional Plenary to consider outstanding assessment issues warranting consideration of changes to management (e.g TACs,

size limits, mesh size). Such assessment issues could be dealt with over the first two to three days providing those with a direct interest an opportunity to use their time efficiently. Thereafter, for the remaining two to three days, the Plenary could concentrate on the regional ecosystem issues including any issues applicable to the EA strategic assessment. Routine monitoring of fisheries, and fisheries for which no change to the applicable management is proposed, could bypass the Plenary.

Under the proposed changes, the function of the TAC subcommittee would be absorbed by the MACs (as shown in Exhibit 1). Individual fisheries would still be serviced by the MACs with the SEF represented by a combined trawl and non-trawl MAC.

Reflecting AFMA's plans to introduce a combined management plan for the SETF, SENTF, SSF, and the GAB trawl fishery, an expanded SEFAG is proposed (as illustrated in Exhibit 2) to include these fisheries. The expanded SEFAG would consider assessments in the wider ecosystem context and nominate issues for detailed (or contested) evaluation by the Plenary. With its expanded emphasis on ecosystem issues, the expanded SEFAG could also include the SETFEAG and similar groups applicable to other regional fisheries. It recognizes the overlap in issues such as environmental influences on fisheries (e.g. sea surface temperature anomalies), the need for a better understanding of ecosystem function generally, and public concerns of effects of commercial fishing on coastal ecosystems. For instance, oceanographic anomalies might explain observed recruitment variability in a quota species and be influential in the assessment of a species or the interaction among fisheries.

Fishery Assessment Groups would continue to have fishery specific input into the process where this is warranted. The Plenary would consider reports from the FAGs on species assessment (preferably against a decision rule framework linked to clear unambiguous performance indicators), and from the expanded SEFAG on broader environmental/ecological issues (linked to EA's criteria for ecological sustainable fisheries). The current review of management needs in the SEF including the application of performance indicators will be relevant here. Participants in the Plenary would benefit from exposure and critical evaluation of new assessment methods and their application in the wider fishery management arena. Importantly, the Plenary could also provide an opportunity for contested assessments such as currently practiced in New Zealand with success. Contested assessments benefit industry by promoting greater rigour and transparency in the assessment process. However, the cost to Industry of such assessments would have to be balanced against any potential benefits.

1.4 Recommendations for more effective industry involvement

- improve the current process by reducing the obvious overlap between stakeholder groups and other Fisheries;
- Expand the SEFAG to include the SEF Research Subcommittee, SETFEAG, SEFAG, and similar groups involved in the SSF and GAB Trawl fishery addressing issues more general to the region e.g. ecosystem issues, endangered or protected species, environmental influences on fisheries, and interactions between fisheries;
- Absorb the TAC subcommittee within the MAC;
- Introduce a common forum, a Plenary, at which reports applicable to assessment and management of south east fisheries arising from the FAGs

(species assessment), and the expanded SEFAG (ecosystem assessment) are presented, discussed, and contested in a transparent consultative forum;

- Issues requiring further consideration, particularly any proposed changes to the TAC, changes to management following an ESD strategic assessment, or other changes to management (as identified by the FAGs, or the expanded SEFAG), should be referred to the Plenary for contested assessment;
- Retain the Fishery Assessment Groups to provide for specific information applicable to the Plenary and introduce a uniform reporting format to include decision rules linked to performance indicators;
- reinforce the role of the ISMP and the SE Industry Development Subprogram to provide for greater input into research and development.

2. Review of the current research plan

2.1 AFMA's Responsibility and links to Research

As the Agency responsible for management of the SEF, AFMA has five legislative objectives under the *Fisheries Management Act* 1991. The objectives are important in the context of aligning management, research and industry needs as shown below.

Management Objective	*Research requirement*	*Industry need*
Implementing efficient and cost-effective fisheries management on behalf of the Commonwealth	• Economic evaluation of transaction costs associated with ITQ management; • cost-benefit analysis	• Access security, • cost-effective participation in the fishery
Ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with ESD 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	• Ecosystem effects of fishing particularly in relation to discarding and habitat disturbance • Identification and development of ecosystem indicators • Technological solutions to by-catch and unfavorable interactions (e.g. seals) • Social and equity issues associated with ESD • Catchability and targeting	• *EPBC* requirements in relation to Commonwealth fisheries • Improved public perception of commercial fishing • Compliance with national and international protocols • Defensibility against the precautionary principle and its potentially negative impact on access rights • Knowledge of ecosystem function and consequences of external factors such as climate change • Transparency and clarity in stock assessment
Maximizing economic efficiency in the exploitation of fisheries resources	• Quantification of changes in effective effort • Economic consequences of spatial/ecosystem management	• Social impact assessment relating to changes in fleet/port arrangements • Cost-benefit analysis of potential changes to management
Ensuring accountability to the fishing industry and to the Australian community in the Authority's management of fisheries resources	• Risk based assessment of fisheries • Ecosystem function in relation to single species management • Stock structure	• Transparency in management decisions • Clarity in managing and maintaining the SE ecosystem • Effective participation in the process
Achieving government targets in relation to the recovery of the costs of the Authority	• Financial evaluation of alternative models and assessment of transaction costs	• Cost-effective participation in management • Effective targeting of industry funded programs

2.2 Fishery Monitoring Programs

The Science monitoring program established in 1995 preceded the Integrated Science Monitoring Program (ISMP) established in 1997. The ISMP provides a better link and coordination between the various state and Federal agencies with an interest in the SEF. Importantly, the ISMP promotes a closer working relationship between researchers and Industry with on-board monitoring extending beyond the 18 quota species to include examination of by-catch and discards. Industry has a measurable stake in the ISMP funding 80% of the program. In bringing on-board observers and scientists in contact with working fishers in the SEF there is an opportunity to align the long-term experiential knowledge of SEF fishers with the formal scientific knowledge and focus of marine scientists.

Although it will always be difficult to reconcile the technical aspects of formal stock assessments with the sea-based experience of fishers, primarily because of the different spatial and temporal scales addressed by scientists and fishers[5], working together builds bridges and empathy for the objectives of each "group". To some extent this bridge building can occur at the representative group (SEFAG or FAG) but, of necessity the same players are involved and "rank and file" contact is important in building confidence in the role of science in management of fisheries.

Apart from the obvious benefits accruing from a closer and more productive working relationship between scientists and fishers, the actual contribution of the ISMP to enhancing understanding of the SEF could be reinforced by linking it to the assessment process. This is especially relevant when considering targeting patterns (among quota species and in interpreting trends in non-quota species). Furthermore, the current electronic data collection trial (the e-boat program) could be extended to provide for cost-effective Industry collection of relevant data.

Other issues in which the ISMP can play an important role include quantification of:

- by-catch;
- discarding;
- high grading (selective discarding of quota species);
- benthic impacts (through recording of benthos retained in trawls);
- interaction with endangered/protected species (seahorses, seals, deepwater sharks);
- environmental data (sea surface temperature).

The current ISMP program covers about 4% of the fishery (in terms of trawl shots) providing significant and substantial coverage. However, information relating to the issues above are semi-quantitative and consideration should be given to developing more robust assessments of by-catch and discarding as these are relevant in the requirement for Strategic Assessments (ESD). Although, observer estimates can be precise, there is a need to monitor, and allow for, variation among observers in estimating quantities (of bycatch or discards).

The need to better understand (or improve) the relationship between catch rates and stock abundance could be addressed through the ISMP. In particular, fishery independent surveys could be undertaken cost-effectively using Industry vessels.

[5] Smith, D. C., Smith, A. D. M., and Punt, A. E. (2001). Approach and process for stock assessment in the South East Fishery: a perspective. *Mar. Freshwater Res*. 52, 671–681. Smith et als. paper provides a usual discussion of the links between the stock assessment process and industry input through the various representative groups.

2.3 Emerging environmental issues

The environmental focus of management of the SEF is enshrined in the *Fisheries Management Act (1991)* which includes (Section 3):

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 ***Ecological 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.*

The terms above are emphasized to show that many stakeholders have difficulty in understanding what ESD and the precautionary principle mean in operational terms. Tilzey and Rowling (2001)[6] cite failure to apply the precautionary principle in management of SEF Fisheries.

The commonly expressed definitions (below) expressed in relevant legislation shed little light on implications for research and management in the SEF.

Ecological sustainable development[7]
"Using, conserving, and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"

The Precautionary Principle[8]
"*The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible damage"*

As the principal agency responsible for environmental management, Environment Australia (EA) has no formal engagement in the management of the SEF or in setting research priorities. Nonetheless, as an agency, EA has political potency and concerns in relation to the impact of demersal trawl gear on the benthos, incentives (or lack of) to minimize by-catch, marine mammal interactions (seals), protected species (e.g. seahorses (sygnathids)), endangered (or potentially so) species (e.g. deep water shark species) present as issues that need resolution (preferably with active Industry involvement). Of note is the participation of non-government organizations (e.g. TRAFFIC, WWF) in SEF stakeholder consultative groups. EA has no formal involvement in SEF consultative groups other than a prospective involvement in the newly established South East Trawl Fishery Ecological Assessment Group.

Environmental issues of some importance in the SEF are by-catch (particularly given the large number of species (> 100) landed and the relatively small number of quota

[6] "*Clearly, socio-economic management objectives (Grieve and Richardson 2001) continue to override concerns about resource sustainability despite indications of further declines in mature biomass and pleas for a more precautionary approach." "In general, assessment scientists are frustrated by the failure of managers to apply the precautionary principle, despite the fact that biomass estimates for major species such as gemfish and orange roughy have fallen well below the biological reference points adopted by management as minimum desirable stock sizes."* Tilzey and Rowling (2001) *Marine and Freshwater Research* 52, page 370.

[7] From Commonwealth of Australia. National Strategy for ecological sustainable development. Australian Government Publishing Service, Canberra 1992.

[8] From Section 391 (1) of the *Environment Protection and Biodiversity Conservation Act (1999)*.

species (18)); discarding (quota and non-quota species); benthic impacts (particularly effects of demersal trawling); protected species (sygnathids); endangered or potentially endangered species (deep water sharks), and introduced species (e.g. the New Zealand screw shell). These issues are discussed in more detail below.

Environmental provisions in SEF management include a minimum codend mesh size for demersal, pelagic, and Danish Seine fisheries. Actual or potential impacts of demersal trawling present as issues which require resolution given increasing public and international concern over the ecological impacts of commercial fishing[9]. Other fishing methods including Danish Seine, mid-water trawl, long lining, drop lining, and trapping have demonstrably less impact on benthic communities. However, issues of by-catch still pertain to Danish Seine (particularly sygnathids) and mid-water trawl (particularly seals).

Although proclamation of marine protected areas (including no-take areas) will apply mainly to coastal regions not directly affecting the SEF, at least one area of Bass Strait under consideration will affect fishing. The seamount areas in Bass Strait are already protected from trawling. At the very least, the SEF must assemble defensible information through targeted research to address EA requirements and public concern expressed politically through non-Government organisations (NGOs).

There is clearly a need for sustainability indicators applicable to by-catch species and, perhaps more ambitiously but presently under consideration[10], development of feasible indicators of ecosystem sustainability as part of an overall ecological risk assessment.

2.4 Current Gaps in Environment Australia provisions for approval of the SEF under the *Environment Protection and Biodiversity Conservation Act 1999*.

As a Commonwealth-managed fishery, the recent changes made to Commonwealth environmental legislation have implications for the SEF. The change to the *Wildlife Protection (Regulation of Exports & Imports) Act 1982 (*which is now part of the revised *Environment Protection & Biodiversity Conservation Act 1999)* has resulted in the marine fish species which were previously exempt from any requirements under this legislation now having to undergo environmental assessment to determine if they can continue to be exported.

Similarly, the new *Act* directly affects all Commonwealth Fisheries, requiring them to undergo a strategic assessment of their environmental performance. The

[9] *For example "Although there are signs of overexploitation in most of the world's fisheries … we have to formally address the effects of fishing on entire ecosystems. The dependence on accurate estimates of single-species stocks, as well as on efficient control of effort and catch, raises serious concerns about the efficacy of current fisheries management strategies in ensuring sustainable fisheries. In addition, reducing effective fishing effort is almost impossible to achieve in the face of gear efficiency through technological improvements…Focusing on only one stock at a time, we fail to realize the significance of serial depletion of individual stocks and fishing grounds as illustrated by fisheries in all parts of the world… In fact, many world fisheries once targeting long-lived, high-trophic-level piscivorous fish, are now catching more invertebrates and short-lived pelagic planktivores'.* From Sumaila, U. R., Guenette, S., Alder, J., and Chuenpagdee, R. (2000). Addressing ecosystem effects of fishing using marine protected areas. *ICES Journal of Marine Science* 57, 752–760.

[10] FRDC Research project (2000/145) Standing Committee on Fisheries and Aquaculture ESD reporting framework. Developing a national reporting framework for fisheries ESD.

assessment under the Act requires submission of applications to EA against a set of guidelines for Sustainable Fisheries (Principles 1 & 2)[11]. This framework is consistent with international initiatives, in particular the United Nations Food and Agriculture Organisation (FAO) guidelines for sustainable development of marine capture fisheries[12].

2.4.1. Principle 1 (Sustainability of target species)

A fishery shall be conducted at catch levels that maintain ecological stock levels at an agreed point or range, with acceptable levels of probability.

For the SEF, relevant data are available for each of the 18 quota species through the logbook program, the ISMP, and from limited fishery-independent data (where collected). There is scope to utilize existing data more effectively. For example, targeting of SEF species is difficult to assess as fishermen often leave the "targeting" field in the logbook blank. The SEF database, going back to 1985 can be used to evaluate targeting in relation to recorded catch rates of SEF species. This is already been undertaken with some success in a joint program (AMC and CSIRO). Estimates provided from SEF 1 (estimates of catch from quota records) should be validated against SEF 2 (estimates of catch from log books).

Paradoxically, with an emphasis on stock assessment promoted through the ITQ management of the SEF, the SEF does not have a strong history of quantitative stock assessment. Much of the research that has been done over the four decades of active scientific attention to the SEF has been informally published in various management reports including FRDC final reports[13]. There are currently no quantitative assessments for nine of the quota species[14].

The likelihood of formal assessments being conducted for six of the quota species (John Dory, Mirror Dory, Ocean Perch, Red Royal Prawns, Silver Trevally, and Western Gemfish) is low as they are considered low priority species. Reliable fishery-independent biomass estimates are available for only two fisheries: eastern zone Orange Roughy and the winter Blue Grenadier fishery. Such estimates come from acoustic or egg surveys which can be expensive and imprecise. The likelihood of successfully getting biomass estimates for other SEF quota species is low given the methodological limitations. Quantitative stock assessments exist only for Blue

---

[11] Adapted from "Making an application to Environment Australia for approval of a fishery under Schedule 4 of the *Wildlife Protection Act* or *Environment Protection & Biodiversity Conservation Act* (generic front end)" www.fisheries.esd.com/doc/APP_EA_WPREISCH4.doc.

[12] see Garcia, S. M, Staples, D. J. , and Chesson, J. (2000). The FAO guidelines for the development and use of indicators for sustainable development of marine capture fisheries and an Australian example of their application. *Ocean and Coastal Management* 43, 537–556. *Note that this paper outlines a framework based on the SEF although it is very much work in progress*. Similarly, see also Chesson, J., Clayton, H., and Whitworth, B. (1999). Evaluation of fisheries-management systems with respect to sustainable development. *ICES Journal of Marine Science* 56, 980–984. *This paper presents some preliminary information on the socio-economic aspects applicable to the SEF together with some suggested environmental indicators.*

[13] As described in Tilzey and Rowling (2001). *Marine and Freshwater Research* 52, 361–375. See also Ford, W. and Lyle, J. Catalogue and analysis of historical catch, effort and biological data for he South East Trawl Fishery. Final report to the Fisheries Research and Development Corporation Project 90/23

[14] Punt, A. E., Smith, A. D. M., and Gui, G. (2001). Review of progress in the introduction of management strategy evaluation (MSE) approaches in Australia's South East Fishery. *Marine and Freshwater Research* 52, 719–726.

Grenadier, Blue Warehou, Eastern Gemfish, Ling, Orange Roughy, Redfish, School Whiting and Spotted Whiting. Of these, Ling, Redfish and Spotted Warehou are considered to be under development[15].

The use of Catch and Effort data in reflecting stock trends for the quota species is problematic in assessments and can promote scepticism in the TAC setting process among Industry participants. Catch rates may not reflect the true status of stocks as rates will change depending on whether a particular quota species is targeted or not. Fleet dynamics, market forces (e.g. prices for individual species), and the behaviour of fishermen generally can influence targeting, catch rates, and catches of quota species independent of the status of individual stocks. In addition to this, there is very little information on the catchability (or selectivity) of SEF species and the lack of such information can undermine the reliability of assessments of key species. Fishery independent surveys could help here although such surveys can be costly (particularly if using research agency vessels).

Applying stock assessment methods to catch rate data when efficiency is changing over time (with improvements in fishing technology) can lead to misleading estimates of management related quantities (e.g. spawning stock size) and poor performance of harvest strategies[16]. Application of modern acoustic and satellite tracking technology has resulted in more effective targeting of fishing grounds including ground previously considered to be unfishable. Consequently, effective effort continues to increase but at an unknown rate. Similarly, the targeting of fish assemblages on hard ground or on previously unexploited ground can have implications for the sustainability of fish stocks and the appropriateness of the applicable TAC. Several quota species appear to be subject to significant fluctuations in recruitment: a point reinforced by the observations of fishermen.

There are reliable estimates of removals of the 18 quota species obtained from the ISMP and other monitoring programs. However, estimates of discards are semi-quantitative. For instance, even though the ISMP records information on discards, weights of discarded fish are not measured directly. Rather, discard rates are estimated by on-board observers and some uncertainty may exist in the use of such information. However, the available information suggests precise estimates (although operator variability (in making estimations) needs to be investigated). Discards of Redfish, Ocean Perch, Mirror Dory, and even Blue eye Trevalla can be substantial and be a significant factor affecting assessments.

There are no reliable quantitative data for recreational extractions of SEF quota species. The recreational fishery in the SEF includes individuals and charter boats particularly targeting Silver Trevally.

[15] Punt et. al. (2001). Defining robust harvest strategies, performance indicators and monitoring strategies for the SEF. FRDC final report 98/102.

[16] A harvest strategy is a set of rules that define the data to be collected from a fishery (e.g. catch rate, size composition, age/length data), how such data are analysed (e.g. stock assessment method), and how the results of the data analyses are to be used to determine management actions (e.g. decision rules). See Punt, A, Cui, G., and Smith, A. D. M. (2001). Defining robust harvest strategies, performance indicators and monitoring strategies for the SEF. FRDC final report for project 98/102.

There is uncertainty in stock structure for most of the quota species with reliable stock differentiation existing only for Blue eye Trevalla, Gemfish, Blue Grenadier, and Ling[17].

2.4.2 Principle 2 (sustainability of the ecosystem)

By-catch presents as a major issue for the SEF because the public have perceptions of waste, ecological damage, impact on endangered species, and vulnerability of some by-catch species. Interaction of the SEF with marine mammals, particularly seals, is also an issue with concerns expressed by the Fishing Industry of large increases in populations of seals with associated negative impact on coastal fish stocks (including some targeted by the SEF). Conversely, some NGOs have concerns that trawl fisheries negatively impact on seal populations.

Monitoring programs have revealed that the incidental capture of sea birds and seals in the SEF is negligible. Even so, deaths of seals can occur, particularly in the Blue Grenadier fishery and AFMA/EA have applied a vessel limit of 15 seal deaths in the winter fishery[18]. Seal deaths or injuries can also occur more widely in the SEF and, although infrequent, proactivity in reducing negative impacts should be promoted by Industry. Current collaborative research in the SEF involving Seal exclusion devices (SEDs) is aiming to significantly reduce seal deaths in the fishery.

Semi-quantitative data on by-catch are available from the ISMP program. No risk assessment of the by-catch with respect to its vulnerability to fishing is currently available for the SEF. The AFMA by-catch action plan specifies strategies to reduce by-catch in the SEF by outlining a framework to assess the long-term impacts of trawl fishing and gear impacts on by-catch species and investigating the opportunities for habitat protection and gear modification to reduce any adverse effects of fishing on the environment. A shift towards the use of roller (bobbins) to access areas of previously untrawlable habitat is of concern to environmental managers (and more recently to the general public) in relation to impact on seafloor communities.

An indicator group of by-catch species (required under the EA protocols) is not currently monitored in the SEF. Similarly, there are no currently available decision rules in the SEF that trigger additional management measures when there are significant perturbations in the indicator species.

Under the EA protocols for sustainable fisheries, sygnathids (seahorses) are an issue for the SEF as a protected species (particularly in the Danish Seine fleet which occasionally catch seahorses). Semi-quantitative data are currently available.

Not much information on the impact of the SEF on ecological communities, or on ecosystem-level impacts of fishing, is available for the SEF. However, in 1994 CSIRO started a 5-year ecosystem study of the South East Australian continental shelf. The aim of the research program was to identify features that could extend the data available to manage the fisheries in this area, particularly the SEF. The research culminated in the production of a comprehensive report that established a

[17] Daley, R. K., Ward, R. D., Last, P. R., Reilly, A. , Appleyard, S. A., and Gledhill, D. C. (2000) Stock delineation of the pink ling (*Genypterus blacodes*) in Australian waters using genetic and morphometric techniques. FRDC Project 97/117. Stock status information is also published in the most recent Fishery Status Reports published by AFFA and BRS (1999).
[18] Apparently an ad hoc figure not based on any objective analysis of the interaction of seals and fishing vessels.

substantial foundation for continuing ecosystem level studies[19]. However, given that research of this nature had received at best only scant previous attention, there is only rudimentary knowledge of the function of the southeast ecosystem. For example, species interactions and associated energy flows (i.e. food chain function) are only one aspect of ecosystem function. The interaction between coastal oceanography (e.g. the confluence of water masses and the influence of upwellings) and fish assemblages has long been implicitly considered by fishermen knowledgeable in the spatial and seasonal variation in species abundance in the SEF.

The results of the CSIRO study suggest that the SEF is structured by food availability (i.e. prey species) rather than the abundance or otherwise of predators. Even though Tiger Flathead may have been important as a predator in the early stages of the SEF development, predators appear to be relatively unimportant in structuring the fishery. Marine mammals such as seals have been implicated in the declines of commercially important fish species. However, studies so far suggest that the principal prey species of seals are not commercial species[20]. Even so, discarding of unwanted fish in the SEF can potentially alter food chains by providing prey species to scavengers. Yet little is known of the ecosystem effects of discarding.

Modifications to gear and fishing practices have potential to reduce discarding but the financial implications of such modifications have not been determined. For example, it is known that juveniles of commercial species are more prevalent in shallow coastal waters than deeper shelf waters. Consequently, many small fish (unmarketable commercial species) are discarded by boats fishing in shallow coastal waters off New South Wales.

Fishermen report the decline in productivity of once-productive grounds in the SEF. For instance, habitat modification through chronic trawling disturbance may be a factor in the reduction of reef species such as Morwong, Snapper, Striped Trumpeter and rock lobster, but in the absence of objective information this is only conjecture. Clearly, more research is necessary on the fate of discards, and on habitat disturbance.

Industry knowledge developed over generations of participation in the SEF is an important resource to guide scientific study. Scientists engaged in the SEF ecosystem study successfully engaged Industry by factoring in knowledge of fishing grounds and seasonal variation in abundance of key species. For instance, local topography at the shelf break influences the availability of nutrient-rich water derived from deep-water upwelling and consequent productive fishing ground. Furthermore, the scientists employed Industry vessels in conducting surveys and mapping studies. Effective partnerships of Industry and Researchers are important, as many fishermen remain fearful that their participation in ecosystem studies will expose information that can be potentially used against them in restricting access to certain habitats in the SEF. Such fears are reinforced by the generally one-sided negative view of commercial fishing portrayed in the popular media.

Recent advances in technology including powerful acoustic instruments linked to geographical positioning systems integrated with formidable information technology

[19] Bax, N. and Williams, A. (2000). Habitat and fisheries production in the south east fishery ecosystem. FRDC Final report 94/040.

[20] See also Lalas, C. and Bradshaw, C. J. A. (2001). Folklore and chimerical numbers: review of a millennium of interaction between fur seals and humans in the New Zealand region. *New Zealand Journal of Marine and Freshwater Research* 35, 477–497.

have provided scientists with tools to map habitats and examine marine communities. Novel underwater camera technology has provided visual perspectives of fish grounds and their associated communities[21]. Such camera technology can also be used to examine fish behaviour in relation to trawl gear. Such studies could result in improved trawl gear with more effective targeting of quota species as achieved in some Australian prawn fisheries[22].

Consistent with the National Oceans Policy, EA is considering the introduction of spatial management to address avoiding impact on threatened (or perceived to be threatened) ecological communities. Spatial management relating to ecosystem management follows from the CSIRO study of the SEF (Bax and Williams 2000)[23]. Fishermen in the SEF believe that demersal trawls fish only a small part of the SEF ecosystem, a point reinforced by the results of the CSIRO study[24].

Fishermen emphasise the climatically-driven variability of the SEF ecosystem which they believe explains the inter-annual variability in component fisheries expressed through variation in catch rates, recruitment trends and so on[25]. With a more recent emphasis on whole-of-ecosystem studies, there is an opportunity to link hypotheses arising from observations of fishers to structured systemic studies of the SEF ecosystem (e.g. Bax and Williams 2000[26]). Even so, there is scant information to progress understanding of ecosystem function particularly relating to the beliefs of fishers.

A risk analysis, appropriate to the scale of the fishery and its potential impacts, as required under the EA guidelines (impacts on the biological community through removal of/or damage to organisms, addition/movement of biological materials such as discards) is not currently available (but could be included as part of AFMA's

---

[21] Barker, B., Helmond, I., Bax, N., Williams, A., Davenport, S., and Wadley, V. (1999). A vessel-towed camera platform for surveys of seafloor habitat. *Continental Shelf Research* 19, 1161–1170.

[22] M. Broadhurst and McShane, P (2000). Refining selective prawn trawls in Gulf St. Vincent the effects of increasing mesh size in the trawl body. *Professional Fisherman* 22 (6), 8–9. This article describes how by-catch in the prawn fishery was reduced by more than 75% with an increase in the catch of the targeted species (large king prawns).

[23] Bax, N and Williams, A. (2000). Habitat and fisheries production in the south east fishery ecosystem: final report to the Fisheries Research and Development Corporation. "*The cooperation of the fishing industry is highly desirable for effective spatial management because vulnerable seabed features often exist at fine-scales. In practical terms, it would be difficult-and potentially counter-productive to enforce effort restriction on such as small scale without Industry cooperation. Alternative approaches, such as restricting effort over larger areas by using spatial buffers, could reduce fishery productivity and cause fishers to fish harder in unrestricted areas. A requirement to use trawl gear that rides high off the seabed, facilitating trawling on hard-ground habitats without removing substrate or benthos, is an option worthy of further consideration. However, it would first be necessary to compare the benefits of reducing removals in fished areas with the benefits of leaving the areas unfished*' p. 389.

[24] Op cit. *"trawl effort is concentrated at small productive areas such as the margins of "hard grounds" that are fished repeatedly"* p 389.

[25] Prince, J. D. (2001). Ecosystem of the South East Fishery (Australia), and fisher lore. *Marine and Freshwater Research* 52, 431–449. This paper provides an overview of perspectives offered by SEF fishers and the available scientific information on relevant coastal oceanography and ecology.

[26] Bax, N. and Williams, A. (2000). Habitat and fisheries production in the South East Fishery Ecosystem. Final Report to FRDC. Project No: 94/040. This report is one of few to address food chain linkages in the SEF leading to a very basic understanding of ecosystem function.

Ecological Risk Assessment of Commonwealth fisheries). A summary of issues relevant to the SEF under EA's strategic assessment of fisheries is shown below.

Strategic Assessment of Commonwealth fisheries under ESD principles

Consequence	*Issue in the SEF*
Major retained/non-retained species	• Discarding • Sustainability of target species • Sustainability of non-target species
By-product species	• Sustainability of non-quota species • Risk assessment of by-catch species
Protected/endangered species	• Sygnathids (sea horses, pipe fish) • Deep water sharks • Seals
Habitat	• Impact on habitat structure • Impact on benthic communities • Importance of habitat in structuring fish assemblages • Risk assessment of above
Ecosystem	• Fates of discards • Food chain linkages • Effects of climate change and oceanographic anomalies • Risk assessment of above • Incorporating spatial management in an ITQ fishery

2.5 Research and development needs from an Industry perspective

The SEF Strategic Research Plan (2000–2001) was produced by the joint Research Sub-Committee of the SETMAC and the SENTMAC in consultation with SEFAG. The three main areas of research identified in the revised Strategic Research Plan (November 2000) are:

- fishery stock assessment;
- ecosystem/environment;
- socio-economics/management.

The consultation undertaken indicated that the Strategic Research Plan[27] has not been treated seriously. Fisheries are dynamic and political priorities can be ephemeral and influence research directions (e.g. ESD and ecosystem effects of fishing). Research can be better targeted to reflect two main areas including:

1. valid SEF research:
    - harvest strategies (targeting);
    - improving assessments;
    - selectivity/catchability;
    - EA requirements to meet strategic assessments.
2. industry development:
    - e-boat;
    - post-harvest (supply chain management);
    - economic/market development;
    - gear technology;
    - Industry training;
    - access security.

[27] South East Fishery Strategic Research Plan 2000-2001. The plan was prepared by the joint Research Sub-Committee of the South East Trawl Management Advisory Committee and the South East Non-trawl Management Advisory Committee. Both MACs have endorsed the plan.

For the first, valid SEF research, the current review focuses on gaps in the EA requirements for strategic fisheries assessment. For the second, Industry Development, the SE Fishery Industry Development Subprogram, supported by FRDC, has already yielded several important initiatives (e.g. the e-boat project applying information technology to cost-effective electronic recording of relevant on-board data) and is seen as very beneficial to Industry. For example, research underway in supply chain management offers to provide significant benefits measurable in higher prices and increased consumer demand for SEF species previously considered to be inferior e.g. Spotted Warehou. Projects such as this fall more in Development than in Research but are important nonetheless in harnessing capacity in the R & D sector, and building constructive partnerships between researchers and Industry.

There are other issues falling between mainstream SEF research and Industry development. Economic and social research is not traditionally favoured by Industry because these topics are somewhat remote from day to day issues in commercial fishing. Furthermore, the economic evaluations conducted so far do not match Industry perspectives or understanding of current status. Consequently, Industry is not encouraged to support further (and relevant) economic studies. Even so, ESD and access rights in fisheries are current and of increasing concern to Industry participants[28].

Gaps in the current research plan in relation to the requirement for a strategic assessment of the SEF (under the *EPBC* Act) are identified below.

Issue	*Gap*	*Identified in SEF research plan*
Fishery assessment	• Quantitative assessments lacking for 7 of 18 quota species	✔
	• Fishery independent biomass estimates (exist only for Orange roughy and Blue Grenadier)	✔
	• Catchability of all quota species	✘
	• Quantification of effective effort	✘
	• Targeting	✘
	• Stock structure for many species	✘
	• Discards	***as ISMP***
	• Recreational extraction	✘
By-catch	• Quantitative assessments	***as ISMP***
	• Assessment of vulnerable species	✘
	• Gear technology/fish behaviour	✔
Protected species	• General assessment	✔
	• Sygnathids	✘
	• Deep water sharks	✘
Impact on ecological communities	• effects of trawling on the benthos	✔
Impact on the ecosystem generally	• fates of discards/trophic interactions	✔

It can be seen from above that the SEF Strategic Research Plan does not currently provide for a number of gaps applicable to the EA Strategic Assessment. However, this may reflect the broad expression of research issues in the plan. For example, for

[28] The BRS has developed a framework for assessing how well fisheries are progressing with respect to ESD. The framework includes a simple hierarchical structure that sets out the effects of fishing, both positive and negative. Social costs and benefits are an important component. A case study drafted by Jean Chesson and Benjamin Whitworth (see www.fisheries-esd.com) illustrates the need for further refinement of social indicators as part of an integrated social, economic, and environmental analysis.

single species assessments and resolution of individual species issues to support fishery/stock assessments, the suggested program activity (2000–2005) is: *special research projects on individual species*.[29] The plan lacks focus and presents gaps in the understanding of catchability, quantification of effective effort, fleet dynamics and targeting, stock structure, and recreational extraction that apply generally across all SEF species. Of these identified gaps, stock structure and recreational extraction could be considered to be lower priority in relation to the TAC setting process, but they are issues relating to the EA Strategic Assessment nonetheless.

2.6 A revised strategic research plan

The revised strategic research plan focuses on current gaps in the requirement by EA to undertake a strategic assessment linked to the *EPBC* Act. It includes the main areas of research identified in the current SEF Research plan: Fishery and stock assessment; the Ecosystem/environment, and Socio-economics and Management. However, as the current SEF research plan identifies considerable overlap between the main areas and issues, the revised plan has been restructured accordingly. In contrast to the current research program, stock assessment is not put forward as a priority area for research. Rather, the plan provides for the components required for improved assessment, and in particular, a more transparent and robust TAC setting process. This is relevant in the context of increasing emphasis of ecosystem management of fisheries.

The Tables below identify needs in relation to current gaps, suggested approaches, comments in relation to Industry issues, and priority (in relation to other needs) (H = High, M = Medium, L = Low).

Existing programs of relevance to the SEF, e.g. the fixed station environmental monitoring program for the SSF could be integrated with SEF research as indicated below.

[29] In Appendix 1 of the plan: Framework and timeframes for research in the SEF. SEF Strategic Research Plan 2000–2001, November 2000.

Issue	Research need	Approach	Comments	Priority
Fishery assessment	• Relationship between catch rates and stock abundance for quota species	Fishery independent surveys using Industry vessels through ISMP	Opportunity to use Industry information and capacity more effectively. Need to address cost issues as Industry pays 80% of ISMP.	H
	• Fishery independent biomass estimates for priority quota species[30]		Fishery independent estimates of biomass only applied to aggregating species (Orange Roughy/Blue grenadier) using Acoustic surveys and egg surveys. The cost/benefit of such surveys, and the practicalities of obtaining estimates for the other priority species suggest that research resources could be better applied on other priority areas.	L
	• Catchability of priority quota species	Integrate information from fishermen with data obtained through the log book program and the ISMP	An opportunity to extend the current electronic data collection trial to obtain information direct from Industry.	H
	• Quantification of effective effort	As above	As above	H
	• Targeting	Use SEF database and revised modeling procedures	Current un-funded study by AMC/CSIRO is developing a model to better understand fleet dynamics and targeting of quota species in relation to catch rates	H
	• Improved assessment techniques	Harness current capacity particularly in CSIRO	Integrate more effectively with data collection programs including potential direct electronic recording of relevant data	H
	• Stock structure for quota species	Genetic/morphometric studies	Information required for the strategic assessment but low priority in relation to other needs	L
	• Discards	ISMP data collection	Particularly for Redfish, Ocean Perch, Mirror Dory and Blue eye Trevalla	M
	• Recreational extraction	Surveys, particularly of charter boats.	Particularly for Silver Trevally	L
By-catch	• Assessment of vulnerable species	Risk assessment program in concert with ISMP	Similar to that successfully completed for the Northern prawn fishery. The risk assessment could utilize the information currently available through the ISMP.	H
	• Reduced impact	Fish behaviour/underwater camera studies Fish gear technology	Current research using underwater cameras to investigate gear performance could be expanded to examine fish behaviour leading to reduced catch of unwanted species	M

Issue	Research need	Approach	Comments	Priority
Impact on ecological communities	• Effects of trawling on the bottom	Experimental trawls Underwater camera program	AFMA funded program Ecological Risk Assessment for Commonwealth Fisheries. Needs to be developed in consultation with industry	H
Impact on the ecosystem generally	• Fates of discards on the ecosystem	Experimental studies to determine food chain linkages	AFMA funded risk assessment. Some information already available from CSIRO study to undertake preliminary risk assessment	H
Protected species	• Seahorses • Deep water sharks • Seals	Linked to risk assessment program above ISMP	Mainly in the Lakes Entrance Danish Seine fishery AFMA funded program: Ecological Risk Assessment for Commonwealth Fisheries. National Action Program for Sharks Midwater trawl, Blue grenadier fishery but SEDs addressing problem. Issue in SETF requiring proactive examination to reduce impact	H H
Economics/ Management	• Interaction of market dynamics and management options	Analysis of quota trading prices in relation to TAC setting process	An issue for the industry is the impact of TAC changes on quota trading prices and the subsequent effect on asset valuation	H
Impact of management on economic efficiency	• Changes in management, particularly introduction of spatial management on economic efficiency of the fishery	Analysis of effort allocation and cost of allocation given various spatial management options	Emerging importance of ecosystem management promoted by EA could lead to spatial management (e.g. closure of some areas traditionally accessed by the SEF)	M
Post harvest/ marketing	• Effect of marketing strategies on the price of domestic seafood	Supply demand analyses	Best included as part of the SEF Industry development subprogram and incorporated in their operating plan	M
Supply chain management	• Whole of chain approach to quality assurance	Work practice analysis and identification of standards	Proactive approach to environmental management from point of capture to consumer. Opportunity for Industry to take responsibility and to develop market opportunities allied to “clean green” product. Incorporated with the SEF Industry development subprogram	M
Industry Development	• Leadership development for effective participation in consultative fora	Targeted training in relevant areas: policy, legislation, ESD, fisheries management, media presentation.	Link to current initiatives in this area to ensure that succession plans are in place for current Industry participants in the consultative process	H

2.7 Research Projects current and proposed in relation to the revised Strategic Research Plan

The current research projects have been identified through the South East Fishery Strategic Research Plan (as listed November 2000) and as listed by FRDC as current SEF projects. Proposed research projects have been taken from those provided by FRDC as the list of projects submitted for the 2002 funding round (see www.frdc.com.au). These projects are aligned to the revised Strategic Plan (see Tables above) and gaps noted.

Issue	Research need	Current projects	Proposed projects
Fishery assessment	• Relationship between catch rates and stock abundance for quota species	None identified	2002/072 Assessing the feasibility of an industry-based fishery-independent survey of the SEF
	• Fishery independent biomass estimates for priority quota species[31]	99/111 Development and application of a combined industry/scientific acoustic survey of Orange Roughy in the Eastern Zone "	as above but no projects directly addressing this issue.
	• Catchability of priority quota species	None identified	as above but no projects directly addressing this issue.
	• Quantification of effective effort	None identified	As above but no projects directly addressing this issue
	• Targeting	Unfunded AMC project with CSIRO using SEF database to identify targeting practices	Continuing studies using SEF database.
	• Improved assessment techniques	98/102 Defining robust harvest strategies, performance indicators and monitoring strategies for the South East Fishery 2000/101 Development of harvest strategies for selected South East species	2002/094 Using information for 'Data rich" species to inform assessments of "data poor" species through Bayesian stock assessment methods.
	• Stock structure for most species	97/118 Stock structure of Australian populations of Orange Roughy using microsatellite analyses	**None proposed**
	• Discards	98/204 Effects of trawling subprogram: Maximimising yield and reducing discards in the South East Trawl Fishery through gear development and evaluation. ISMP data collection	ISMP observer program
	• Recreational extraction	National Recreational Fishery Survey	**None proposed**
By-catch	• Assessment of vulnerable species	AFMA Ecological Risk assessment program	2002/086 National ESD for fisheries: from reporting to assessment
	• Reduced impact	Effects of trawling subprogram (as above)	2002/034 Effects of trawling subprogram: Bycatch reduction in the NSW and SEF royal-red prawn fishery through modifications to gear and fishing practices 2002/093 Selectivity and bycatch reduction of eastern school whiting nets in the Danish Seine fishery

Issue	Research need	Current projects	Proposed projects
Protected species	• Seahorses	ISMP observer program	**None proposed**
	• Deep water sharks	As above	2002/033 Rapid assessment of sustainability for ecological risk of shark and other chondrichthyan bycatch species 2002/031 Critical habitat and movements of endeavour dogfish (*Centrophorus* spp.) in southern Australian waters
	• Seals	As above SED program	**None proposed**
Impact on ecological communities	• Effects of trawling on the bottom	2000/153 Integrating fishing industry knowledge of fishing grounds with scientific data on seabed habitats for informed spatial management and ESD evaluation in the South East Fishery	AFMA funded program Ecological Risk Assessment for Commonwealth Fisheries.
Impact on the ecosystem generally	• Fates of discards on the ecosystem	2000/153 Integrating fishing industry knowledge of fishing grounds with scientific data on seabed habitats for informed spatial management and ESD evaluation in the South East Fishery	2002/086 National ESD for fisheries: from reporting to assessment. 2002/028 Trophic dynamics of the eastern shelf and slope of the South East Fishery: impacts of and on the fishery 2002/029 Identifying and understanding critical habitats of major fish species in the South East fishery
	Environmental monitoring	Fixed station environmental monitoring SSF	
Economics/ Management	• Interaction of market dynamics and management options	None current	**None proposed**
Impact of management on economic efficiency	• Changes in management, particularly introduction of spatial management on economic efficiency of the fishery	None current	**None proposed**
Post harvest marketing	• Effect of marketing strategies on the price of domestic seafood	AFFA funded study by AMC value adding Spotted Warehou	**None proposed**
Supply chain management	• Whole of chain approach to quality assurance	As part of operating plan for the SE Industry Development Subprogram	2002/245 South East Industry Development Subprogram: Development of an Australian seafood industry waste utilization company (and related projects)
Industry Development	• Leadership development for effective participation in consultative fora	Seafood Industry Leadership Development Program AMC MAC training courses	Link to National Seafood Industry Training package focused to Industry needs

2.8 A proposed schedule for Research and Development in the South East Fishery. *(high priority projects are green, lower priority orange)*

Issue	Project	2002/3	2003/4	2004/5	2005/6	2006/7
Fishery	Assessment of options for fishery independent survey					
	Catchability of priority species with fishery independent surveys					
	Targeting in relation to reported catch rates and fleet dynamics					
	Evaluation of electronic data collection by fishery participants					
	Application of expanded data collection protocols utilizing electronic data from the fleet					
	Inclusion of improved parameter estimates in assessment and modeling of priority species					
	Evaluation of observer monitoring program to provide for robust estimation of discards					
	Estimation of change in effective effort and inclusion in revised assessment of priority species					
	Estimation of recreational fishery extraction for quota species					
	Stock structure of remaining quota species					
By-catch	Ecological risk assessment					
	Impact mitigation strategies for at risk species					
	Reducing catches of sygnathids					
	Assessment of impact of SEF on deep water sharks					
	Impact mitigation strategies for seals					
Ecological communities	Ecological risk assessment: impact of benthic trawling					
	Impact mitigation strategies for demersal trawling					
	Effects of discards on SEF food chains					
Ecosystem	Ecological risk assessment: fisheries interactions					
	Environmental monitoring program					
Economics/ management	Impact of management changes to ITQ on quota values					
	Impact of spatial management on economic efficiency					
Post harvest	Value adding strategies					
Supply chain management	By-catch utilization/evaluation					
	Application of by-catch utilization in the SEF					
	Environmental accreditation program					
Industry Development	Leadership/career path development					
	Entry level training (OH&S, environmental management)					

2.9 Recommendations in relation to revised Strategic Research Plan

- Harness Industry capacity more effectively particularly in extending the ISMP to provide for fishery independent surveys and utilization of electronic data collection capacity;

- Harness Industry capacity more effectively to develop onboard data collection capacity for environmental data (e.g. sea surface temperature);

- Improve utilization of Industry data (and the SEF data base) to identify targeting practices (fill out "target" field in logbook record);

- Improve utilization and reliability of Industry data by validating SEF 1 (estimates of catch from quota records) against SEF 2 (estimates of catch from logbooks);

- Improve understanding of the relationship between catch/catch rates and stock abundance by undertaking fishery independent assessment (through extension of the ISMP), analysis of targeting practices (as above), and correlating with environmental data such as sea surface temperature;

- Address gaps in the EA requirement for strategic assessment particularly relating to ecological risk assessment;

- Address gaps in the EA requirement for vulnerability assessment of endangered/protected species (particularly seahorses and deep water sharks);

- Link environmental programs in other fisheries (e.g. Southern Shark fixed station research) to the SEF;

- Improve utilization and robustness of ISMP data in evaluation of by-catch, discards, vulnerable species, by evaluating and allowing for operator variation in estimation procedures;

- Extend results of Industry programs and encourage greater participation in collaborative industry research, particularly ISMP and the SE Industry Development Subprogram, by the "grass roots" through port visits and presentations;

- Promote targeted training programs to develop awareness of the 'big picture' issues facing Industry (e.g. ecosystem management, ESD, supply-chain management, access right security, public relations);

- Promote timely evaluation and assessment of research projects via the expanded SEFAG and, where necessary, undertake contested assessments via the Plenary.

3. Research Funding Sources and Strategies

The Ecological Risk Assessment for Commonwealth fisheries supported by AFMA should be focused on the SEF. Opportunities to link or extend the risk assessment (addressing the EA's strategic assessment) should be pursued with FRDC as FRDC funded a similar assessment of the Northern Prawn Fishery.

With a reinforced Industry/researcher partnership linked to a transparent targeted research planning process, funding from traditional sources such as FRDC should be at least maintained. With the development of regional plans as part of the National Oceans Policy, there are opportunities for coordinated studies of the southeast marine ecosystem coordinated through the National Oceans Office harnessing capacity in CSIRO and the state based agencies and Universities. The need for long-term coordinated studies is consistent with Industries need for a more defensible basis for their continued operation. Substantial funding opportunities are available, including Australia Research Council where large grants are applicable

Other programs relevant to the SEF are summarized below:

AusIndustry
Ausindustry is the Commonwealth Government's business unit, designed to help Australian businesses become more competitive and internationally competitive. It provides funding to businesses/and or organizations through its R & D start program. R & D Start provides up to 50% of R &D funding with the remainder provided by the Industry participants. This program is more applicable to individual businesses within the SEF rather than the Industry itself. However, there is potential to develop innovative applications such as By-catch utilization. (see www.ausindustry.gov.au).

Supermarket to Asia
The government's Supermarket to Asia strategy brings together government and industry leaders to work on improving the competitiveness of Australia's fresh and processed food exports to Asia. A key element is the emphasis on supply chain management that would link well with current initiatives in the SEF. Typical projects will help Australian exporters target international supermarket and food service chains. Although there is little direct relevance to the SEF at present, successful value-adding initiatives (e.g. spotted Warehou) could provide export opportunities developed through this program (see www.supermarkettoasia.com.au).

Agriculture – Advancing Australia
FarmBis
There are two elements to FarmBis funding – the ongoing FarmBis program jointly funded by the Commonwealth and the States, and the new national component – FarmBis Australia. Activities supported by the joint Commonwealth state initiative include skills development, quality assurance, leadership development and marketing. Thus, this aligns well with the proposed Industry development programs identified in the revised strategic plan. The national program supports strategic projects aimed at enhancing the business management skills of Australian fisheries (among other primary producers). Examples include development of supply chain accreditation programs (e.g. current submission for "pot to plate" accreditation of the South Australian rock lobster Industry).

Farm Innovation
The Farm innovation program provides grants to eligible fishing businesses to adopt innovative practices, processes or products. Current examples of projects supported by Farm innovation include the SEF e-boat initiative. Other opportunities relate to

proposed by-catch utilization, electronic data utilization, and supply chain management. Projects are funded up to 50% of the eligible project costs with no minimum or maximum funding levels set. (see www.affa.gov.au).

Australian Research Council (ARC)
The ARC is the main funding agency in Australia for basic research. It is generally applicable to the Universities, state or federal research agencies not being eligible. However, there are opportunities to progress partnerships with researchers in University particularly in relation to the need for wider scale ecosystem studies in the SEF (see www.arc.gov.au).

Environment Australia
Environment Australia administers the Coasts and Clean Seas component of the National Heritage Trust to tackle Australia's coastal and marine environmental problems, now and into the future (www.ea.gov.au/programs). Programs including pollution mitigation in the fishing industry have been funded (e.g. South Australian rock lobster fishery for port waste disposal facilities) and provide similar opportunities for the SEF. Such initiatives are also funded through the *Marine Waste Reception Facilities* program. The Marine Species Protection program provides opportunities for funding studies of, and programs aimed at reducing impacts of, endangered or protected species. This has relevance in the SEF particularly for sygnathids, seals, and deep-water sharks.

National Oceans Office
The National Oceans Office provides grants linked to the *Coastal and Marine Planning program* (www.oceans.gov.au). This program assists Local and State Governments to improve the quality of their plans that effect the coastal and marine environment. Proactive strategies to reduce the impact of commercial fisheries on the marine environment would be relevant here and provide opportunities for the SEF.