An Evaluation of Completed FRDC Projects

Final Report

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NON TECHNICAL SUMMARY:

OUTCOMES

This project measures (both quantitatively and qualitatively) the performance of FRDC funded R&D including the extent to which it has contributed to the decisions made by (primarily) fisheries management agencies. It is intended that this information will then be used by the FRDC to improve the planning, funding and management of its portfolio as well as documenting R&D performance over time.

The results of this study shows that the FRDC R&D portfolio has generally performed to a high standard. Completed R&D is consistently used to inform fisheries management decisions and is shown to have contributed significantly to the sustainable management of important recreational and commercial fisheries.

Expenditure on fisheries research in Australia is significant, with over $A20 million spent annually by the FRDC. The FRDC undertakes regular project and program evaluations that are aimed to inform the way in which the FRDC goes about its core business. This study is one example of the FRDC project evaluation process.

The study reported here includes two separate end-user surveys as well as three separate fishery case studies including the Northern Prawn Fishery, the South Australian Rock Lobster Fishery and shared recreational/commercial fish stocks in Queensland. Although the focus of the study was on R&D that pertained to the wild catch sector and fisheries management in particular, the two surveys did include projects based on other subjects including aquaculture, human health and environment.

The research method used for the case studies was semi-structured interviews with end-users and research providers. The results from both surveys as well as the case studies, are presented in this report.

The results showed that the research undertaken throughout the 1990's has been consistently used to inform fisheries management and other decisions made by agencies and businesses engaged in the fishing industry. Completed projects averaged a score of 70% when evaluated by end-users.

FRDC projects were demonstrated to have been instrumental in contributing to the information base underpinning some of Australia's key commercial and recreational fisheries. This contribution is such that some of the critical fisheries management decisions may not have been made, least of all within the necessary period to allow a timely biomass rebuilding or optimal resource allocation response.

Areas of potential improvement to the project planning, funding and management process were also identified, as were the most critical points in the life cycle of a project. These areas of potential improvement include communication with and involvement by end-users, as the study suggested that there may be need for improvement in this area. In addition, ensuring that only the highest priority research is funded together with a clear management adoption process, will also require ongoing discipline so that the already high rates of adoption, are further improved.

The results also suggest that end-user surveys and semi-structured interviews are a practical technique for portfolio or program level evaluations, as an augmentation to but not replacing traditional benefit-cost analysis. To this end, comprehensive periodic (every 3-4 years) end-user surveys would make a valuable contribution to the FRDCs project and program evaluations.

KEYWORDS: **Research evaluation, project evaluation, ex-post, survey, end-user**

Background and Need

Governments are increasingly demanding that publicly funded Research and Development (R&D) recipients demonstrate that public money is being spent appropriately and that research expenditure is generating positive impacts for the community (Industry Commission 1995, Huffman and Just 2000). Every four to five years, the British 'Research Assessment Exercise' (RAE) is used to measure (via a panel approach) research quality across the British university sector. In the case of the most recent RAE, the UK Government used the results to distribute around five billion pounds in research funding (Hero 2002). In the United States, the US Federal Government's *Government Performance and Results Act 1993* requires all US federal agencies to set measurable goals for their programs. The extent to which these goals are achieved must then be quantified and reported on under the act, and it is this measurement – the measurement of performance - that has created a unique set of problems for agencies that primarily fund research (Cozzens 1997).

A similar trend in federal Government reporting requirements has occurred in Australia. In 1997, the federal government introduced an outputs and outcomes reporting framework for all its agencies, claiming that this will improve the efficiency of the public sector and bring it into line with best practice in the private sector and facilitate a culture of performance (DOFA 1998). Although not designed primarily for reporting on or evaluating research performance, outputs and outcomes are now used by many Australian federal R&D agencies to measure their performance, particularly for the purposes of reporting to government.

The issue of research evaluation is gaining increasing currency in Australia and the field is rapidly evolving. In 2005, the Federal Government released an issues paper titled *"Research Quality Framework: Assessing the quality and impact of research in Australia"* (DEST 2007).

In 2006, the Government announced that the 'RQF' will be implemented through 2007 and 2008 as a new and comprehensive research evaluation process, with funding tied to the results from 2009. It is quite likely that the introduction of the RQF, which appears to be similar in aim and scope to the British RAE, will shift resources towards a more

comprehensive evaluation process for research than we have seen in the past, as research institutions implement new research management and performance evaluation systems.

Science plays an important role in environmental management and in the context of ocean governance, has made significant (if variable) contributions (Boesch 1999). Management of the marine environment and fisheries in particular, has and will continue to rely on science in order to optimise management (Kearney 1978, Kesteven 1999, Ward et al 2000).

The role of research management in influencing the performance of fisheries research (and environmental research in general) is also likely to receive much greater attention as the drive to demonstrate performance within the context of the RQF intensifies. Further, post project evaluations are important institutional learning mechanisms (Busby 1999) and their role in improving Australian fisheries research should not be underestimated.

The FRDC is considered to be the lead agency responsible for fisheries research in Australia (FRDC 2000). It is the single largest funding agency for fisheries research in Australia, with expenditure over the period when the research subject to this study was completed, of approximately $A20 million, $A18 million of which is provided by the Federal Government (FRDC 2002). In 2005, over $A60 million was invested in FRDC projects. This represents the bulk of fisheries research undertaken nationally. Given the FRDC's prominent role in the Australian fisheries research landscape and its policy of continual improvement in the fisheries research planning, funding and management process, it needs to and does, regularly undertake project or program evaluations.

Publicly funded scientific research appears to have reached a 'steady state' (Zinman 1994) whereby budgets cannot keep increasing as they have in the past and scrutiny of publicly funded research performance is increasing as evidenced by the Australian Federal Government's proposed RQF. Fisheries research budgets have not been exempt from this pressure, with either budget reductions or greatly increased competition for limited funds (Gray 2000, FRDC 2006) being typical of the current business environment. This alone provides sufficient imperative to document research performance with a view to continual improvement and ex-post research evaluations such as this, can play a useful role in achieving this.

Objectives

1. Determine the extent to which Fisheries Research and Development Corporation (FRDC) funded R&D has contributed to the decisions made by fisheries management and other agencies and businesses, engaged in the fishing industry

2. Develop and or inform the development of a quality procedure for ongoing program evaluation

Methods

Survey One

The end-users of 70 completed FRDC projects costing the FRDC a total of $A13.2 million were surveyed. Those surveyed typically included fisheries managers, fishing industry representative organizations, owners or managers of commercial seafood enterprises, individuals involved in technology transfer to the seafood industry as well as fisheries 'Management Advisory Committees' (MACs).

The 70 projects were undertaken between 1990 and 1998, with the final reports being submitted between 1996 and 1998. Projects of a very generic nature or where direct end users were difficult to identify for some other reason, were excluded from the study because the method required clear identification of end-users for survey purposes. At least six months, although typically longer, was allowed to elapse between the submission of the final report and survey being distributed. This was designed to maximise the time available for the R&D adoption process.

Two hundred and twenty self administered surveys (questionnaires) were mailed to the end-users of these projects Australia wide, over a two year period. The questionnaire comprised 12 items that were used to elicit end-users' opinions regarding the planning, execution and use of project results. Each item was scored so that the more positive the response, the higher the score. Projects included were post harvest, fisheries management/science, aquaculture, habitat and environment, research planning, human capital development and basic science, and resource allocation

Survey Two

The end users of 32 completed FRDC projects worth a total of $A12.9 million were surveyed. Typical end-users were little different to those of survey one. The 32 projects were undertaken between 1991 and the start of 2001, however over 90% of these projects had a final report submitted between 1998 and 2001 and all fell within the project number range 1991-1998.

The sample was selected with an emphasis on projects that started in 1995 and 1996 as these project years were underrepresented in the previous survey because so few had been completed when the first survey was undertaken. There was also a more restricted range of project topics than for the first survey and with an emphasis on projects that were fisheries management/science focused, although aquaculture, habitat/ecosystem and human health projects were also included. The reason for this was because fisheries management/science focused research was to be subject to further evaluation using semi structured interviews.

One hundred and fifty five self administered surveys (questionnaires) were mailed to the end users of these projects, over a two year period. One of the results of the first survey was that the length of time involved in completing a fisheries project (between 4-7 years) means that the person who was involved in the development of the project may not be the person using the results. Survey two was designed to accommodate this via a 'my predecessor' response option. No scoring system was used for the second survey.

Case Studies

Three separate fisheries were chosen that had a history of FRDC funding. The overall aim was to document the extent to which FRDC projects had contributed to fisheries management outcomes. The fisheries chosen were:

- The Northern Prawn Fishery (NPF);
- South Australian rock lobster; and
- Fish stocks in Queensland shared by the recreational and commercial sector

Key end-users of FRDC project outputs as well as the main research providers were interviewed using a semi-structured interview technique. In some cases where end users had very limited time available, less structured interviews were used. Those interviewed included the key fishing industry representatives as well as fisheries managers and researchers for each of the case studies.

The reason for choosing these particular ‘fisheries’, was that they represented (to some extent) the diversity in the Australian fisheries landscape. The NPF which is one of the largest and corporatised fisheries in Australia, through to what has (until recently) been an owner operated SA Rock Lobster Fishery, and the inshore and reef fisheries in Queensland, where stocks are shared (and heavily competed for) between the commercial and recreational sector and where recreational fishing participation is over 700,000 annually.

Results

Survey One

The overall response rate from all end-users was 45%. Response rates between 'industry' and 'non industry' end-users was similar and not significant. However, MAC end-users responded poorly to the survey, at a rate of only 16%.

Table 1 below presents the individual items and the proportion of respondents who gave a positive response to each item. A positive response was generally defined as being above the mid-point of the scale.

Table 1. Item descriptions and proportion of positive responses from end-users

Item No	Item description	Proportion of positive responses
1	Awareness of the project	80%
2	Extent of initial consultation	57%
3	How urgent was the need for the research	74%
4	Extent of industry involvement in the project	36%
5	Effectiveness of communication during the project	45%
6	Effectiveness of communicating project results	58%
7	To what extent were the project objectives achieved	66%
8	What do the project results mean for the fishing industry and community	78%
9	Extent to which results will be adopted	71%
10	Suggestions for further research	na
11	Overall impression of project results	90%
12	Overall impression of the value of this project	86%

Note: Question 10 was open-ended.

Composite scales

In order to examine relationships among the different items, a sub-set of composite scales was created by combining the scores on those items that appeared to be tapping a similar theme. The composite scales were:

- Research priority;
- effectiveness of communication; and
- adoption of results.

Correlations among the items were then examined to determine which themes were related. Not surprisingly, all the scales were moderately associated, indicating that a more positive appraisal in one theme was associated with a more positive appraisal in another. This means that although effectiveness of communication and adoption of results are important, the priority of the research had by far the strongest relationship to end-users overall impressions of research performance. When testing this result via a multiple regression, research priority had the greatest unique contribution to end - users overall impressions of projects, by approximately three times.

Project scores

A total score for each project was computed by adding the scores for each item and averaging these scores across the end-users. This yielded a scale that could range from 0-30, which was rescaled to range from 0-100 to be more easily interpretable. The average score for the projects where full responses were received, was 70%.

Analysis of variance was used to determine whether the total project scores differed by type of project. No statistically significant differences were observed between projects of different types ie fisheries management/science, aquaculture etc. Total scores for the composite scales (communication, priority, adoption and overall impression) were also calculated and analysed for differences by type of project. Again, there were no significant differences.

The average total score for projects which were focused on issues where State/Territory Governments had management responsibility was 76% (SD=24.3) and where the Federal Government had management responsibility, the average score was

77% (SD=22.8). This difference was not significant. Differences were also considered by comparing project age with the total score as well as the composite scale scores. Again, no significant differences were found.

There was however, a significant difference in the total scores when evaluated by 'industry' or ‘non industry’ end-users. On average, non-industry end-users gave significantly higher ratings to projects than industry end-users (mean=78% for non-industry, mean=65% for industry).

Survey Two

The overall response rate from all end-users was 33%. Categorisation of respondents for this survey went beyond that of survey one, and included fisheries ‘managers’, fishing industry ‘representatives’, fishing ‘businesses’ and Management Advisory Committees ‘MACs’. The response rates for each category of respondents was:

a. Managers = 49%
b. Representatives = 26%
c. Businesses = 14%
d. MACs = 38%

In a marked change from survey one, the response rate for MACs exceeded the average while fishing businesses and industry representatives responded at a rate below the average.

Table Two and Three below presents the individual items and the proportion of positive, negative and unsure or average, responses for each. A positive response was defined as being above the mid-point of the scale. A neutral response was the mid point of the scale specifically, “unsure” or “average” and a negative response below the mid point.

As a result of feedback from the first survey, the second survey made provision for respondents to answer even if they personally had not been involved in the planning or implementation of the project. Given the many years it takes to plan, undertake and

then implement the results of a fisheries project, it became apparent from the first survey that some of the key end users had changed jobs by this time – hence the 'my predecessor' response category. As it turned out, this response option did not prove to be particularly useful as the majority of respondents were able to complete the survey in the first person hence, a large number of missing fields from the "my predecessor option" made a robust statistical analysis all but impossible. However, where the data is reliable and useful (as presented in table 3) it has been included in this report.

Table 2: Responses for each item from end-users selecting the "Me" response category

Item No	Item description	Proportion of positive responses - Me	Proportion of neutral responses - Me	Proportion of negative responses - Me
1	Involvement in identifying the need for the project	39%	17%	44%
2	Involvement in planning and developing the project	12%	9%	79%
3	Extent of involvement during project	25%	12%	63%
4	Effectiveness of communication during the project	33%	18%	49%
5	Effectiveness of communication of project results	54%	14%	32%
6	Use of project results	50%	17%	33%
7	Achievement of project objectives	77%	10%	13%
8	Quality of the science	94%	6%	0%
9	Researcher reputation	81%	15%	4%
10	Research organisation reputation	70%	23%	7%
11	Level of research priority	86%	2%	12%
12	Overall impression	85%	9%	6%
13	Project benefits	77%	6%	17%

Note: Item14 was not scaled so it is not presented in this table

Table 3. Responses from end-users selecting the "my predecessor" response option

Item No	Item description	Proportion of positive responses – My Predecessor	Proportion of neutral responses – My Predecessor	Proportion of negative responses – My Predecessor
1	Involvement in identifying the need for the project	33%	29%	38%
2	Involvement in planning and developing the project	14%	41%	45%
3	Extent of involvement during project	19%	24%	57%
4	Effectiveness of communication during the project	32%	53%	16%
5	Effectiveness of communication of project results	47%	29%	24%
6	Use of project results	31%	46%	23%

Note: Item14 was not scaled and the "my predecessor" option was not applicable to items 7-13 so they are not presented in this table.

Analysis of variance was used to determine whether the responses to each item differed by type of project, by project age and by end user. The end-users were catagorised as described above and the projects were grouped into the following:

- Fisheries science/management
- Aquaculture
- Environment
- Human health

Generally, no significant difference in responses was obtained for those end-users responding as 'industry' end-users and those responding as 'non –industry' (the majority of which were government employed fisheries managers). The one statistically reliable exception was for question 9 which asked the end-user for an opinion on how they felt the researchers' reputation influenced the overall outcome of the project. Here, 'industry' end-users consistently responded more negatively on the 5 point scale than 'non industry' (mean 3.8 SD 1.1 Vs 4.5 SD.75)

Projects in the fisheries science/management category had significantly greater positive responses for items 4, 5, 6 and 11 in the questionnaire ie communication during and post project completion, results adoption and the priority of the project. Further, the responses to most questionnaire items for fisheries/science management type projects showed a clear trend towards being more positive than the other project types (although for various methodological reasons, they were not statistically significant except for the items above). This result was in contrast to the first survey where there was no statistically significant difference between end-users evaluations of the various project types.

Also in contrast to the first survey was the result that showed the mean responses to items 3a and 4a (extent of involvement during project & effectiveness of communication during the project) got progressively more negative the more recent the project was. In order to ensure the most balanced analysis, projects were grouped into 3 age groups, 1991-1994, 1995, and 1996-1998 and an analysis of variance undertaken. This analysis shows that projects in the 1996-1998 age group had more negative responses than the 1995 projects which in turn were more negative than the 1991-1994 cohort.

Composite scales were not developed from this survey data. However a similar process involving the study of the relationships between the survey questions, was undertaken using a different analytical technique. The results largely confirm those of the first survey, in that research priority was the factor most strongly related to whether end-users thought positively of completed projects. However, as for survey one, other factors that were significantly correlated with overall impression were:

- extent to which end-users were involved in project planning and development;

- quality of the communication process both during and after the project;
- quality of the science;
- reputation of the researchers and their organisation; and
- extent to which project results were used.

One other difference between the results of the first and second survey was that in the first survey, industry end-users rated projects less positively than non-industry end users. The second survey showed no significant difference between end users responses to any item in the survey except item 9 (researcher reputation effect on project outcomes) as discussed above.

Discussion

Survey One and Two

The use of questionnaires to survey end-user opinion was generally successful, with a response rate of 45% and 33% for survey one and two respectively. This enabled a rigorous statistical analysis. Deriving a project score from the responses for survey one also provided an additional assessment tool.

The findings from both surveys indicate that the fisheries research funded by the FRDC is well regarded by the people who are at the front line of research adoption and implementation, with an average score across all project types of 70% (in survey one) and 85% of respondents in survey 2 providing a positive 'overall impression'. However, areas of apparent weakness were identified, most notably dealing with communication and consultation, both during project development and while the project was being undertaken and this is discussed below.

The findings also showed that a positive evaluation of a project in one area eg priority of research, was associated with more positive evaluations in all the other areas. Even though research priority was the strongest predictor of an end-users' positive evaluation of a project, communication and involvement in the planning process is still important. It is likely (and probably no surprise) that 'getting off to a good start' in terms of consultation or communication between research service providers and end-users, should not be underestimated.

The priority of research was also the most significant factor in determining whether an end-user thought the project was worthwhile. These results suggest that in order to maximise end-user satisfaction, it is important for research funding agencies and service providers to ensure that only high priority research is undertaken and that mechanisms to ensure input from end-users are institutionalised. The FRDC has done a lot on this front although the results indicate some possible room for improvement.

If one assumes (perhaps arguably) that end-users' interpretation of 'high priority' research generally excludes 'basic' or 'strategic' science projects (projects that may not have an immediate and well defined practical use but which may play an important part in scientific training or pave the way for subsequent research) then the results of this study suggest there may be implications for the way research funding agencies decide to allocate future resources. That is, if their aim is to maximise end-user satisfaction, an increased emphasis on applied research (and even then only the high priority projects) may come at the expense of strategic science to the point where this type of research may no longer be funded.

Most of the projects evaluated within this study were 'applied' in nature and typical of the FRDC portfolio. While funding only the high priority research is likely to contribute to end-user satisfaction, it may not necessarily result in an optimal research portfolio, especially given that the most desirable mix of applied research and basic science is rarely clear-cut and also tends to change depending on circumstances (Pannell 1999). It is likely that the apparent tension suggested in the results of this study between maximizing end-user satisfaction through funding only the high priority research at the expense of basic research, is likely to continue into the foreseeable future.

Project scores and responses to survey items

A total project score based on the response of end-users to the items in the survey proved to be an effective way to present the evaluation results for survey one. Qualitative evaluations along with quantitative metrics such as citation indexes, are widely used in international research assessments (DEST 2005) as typified by the British RAE, so the scoring approach used for survey one proved to be an interesting exercise.

It was logical to use questionnaires as the major research tool as it combined both the quantitative elements usually restricted to citation indexes or BCA, with the qualitative elements typified by peer or expert stakeholder reviews - but with the added function of enabling the calculation of a project score at the end of it.

The results for each item in the questionnaires (summarised and presented in Tables 1-3) also provided more specific information on end-users' opinions of project performance at various stages throughout the project cycle. For instance, the results of the survey items addressing project communication issues showed that the proportion of positive responses varied between 33% - 58% across both surveys.

Given that 'industry' end-users evaluated projects so they scored significantly lower than those evaluated by 'non industry' end-users in survey one, it appears that the industry involvement may have been inadequate. Project communication among all end users still appears to be in need of some improvement and the surveys show no clear indication that this has happened between the project years 1991-1998. In fact, end-user involvement while the project was being undertaken and the communication they received was shown to get worse as the years progressed, not better. This is despite the increased emphasis the FRDC was placing over this period on the importance of communication between research providers and end-users.

It is important to recognise though, that the issue of consultation and communication with end-users is one of balance and funding agencies and service providers must assess the benefits of increased consultation and participation against the possible disadvantages such as increased time and administration costs and raised expectations (Davis 1996).

End-user consultation in the research process also requires significant staff time within the funding agency as well as end-user time and operating funds to attend meetings, make presentations, provide written submissions, consult with their constituency etc. For this reason, it is not always a simple case of 'more is better' when it comes to consultation and communication.

The decision over level of consultation and communication will be determined by the extent to which participation in the research process is a means to an end or an end in itself (see Buchy and Hoverman 2000 for concise discussion on this topic) and this will vary between fisheries and the type of R&D. What the survey results do show is that the communication and consultation processes used by the FRDC over the first 10 years of its operation may have been less than optimal if end-users opinions on this

issue are to be taken as a literal guide and it provides a useful benchmark for future measurement.

Another important finding of the first survey that warrants discussion is that only 36% of the industry end-users provided a positive response regarding the extent of their involvement in projects. Again, this suggests a potential area for improvement, although the results should be interpreted with caution as not all fisheries projects are conducive to industry participation. As with the broader end-user consultation discussed above, more industry participation is not necessarily better as there can be significant costs associated with it.

The importance of industry participation in research is not new in the literature and Harte (2001) argues that industry participation in research has many benefits and that the benefits go far beyond the role of providing additional data or funding. In the action research field, Russell et. al. (1987) also argues that participatory research is vital to achieving optimal development and resource management outcomes.

The fisheries co-management literature also discusses the need for stakeholders to participate in the fisheries management process (Symes 1997, Pomeroy & Berkes 1997, Noble 2000). There is also evidence to suggest that excluding a key group from any participatory process (whether by accident or design) can lead to that group refusing to accept the outcomes (Glicken 2000).

Industry participation is not simply a matter of being in or out, it is a matter of degree. This can and does vary depending on how industry views the relevance of the research as well as the nature of the research. For example, projects that focus on the development of mathematical models are very difficult to involve the industry in. There are very practical limitations to involving end-users (and industry in particular) in this type of work. However, the long standing partnership between the CSIRO (a key research provider for the Northern Prawn Fishery) and the NPF industry demonstrates that this participation balance can be achieved, although it has only come about through hard work over many years – a point that was made clear by end-users interviewed as part of the case studies discussed in the next chapter.

Given the important role that science should play in a fisheries management system (FAO 1995) there is good reason to consider industry participation in the project development process (not necessarily each and every project) as being at least as important as industry's participation in framing fisheries management arrangements. This participation in the project development process should then extend to the project itself, but only when appropriate.

In survey one, there was no significant relationship between project score, the individual scores for the composite scales (communication, priority, adoption and overall impression), and the following variables:

- the age of the project;
- whether the fishery fell under the jurisdiction of state or territory or federal governments; and
- the type of research (wild catch fisheries, post harvest, resource allocation, aquaculture etc).

The finding that non-industry end-users evaluated completed projects more positively than those from within the fishing industry (mean=78% for non-industry, mean=65% for industry) is not really surprising. Given the harsh reality that the results of research have and will continue to be used to reduce fishing effort, sometimes among great controversy over the meaning of the science, it is not unexpected that the fishing industry will be more sceptical about the 'benefits' of completed research than government employed fisheries managers. However, the attitude of the fishing industry to R&D appears to have evolved.

The second survey, which addressed more recent projects and where the FRDC industry consultation processes had been steadily improved, showed no significant differences in responses between industry end-users and non industry, except for item 9 which asked about the effect of researcher reputation on project outcomes. The fact that industry end-users considered that the reputation of individual researchers had a less positive influence on overall project outcomes (3.8 Vs 4.5 on the 1-5 scale) than did the non-industry respondents, is an interesting result. While keeping in mind that industry respondents still considered researcher reputation to have a positive

influence in terms of the scale ie 3.8, it is possible that industry end-users may regard the very subjective process of message delivery as being more important than the more dispassionate fisheries managers who comprised the bulk of the non-industry end-users, with researcher reputation being about as subjective an issue, there is.

The results for survey one showing no significant differences between project type and total project scores or the scores for each of the composite scales, was also unexpected. A cursory look at the data for survey one would suggest that certain project types may have scored more highly than others but when complete, the analysis revealed no statistically significant differences.

These results highlight the importance of a thorough and robust analysis when drawing quantitative conclusions from this type of data. Large standard deviations and associated standard errors were responsible for the lack of significant differences between project types as well as no scoring differences between projects of different age for survey one. There was wider variation within project types and age than between them, indicating that positive evaluations are more heavily influenced by factors within a project than between them.

Although no differences in responses between project types were identified in survey one, it was not until a new cohort of projects were evaluated by the end-users in survey two, that projects in the fisheries science/management category showed a clear trend for more positive evaluations than other project types. This result tends to support the hypothesis of an evolving or maturing of the R&D prioritisation and development process, particularly within the wild catch sector.

MACs, fisheries managers and industry bodies have developed a significant capacity over time to drive the R&D process associated with target stock management, while the FRABs have also done much to facilitate this. Although there is a need for caution when interpreting these results given the focus on fisheries science/management projects in the survey, it is possible that this R&D capacity has contributed to the more positive evaluations.

With the maturing of the aquaculture sector and the increase in the use of 'sub-programs' over recent years, it is possible that similar trends for aquaculture research in particular, but also post-harvest and marketing research, will be identified in future.

Response rate

Fowler (1988) and De Vaus (1990) suggest that response rates for a self administered survey such as this questionnaire can vary from as low as 5% to as high as 75% when numerous follow up attempts are made on non respondents**.** De Vaus (1990) suggests that self administered questionnaires are a good survey technique when dealing with a topic of particular relevance to the people being surveyed. The fact that all those surveyed were selected because they were considered direct end-users of the completed project, assisted in ensuring relevance. Jiang and Klein (1999) argued that the 30% response rate they obtained when surveying information system professionals appeared to be consistent with other similar mail surveys so the response rate in this study is reasonable.

Critical elements in the research life-cycle

The analysis of the relationships between the survey items suggests that in the opinion of end-users, the lifecycle of a fisheries research project is not made up of discreet and disconnected phases. The interrelationship between these phases appears to be consistent with developments in the project management field, where interpretations of project life-cycles have become more flexible (Mian & Dai 1999), implying a degree of feedback and interconnectedness between project phases. For example, end-users do not just see the process of project development to be separate from the process of post project results extension.

The significant association among all the composite scales in survey one means that end-users generally maintained a consistency in their evaluations whereby a positive evaluation for one item usually meant a positive evaluation for the others, and vice versa. This finding may have implications for funding agencies and service providers in planning the project cycle, particularly if they are accountable to end-users. For example, if end-users are not involved early on in the research life-cycle, they are less

likely to have a positive view of the project and are less likely to consider that project results will be adopted.

The multiple regression analysis for survey one adds further weight to the suggestion that end-users' overall impression of a project is influenced by performance throughout the entire project life-cycle. However, the regression analysis also revealed that the research priority was three times more strongly related to overall impression than either communication or adoption of results. This means that although end-users consider all aspects of the project cycle when making an evaluation and other issues such as communication are important, **the priority of the subject being researched is by far the most significant factor that end-users consider**.

While possibly coming as no surprise to funding agencies and service providers, this result has important implications for resource allocation, prioritisation processes and project planning, especially if end-user satisfaction is considered important.

Case Studies

The following are the results and discussion of each of the major topics discussed in the end-user interviews for each case study.

Project participation and communication with end-users

There was an almost universal consensus that end-user participation and communication at appropriate stages of the project life-cycle, plays an extremely important role in maximising successful research outcomes. Although many end-users considered that most FRDC projects did have appropriate levels of end-user participation and communication, this did vary depending on what the particular individual regarded as appropriate.

Despite the acknowledgement by end-users of the importance 'in-principle' of end-user participation, it was tempered by the suggestion that excessive influence over R&D (by both industry and management) had resulted in the further promulgation of existing management paradigms suiting vested interests. This was regarded as inhibiting the process of exploring different [and perhaps necessary] management approaches. Examples given were the need to progress to more clearly defined spatial management in the NPF and managing the Northern Zone Rock Lobster Fishery (NZRLF) via a TAC instead of input controls, both of which did or do face significant opposition from specific end-user interests.

Contrary to most other projects in the other case study fisheries, it was suggested by industry-end users in the NZRLF, that despite a genuine commitment to research and a sound historical record of participation, effective industry involvement in the research process had ground to a halt.

Overall, end-users emphasized that project participation, while vital, was still a matter of balance. The most appropriate level of participation varied depending on the type of project and to some extent, the ability of the principal investigator (PI) to work with end -users. Similarly, the need to target participation at the right stage of the project life-cycle was also regarded as important.

Some specific examples that illustrate these points include the stock assessment/modelling type projects in the NPF (examples below) which obtained most benefit from end-user participation at the outset when establishing key assumptions. After this initial period, the focus becomes one of communicating results as they emerge, although fisheries managers and industry can both be used as a reality check on interim result/scenarios.

- 1998/109 *'Risk analysis and sustainability indicators for prawn stocks in the Northern Prawn Fishery'*;
- 1999/100 '*Spatial and seasonal stock dynamics of northern tiger prawns using fine-scale commercial catch-effort data'*;
- 2001/002 '*A new approach to assessment in the NPF: spatial models in a management strategy environment that includes uncertainty'*;

Unfettered industry involvement all through the life-cycle of these types of projects can be counterproductive. PI time is limited and industry can disagree over the details of model inputs, so running a myriad of options through models can prove to be a significant impost on PI productivity and achieving the project objectives.

Projects aimed at changing the behavior of fishermen or the their gear, or research that requires extensive industry involvement in providing samples, effort data or tag returns, requires much greater industry participation. This includes communication during the design phase, all the way through to management measure implementation. Some examples of projects cited in the interviews where such participation was necessary and which was achieved are:

- 1993/074 '*Assessment of the fishery for snapper (Pagrus auratus) in Qld and NSW';*
- *1993/087 'Population dynamics of southern rock lobster in SA waters';*
- 1996/254 '*Effects of Trawling Subprogram: commercialisation of bycatch reduction strategies and devices in northern Australian prawn trawl fisheries'*.

– *1998/135 'Fishery biology and management of black jewfish Proteonibea diacanthus (Sciaenidae) aggregations near Injinoo community, far northern Cape York'*

Project priority

There was a general consensus that the vast majority of approved projects were of high priorities with one end user summing up the situation with "the days of low priority research being funded are well and truly gone". End-users regarded this as a positive development with due recognition for the role the FRDC has played in establishing the current system of project development and prioritisation, including the role of FRABs. In contrast to FRDC funded projects, some end-users stated that there were still examples of projects receiving funding from other sources such as NHT or State based funds, which were not high priority.

The system for screening project proposals within research provider agencies was regarded as largely (although not 100%) effective at removing lower priority projects, while the FRABs acted as the final filter prior to submission to the FRDC. Again, in contrast to other projects in other fisheries (and contrary to the survey results for earlier projects), the NZRLF industry end-users considered that recent projects did not address the highest priorities. In recent years, both the research providers (SARDI) and the FRAB, appeared to have adopted quite different views to the industry about which research is the highest priority.

Quality of science/research provider

Not surprisingly, there was not one case of an end-user expressing anything other than complete adamancy that quality science undertaken by experienced, unbiased researchers, was critical to the successful adoption of research results. While not a guarantee that projects fitting all these criteria will result in research outputs being accepted by stakeholders, any perception of researcher bias had a flow-on effect when it came to the management adoption of the project results.

There were very few examples where researcher bias or poor science was evident and this is consistent with the survey results in Table 2.

However, in each of the case-studies there was at least one project where these issues were considered by at least one end-user, as being problematic. In these cases, the projects focussed on those issues in the fishery that were extremely controversial and which represented a significant disadvantage to one sector or group if the expected management response was forthcoming as a result of the research. Inevitably, upon closer scrutiny of these specific projects, claims of significant bias or poor science were not demonstrable and had more to do with the diametrically opposed views of particular end-users.

Achievement of project objectives

Nearly all projects achieved most of their objectives and there were few examples cited by end-users of projects totally failing to deliver anything of substance. Even where the majority of project objectives were not achieved – such as project 2000/160 *Surrogates 1 - predictors, impacts, management and conservation of the benthic biodiversity of the Northern Prawn fishery,* the lack of success in achieving specific objectives did not detract from the fact that the project produced useful information to progress fisheries management, as well as informing subsequent scientific endeavors. This project showed that discovering what does not work is just as important as knowing what does!

It was quite common for projects to have at least one objective revised after project commencement. The reasons given for this included:

1. the need to re-focus efforts on aspects that gained sudden political or industry currency;
2. responses to practical or logistical issues impacting on (for example) sampling frequency; and
3. unexpected methodological problems such as poor tag retention

Although end-users considered it quite appropriate that researchers amend objectives in response to these issues, both end-users as well as research providers also observed that project objectives are often too ambitious. Although it was not possible in this study to confidently identify the reasons over ambitious objectives are proposed, 'selling' the project to the MAC/FRAB/FRDC or naivety, was suggested by some as being the main driver.

Adoption of results

Results adoption is a central one for the FRDC and as such it was focused on in these case-studies. For the purposes of this study, 'adoption' of project results, is defined as the extent to which results are used in the decision making process and that the subsequent management decisions are consistent with these results.

This second point is important because 'doing nothing' in the fisheries management context, may be a legitimate adoption of project results if those results confirm existing management arrangements. A number of end-users stressed this and emphasised that the absence of change in a fisheries management regime does not in itself demonstrate poor project results adoption. Alternatively, if a project's results are considered within the fisheries management process but subsequent decision(s) are not consistent with the results, then it is argued that results adoption has been less than optimal.

For the majority of projects within the Queensland recreational fishery case-study and the NPF, end-users considered that project results had been well 'adopted' by fisheries management although examples were provided where either some or all of the results of specific projects had not been adopted. Even in the NPF, where it became evident that project results have been applied in a more consistent and systematic manner than the other two case-study fisheries, there were still examples of projects with less than perfect adoption.

In the case of the NZRLF, there has (at the time the interviews were undertaken) been a more systematic failure of the research/management process that cannot be explained simply by assessing adoption of specific projects. Moreover, a number of factors appeared to have contributed to this failure and these are further discussed below as it provides an instructive example of the dynamic nature of the science/management/industry nexus and one which typifies the FRDC's business environment.

The reasons for adoption failure are not always clear are and often caused through a combination of events.

End-users often disagree over the causes for adoption failure thereby increasing the difficulty associated with trying to quantify it or at the very least, understand it

Why is it then, that the results of some projects are adopted where as other projects results are not? The findings of this study suggest four main reasons:

1. The project's rationale was either wrong or unachievable to start with; and or
2. Technical/methodological problems meant that results were invalid; and or
3. The project did not address an area deemed by end-users to be of high priority hence no pressure to ensure the adoption of research outputs; and or
4. Institutional impediments and or 'political' issues prevented (or impeded) the adoption process.

Examples – Adoption Failure

There were few examples where project results had not been adopted because the rationale was wrong or unachievable. One (arguable) exception was project *1999/354 QFISH Foresight Project - a strategic planning and futuring project designed to create a strong coordinated commitment by all stakeholders to an agreed vision of the fisheries of the future.* End-users suggested that this project was overtaken by political developments, hence stalling before any significant results emerged. However, given that the resource allocation debate within Queensland is highly contentious and therefore politically sensitive, it could be argued that a project such as 1999/354 was never going to be successful despite the laudability of the objectives and the good-will of those involved.

Similarly, project *1995/140 Determining the economic values of King George Whiting and snapper to recreational anglers and commercial fishers in South Australia,* has not resulted in a high level of adoption. Although not included in the case-study interview process, the mail survey results were clear in that the project results have not been incorporated into the fisheries management regime.

As is typical of projects that are not well adopted, end-users disagreed as to the cause of adoption failure for 1995/140.

However, the highly contentious and political nature of the allocation of king george whiting and snapper stocks meant that it was unlikely management decisions would heavily draw on fish 'values' derived using economic techniques. For this reason, it could be argued that this project also fell in to the category of a project for which the entire rationale was probably wrong as well as being unachievable given the controversial nature of the subject.

There were few examples where technical/methodological problems meant the results were invalid. One exception was 1998/132 *Distribution, abundance and population dynamics of beachworms (Onuphidae) in Queensland/NSW and the impact of commercial and recreational fishing.* In this case, a mixture of poor project planning and supervision and a lack of institutional support combined such that results have not been adopted. Project planning, supervision by experienced research personnel and institutional support, were shown to be three key elements to a successful project. They are individually important but when all three are less than satisfactory as in this case, it is unlikely that project results (such as there are) will be adopted.

It was also uncommon within the Queensland recreational fishery and NPF case-studies for end-users to suggest that any projects were not high priority although there were some exceptions to this. Some projects also ended up being much more important than others but this is to be expected.

This finding is consistent with the survey results where end-users (between 10-25%) considered that some projects had not addressed the most urgent or high priority issues. However, as presented in the survey results, projects addressing fisheries management/science issues were generally regarded by respondents more positively in terms of the extent to which they addressed priority issues.

Institutional impediments and or political issues preventing (or impeding) the adoption process was by far the most common reason encountered for less than optimal research adoption. In all case studies as well as in the surveys, it was clear that some project results were simply not adopted, regardless of the scientific validity, due to these 'other' factors.

This raises the question of whether it was expected (or could be reasonably forseen) that certain results would not be adopted? The answer to this question could mean the saving of significant research funds which would then be re-directed to other projects where adoption is more certain.

Finer Scale Spatial Management in the NPF

In the case of the NPF, numerous projects (1995/014, 1995/016, 1997/108, 2002/101) have demonstrated the benefits of finer scale spatial management, although at the time of writing this has not happened (although it has been incorporated into the stock assessment process). End-users disagree as to why finer scale spatial management has not been incorporated into the NPF's management regime, given it is a logical response to the results of numerous projects. The reasons suggested by end-users for the lack of finer scale spatial management includes:

- Vested interests in the existing management regime influencing management direction;
- Lack of willingness on the part of AFMA to consider finer scale spatial management arrangements because they represent a significant shift from the status quo;
- A very real concern that introducing new spatial management measures will 'open a can of worms' that could lead to unsustainable flow-on effects elsewhere in the fishery.
- The relative low priority of introducing such measures compared with the pressing need over this same time period, to focus on the key management issue (reducing effort) and the possible incompatibility of the two over the short-term.

Another interesting example is project *1995/016 The impact of changes in fishing patterns on red-legged banana prawns (Penaeus indicus) in the Joseph Bonaparte Gulf (JBG).* This projects' results suggests that the existing temporal closure means the fishery returns approximately 15% less than would be the case under an optimal closure regime.

It is almost certain this project lead to greater overall knowledge about the banana prawn resource in JBG and was an important precursor to *1997/105 Growth, mortality, movements and nursery habitats of red-legged banana prawns (Penaeus indicus) in the Joseph Bonaparte Gulf*, which also identified significant sustainability issues. However, despite the results being relatively unambiguous, there was no subsequent management response consistent with these findings.

End-users were unable to provide a definitive reason for this apparent lack of adoption although the sensitivity of the project results to some uncertain parameters such as growth and mortality, was suggested as a possible partial explanation. The fact that JBG is not managed separately from the rest of the NPF and likely industry concerns should it be managed as such, appeared to be the primary reason for the lack of adoption in this case. Further, it was suggested that management concluded that the advantages of altering the temporal closure arrangements in JBG to maximise profits would be outweighed by potentially creating problems elsewhere in the fishery.

Given the good track record of management in the NPF (see appendix 1 for timeline plotting NPF management change and research outputs), this management response may be sound, but the issue of results not having been adopted, remains. It seems there was never great scope to make management changes to the red-legged banana prawn fishery in JBG without affecting the rest of the NPF. Given this limitation, it is difficult to see the merit in a project seeking to establish (and then recommending) an optimal closure regime given that the existing management paradigm could probably never accommodate it.

<u>Queensland Inshore and Reef Line Fishery</u>

An example of a Queensland project that has had less than optimal results adoption due to political or 'other' factors is *1998/117 Fisheries biology and assessment of the blue swimmer crab (Portunus pelagicus) in Queensland.* One of the major findings of this project was that there is no biological reason for the current prohibition on retaining female crabs. Despite this finding, the prohibition on retaining female crabs remains.

One end-user suggested that the reason for this is that despite the biological evidence, "you don't change a management measure like female crabs overnight when it has widespread understanding in the community". End-users all agreed with this explanation for the lack of adoption.

The mackerel fishery in QLD has also been the focus of FRDC projects including *2001/019 Exploitation dynamics and biological characteristics of east coast Spanish mackerel harvested by the recreational and commercial sectors* and *1992/144 Fisheries biology and interaction in the northern Australian small mackerel fishery.* Another project (2002/096) reviewing current and future research needs for the key species of mackerel in northern Australia, has also been completed.

It was clear through the interviews with end-users that not all the results of project 1992/144 had been adopted. As for the examples discussed above, it appears that politics and 'other' factors overwhelmed some of the science in this fishery. The results of 1992/144 clearly state that (among other things):

- There was no evidence that fishing mortality associated with 'net drop-out' (fish caught and killed in the net then drop out so they are not recovered by the fisherman) occurred in the mackerel fishery;
- suggested that minimum mesh sizes be increased to improve selectivity and reduce the incidence of the capture of undersized fish which was a problem in some areas
- suggested that the current (at the time) minimum size limit of 50cm be maintained. Although a "small" increase in minimum size for spotted and grey mackerel may be appropriate on the grounds of basic biology, it was cautioned that the post release mortality implications of doing this, for both line caught and netted fish, were significant, although net size could be tailored to avoid capture of undersized fish.

Despite these results, gillnet fishing for mackerel was prohibited in December 2002 while the size limit increased by 10cm to 60cm for spotted mackerel and a TACC of 140t set. The size limit for grey mackerel was also under review at the time the interviews were undertaken although it has since been set at 50cm.

The logic behind prohibiting the one form of fishing (gillnets) that allows for accurate size selectivity when post release mortality is significant and a TACC has been set (thereby removing the need for input controls to cap effort), is difficult to establish. The consensus of end-users was that the issue of mackerel netting had been a political issue in Queensland for sometime and so this result was not surprising. Curiously, the results of project *2002/096 To review previous research on northern mackerel and to assess current and future research needs for these fisheries,* did not identify nor discuss this lack of research adoption.

Results adoption for *2001/019 Exploitation dynamics and biological characteristics of east coast Spanish mackerel harvested by the recreational and commercial sectors* has also been less than optimal, although the management response for spanish mackerel has yet to run it's course and research is still underway. The final report for 2001/019 cites recent yield-per-recruit analysis suggesting that the current size limit of 75cm is 5 cm larger the optimal. As for project 1992/144, the authors warn of the serious problem posed by post-release mortality and cautions against increasing size limits for this reason.

Despite these results, management still appears to be seriously considering (according to the final report and a QLD fisheries agency newsletter*) increasing the minimum size limit and introducing a spawning closure. This, the PI states, could have a negative impact on the fishery by transferring effort to pre-recruits. It will be interesting to see how the results of current research are adopted and to what extent they differ (if at all) from the recommendations in 2001/019 although at the time of writing the minimum size limit was still 75cm.

Another example of inconsistent R&D results adoption is that of a Queensland project investigating the biodiversity impacts of net fishing (1997/206).

*Fish. Volume 3, Issue 4, Queensland Government

Although addressing commercial fishing techniques specifically, the key species caught in the Queensland inshore net fishery are shared with the recreational sector and therefore recreational fishers took a keen interest in this project including positions on the steering committee.

The project results were unambiguous in that there was no impact on biodiversity from net fishing, yet at least one key end-user, voiced a lack of confidence in the results and in doing so, cited a number of specific concerns. While it is difficult to confirm or reject the accuracy of these concerns, it appears that the driving force behind the lack of confidence in the project's results is that of the possible fisheries management response rather than anything else.

Despite the findings of this project, inshore net fishing in Queensland is still in decline. Closures to net fishing have continued, albeit largely through the GBRMPA re-zoning process and or the QLD Government's complimentary MPA declaration and zoning policies rather than for target stock management or ESD purposes.

The continuing reduction in areas open to inshore net fishing raises the question of what the future would have been for this form of fishing in Queensland had this project had not been undertaken? The Queensland Government's 2003 Resource Allocation Policy clearly states that access to fisheries resources will be addressed separately from target stock management and ecosystem considerations. Hence there is still considerable scope for net fishing closures based on socio-economic reasons alone.

While the closures associated with the GBRMPA re-zoning have been in addition to this, they do not (at least in theory) purport to re-allocate fisheries resources for consumptive use although commercial net fishermen excluded from the new 'yellow' zones while recreational fishing remains would probably take issue with this. Nevertheless, the extent to which results of 1997/206 were adopted has been affected by the politics of the Great Barrier Reef re-zoning process.

Had it not been for project 1997/206, it was suggested by end users that the uncertainty over the ecosystem impacts of net fishing when combined with resource allocation tensions and the GBRMPA re-zoning, would have resulted in accelerated closures to this form of fishing. However, whether this likely increase in the rate of net fishing closures in the absence of 1997/206 justifies the FRDC contribution of over half a million dollars to the project, is a legitimate question but one which is difficult to answer without a rigorous BCA.

Project *1997/124 Effects of line fishing on the Great Barrier Reef and evaluation of alternative potential management strategies* has also been the focus of a great deal of attention from both the commercial and recreational sectors as well as green groups. From a fisheries management perspective, the results of this project have not been adopted to the extent that may have originally been forseen by the industry, fisheries management and the FRDC.

The final report for 1997/124 states that coral trout stocks (the primary target species for the reef line fishery) are in good shape, thanks largely to the current conservative minimum size limit. However the report cautioned that expected increases in effort, if not managed, are a threat to sustainability and that this threat may be exacerbated when spatial closures [GBRMPA re-zoning to increase no-take zones] are maximised. The report also states that the performance of the fishery will be negatively impacted by the GBRMPA re-zoning.

The management of project 1997/124 and the involvement of end-users was praised by those interviewed but despite this, the overwhelming political nature of the GBR re-zoning meant that management approaches designed to maximise the performance of the coral reef line fishery ended up being of secondary importance. This is not to say that the project's results as a whole, were not adopted, rather that the nature and extent of the adoption was impacted by those political pressures that have come to typify the environment in which fisheries projects are undertaken. In fact one end-user was quite definite that without 1997/124, there would have been even greater pressure to introduce additional green zones, thereby further impacting on the performance of the fishery.

This appears to be yet another example of a fisheries project where despite less than optimal adoption, the outcome for the fishery was better than would otherwise have been the case had the project not been undertaken!

The South Australian rock lobster fishery

This case study told a different story to that of the two other case-study fisheries. In many ways, it demonstrates how the mere existence of research, does not in itself mean that a fishery will be managed sustainably, even in absence of broader socio-political resource allocation forces such as experienced in Queensland. Although reviewing the reasons for the poor performance of the NZRLF is not within the scope of this project and it is difficult to do justice to such a highly complex situation in any case, it is worth spending some time to discuss this fishery. This is important as it provides a context in which to place the role of R&D in the gradual decline of the fishery.

In the South Australian rock lobster fishery (comprising both a northern and southern zone) the southern zone has progressed to become a stand-out fishery management success where as its northern cousin, is in the worst shape it has ever been with recent stock assessment reports showing all performance indices falling well below their targets with total catch, estimated biomass and CPUE being at their lowest levels since the 1970's (Ward et al 2005).

A preliminary analysis may lead to the conclusion that the reason for this major difference in success between the two fisheries is simply that the southern zone adopted an effective quota management system in the early 1990s to control effort. In contrast, the Northern Zone, insisted on pursuing input controls only, at least up until the 2003/4 fishing season. As a result, significant over-fishing appears to have occurred and the fishery continued to decline to its current state.

It is possible that had a quota system been introduced in the Northern Zone at the same time as in the southern zone, the fishery would not have declined so significantly.

However, that does not explain the underlying reasons for the management failure and or the failure of R&D to adequately inform and or influence the fisheries management regime.

In both zones of the fishery over a ten year period, research focused on providing information to support stock assessment which in turn provided the basis for determining a sustainable catch. The fact that both these fisheries continued on opposite trajectories given the similar R&D support suggests that science alone is not enough to ensure successful fishery outcomes where biophysical, economic, political and technological factors combine in a fishery in such a way as to make even the best science, insufficient.

During the first half of the 1990's, the northern and southern zone fishery invested heavily, both 'emotionally' (as described by one research end-user) and financially, in research that aimed to ensure biological sustainability. During this period, the principal research provider (SARDI), the fishing industry and the FRDC directed significant funding towards establishing a comprehensive research infrastructure within the fishery. For instance, between 1991 and 2002, the FRDC funded at least a dozen projects focused on, or with the major flow of benefits to, the SA rock lobster fishery while numerous other projects involving no FRDC funding were also undertaken over this period. Some of the key FRDC projects included:

1. *1991/078 An economic evaluation of the 1987 Buy back in southern zone rock lobster;*
2. *1993/087 Population dynamics of southern rock lobster in South Australia;*
3. *1995/137 Feasibility assessment of an adaptive management experiment;*
4. *1995/138 Survey sampling design and length frequency for ongoing monitoring and model parameter evaluation;*
5. *1996/160 Field application of the techniques for condition assessment developed in the laboratory;*
6. *2000/123 Risk analysis and sustainability of the southern rock lobster;*
7. *2000/072 Developing options for improving planning and management of abalone and lobster wild catch R&D;*
8. *2002/007 Larval transport and recruitment processes in rock lobster.*

Among the projects above, *1993/087 Population dynamics of southern rock lobster in SA waters,* engendered significant industry support and was suggested by those interviewed as an example of the commitment of both government and industry to establishing a clear science base with which to inform good natural resource management. The results of the project had been used to establish the parameters for most stock assessment and modeling exercises undertaken in the fishery.

1993/087 included tagging and pot sampling to obtain sex and size data as well as condition indices aimed towards generating a pre-recruitment index. Following on from *1993/087, 1995/137 Feasibility assessment of an adaptive management experiment* was heavily relied on to refine the time management system for the Northern Zone and as such, all in the fishery were confident that management and science was establishing a sound basis to optimize fishery performance. Yet despite this work and the subsequent qR model development, the NZRLF continued to decline.

Research had already indicated that the NZRLF was typified by large variations in recruitment and the general feeling among management and industry was that an input control fishery rather than a quota managed fishery, was the best approach. The principal research scientist within the fishery over this period was a strong proponent of this management approach and it is likely that the industry found it easy to put their support behind a management system they found palatable (the alternative being a quota managed fishery like the Southern Zone).

Despite concern through the 1980's and 1990s about increases in effective fishing effort, there was no rigorous program to quantify effort creep in the fishery over this critical period of technological advances eg GPS & planning hulls, like that which was undertaken in the NPF. It must be said that while an attempt to estimate effort creep was eventually undertaken by Prescot (2001), it was probably too late and still subject to great uncertainty given the data available (as pointed out in the Breen & McKoy review discussed below). Further, at least one end-user suggested that it was significantly underestimated anyway given the way the fishery subsequently declined.

As a result, unquantified effort creep had become one of the major concerns within the fishery. Further, the extent to which the recent stock assessments and science in general was adequately informing management, was also being seriously questioned.

In 2002, in response to the concerns about the fishery and the underpinning stock assessment, Paul Breen and John McKoy, two independent lobster fishery experts from New Zealand, were commissioned by PIRSA to review previous and current stock assessments for the Northern Zone. Although numerous recommendations and caveats were made, including the recommendation to undertake an integrated assessment, Breen and McKoy considered that the stock assessment was sound and the fishery was "reasonably stable and in a healthy position". Further, Breen and McKoy noted that the concerns being expressed by those in the fishery (including the stock assessment scientists) about significant increases in effective effort, was not evident in the data.

Despite previous effort reductions and the Breen/McKoy scientific review, the fishery continued to decline and in May 2007, a draft management plan for the fishery was released, the major aim of which is to increase biomass from the historical low level and return the fishery to sustainability by 2014. It forecasts yet another reduction to the TACC in a fishery where annual catch is already at a record low.

Only time will tell whether this new Plan, coming into effect nearly 10 years after alarm bells began to ring, will result in fishery sustainability. However, it is clear that to date, the target stock projects undertaken in the fishery (many of which were FRDC projects) has not resulted in positive fishery outcomes. Paradoxically, management adoption of these project results was more or less consistent with good management practice like in the other fisheries discussed above. It's just that in the case of the NZRLF, the science did not provide advice that was sufficiently timely or accurate given the nature of the fishery and its information gaps.

This in no way reflects poorly on the scientists involved as the Breen & McKoy review demonstrates that that the assessment was of a high standard – its just that in this instance, a combination of factors meant that it was not enough to ensure the success of the fishery.

The reasons cited by research end-users for the Northern Zone's 'failure' varies from the suggestion that it was simply the result of a powerful industry lobby to those who believe the science was fundamentally flawed to begin with. However, the heavy reliance on fishery dependant data linked with the failure to accurately quantify effective fishing effort, industry lobbying delaying the introduction of quota and the biophysical characteristics of the fishery, when combined, all appear to be key factors.

It was also suggested by one senior research end user that the very existence of and confidence in the science underpinning the management of the fishery through the 1990s was such that it resulted in overconfidence. Consequently, management was less precautionary than it otherwise would have been. This observation raises a number of vexed questions regarding the role of R&D in a fishery management system. In particular, the extent to which that system relies on science to provide an answer, which is then usually acted on – but sometimes ignoring the uncertainty surrounding that answer. This uncertainty (specifically the lack of uncertainty estimates) and the lack of an integrated assessment, were major recommendations of Breen and McKoy and may have perhaps gone some way to improving the situation in the fishery had they been enacted earlier.

When the interviews with end users were undertaken it was made abundantly clear that unfortunately, confidence in R&D no longer existed and that industry confidence in the fishery's science post approximately 2002, is a great deal less than the preceding decade. In the case of the Northern Zone, the entire industry/research/management relationship had become almost dysfunctional, as the factors described above conspired against it. In this environment, measuring the adoption of specific projects becomes almost meaningless. However, looking at the bigger picture and making an assessment as to the role played by R&D more generally in the fishery proved to be a valuable exercise.

Conclusions

Quantifying the extent to which individual FRDC projects have been adopted and using this as a proxy for making an assessment of the project's performance, is not easy. However, it is possible and in doing so, it elucidates valuable information that can be used to improve future R&D in the fishery as well as provide for more general improvements to the planning, funding and management process.

Given its inherent subjectivity, the survey/score approach used in this study should not be expected to provide an accurate and quantitative evaluation of individual fisheries research projects. Using an arbitrary scoring figure of 80% for example, to define a successful project from an unsuccessful one, is too simplistic and would be unlikely to result in good policy or sound future research funding decisions. Rather, the results of surveys of end-users should be taken as a portfolio wide guide to research performance, rather than a quantitative tool for specific projects.

More precise, quantitative evaluations for individual projects are still best undertaken using targeted semi-structured interviews and benefit-cost analysis – a technique that despite its inadequacies has been well tested and which the methods used in this study cannot and should not replace.

Individual fisheries projects do not typically lead to a ground breaking discovery and a subsequent major management response. Rather, each project builds on the results of the previous work until a critical mass of knowledge sufficient to make sound decisions on optimal harvest and the provision of tools to implement these decisions.

As a fishery gradually achieves an R&D 'critical mass', subsequent projects tend to become more tactical with expected management responses clearly articulated at the outset eg increasing the minimum size limit in response to a new understanding about age and size at first spawning; or reducing effort by a particular percentage in response to economic research.

These types of projects lend themselves much more easily to one-off post project evaluations. However, research with such clearly defined management responses prior to the project being undertaken may only represent a minority of the portfolio at any given time and regardless, there is a need to measure the performance of the portfolio more generally.

As a result, factors the FRDC should consider in implementing a meaningful project/program evaluation process includes:

- There has to be sufficient time in between project(s) completion (often including the need for follow up projects) to allow fisheries managers time to respond and to enable an assessment of the fishery's performance in an environment where hindsight is the only 100% reliable tool. This can be >10 years and rarely less than 2-3 years;
- Fisheries that have an R&D 'critical mass' are much better placed to be assessed for their adoption of R&D than fisheries where only one or two small projects have been undertaken;
- All end-users must be sampled for their views including industry leaders, grass roots industry, research providers and fisheries managers. It is surprising how very different opinions can emerge over a project where a fairly homogenous response would be expected;
- The need for multiple approaches to measuring portfolio performance including end-user surveys, one on one interviews (face to face and telephone), Benefit Cost Analysis and focus groups; and
- The use of practitioners who understand the relevant fisheries business environment more broadly as well as the way in which specific research outputs are (or should be) implemented as management measures. Also desirable is the use of practitioners who are trusted by those being interviewed but who do not maintain any sort of 'colleague allegiance' that creates a tendency to avoid even warranted criticism.

The FRDC has long considered (at least intuitively if not explicitly) most of these factors when implementing its program evaluations. However there is merit in formalising them and to consider adopting an explicit response strategy depending on the evaluation result scenarios. For example, what does it mean for the FRDC when a program evaluation identifies that the relationship between science/management and the industry has broken down (as exemplified by the NZRLF) and that despite significant investments in R&D, fishery outcomes remain poor? What also, does it mean for the FRDC when a post project evaluation indicates that a management response is not consistent with the findings of the project?

In the NZRLF case, it is difficult to identify actions that the FRDC could have undertaken in its relatively limited capacity as a research funding agency and as a leader in the fisheries research field, which would have improved the performance of this fishery and the resulting R&D investment.

While industry lobbying and fisheries management practice fall outside the purview of direct FRDC influence, it can orchestrate some appropriate leverage via its contribution to State and Commonwealth fisheries agencies research budgets. Specifically, the broader structure of these agencies research programs for each fishery in which the FRDC is asked to invest, can and should be subject to FRDC scrutiny even beyond those projects that it has a direct funding stake in. There are however, significant resource and political impediments to doing this across the board as it would be moving towards a 'sub-program' approach for each fishery or suite of key species.

With the advantage of hindsight, it is probably fair to say that the only thing the FRDC could have done to contribute to improving the situation in the NZRLF is what PIRSA ended up doing (albeit to late), which was to commission an independent review of the science. However, given the results of that review which generally (with caveats) gives the stock assessment and the fishery's performance a favourable rating, it's possible there would have been no demonstrable change in any case.

What makes the NZRLF particularly interesting is the possibility that the very existence of a good body of science exacerbated the problem (at least over the short

term) as management tended to be over confident over what is now known to have been a fishery in a precarious state.

Some may interpret this to mean that it is better to have no information and to simply manage cautiously as a consequence, than it is to have some good data which then inspires the confidence to push the biological boundaries of the fishery. Others would argue that there are numerous examples (the NPF being one) where had it not been for good science addressing the key questions in the fishery, the fishery would have almost inevitably declined because the scientific rationale for making painful but vital industry structural adjustments, would simply not have existed.

Fortunately, the case of the NZRLF is not one frequently encountered. However, it is quite usual, even in well managed fisheries like the NPF, where projects supported by the FRDC to the tune of many hundreds of thousands of dollars, end up not being implemented. Examples cited above where this has occurred include:

- Finer scale spatial management in NPF
- Harvesting female mud crabs in Queensland
- Increased closures to inshore net and reef line fishing in Queensland

It is not within the scope of this study to argue for or against the case for specific project results being implemented. Rather, it was to identify where management actions have not been consistent with project results and if possible, the rationale for this inconsistency. If and when this does occur, is it appropriate for the FRDC to have a predetermined response strategy and if so, what form could it take?

The FRDC has long been engaged in engendering fisheries management support for projects at the earliest design phase and (notwithstanding the examples above) appears to have done a good job at facilitating this as evidenced by the results of both surveys and the case studies. This has done a lot to ensure the results of most projects are adopted.

It remains though, that when a management response is inconsistent with project results, it is reasonable to question if that project represented an optimal use of limited

FRDC funds. It would also be a reasonable for the FRDC to seek a clear explanation for such a lack of adoption and if it is judged that the explanation does not have a sound basis in science, then some form of sanction could be levied against that management agency's future project applications.

All applications require a clear statement as to the intended management responses should a project be funded, so it is not as if a management agency can claim ignorance. Although the FRDC would find the political reality of implementing such an explicit response strategy difficult, it is likely that without one, instances of poor results adoption will remain. Even if such cases do continue to be in the minority (~10% of completed projects for example) this represents a significant cumulative financial impact.

As pointed out in the FRDC 2005-2006 Annual Report, the demand for fisheries R&D is increasing, due largely to the environmental concerns being expressed by the community and governments. At the same time, government funding has reduced over recent years due to the declining GVP and to complicate matters further, a tension exists among stakeholders as to the relative priority of the various R&D programs. In this business environment, it is more important than ever to measure the performance of the portfolio and ensure that R&D results are not only implemented, but are seen to be implemented.

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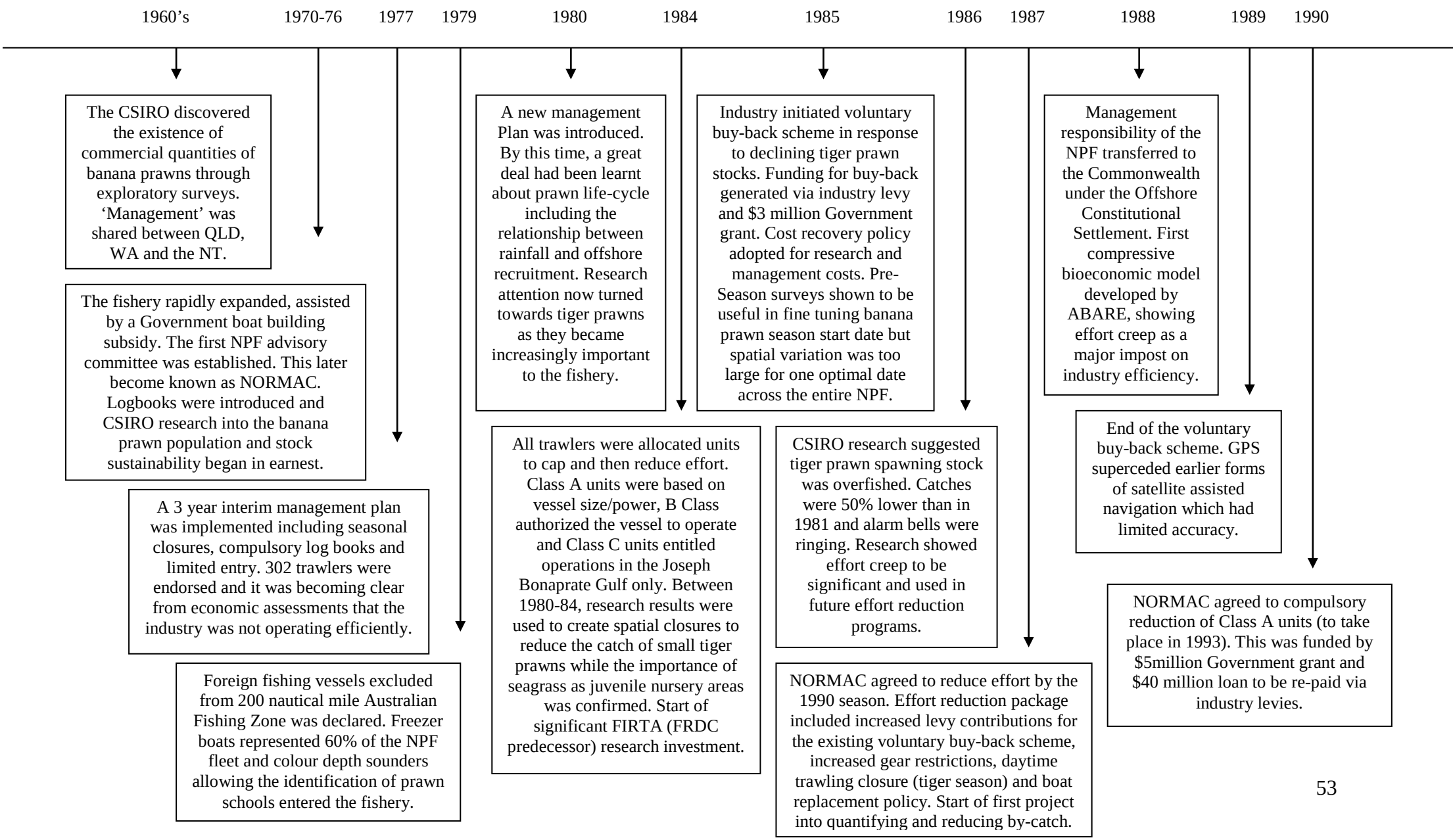
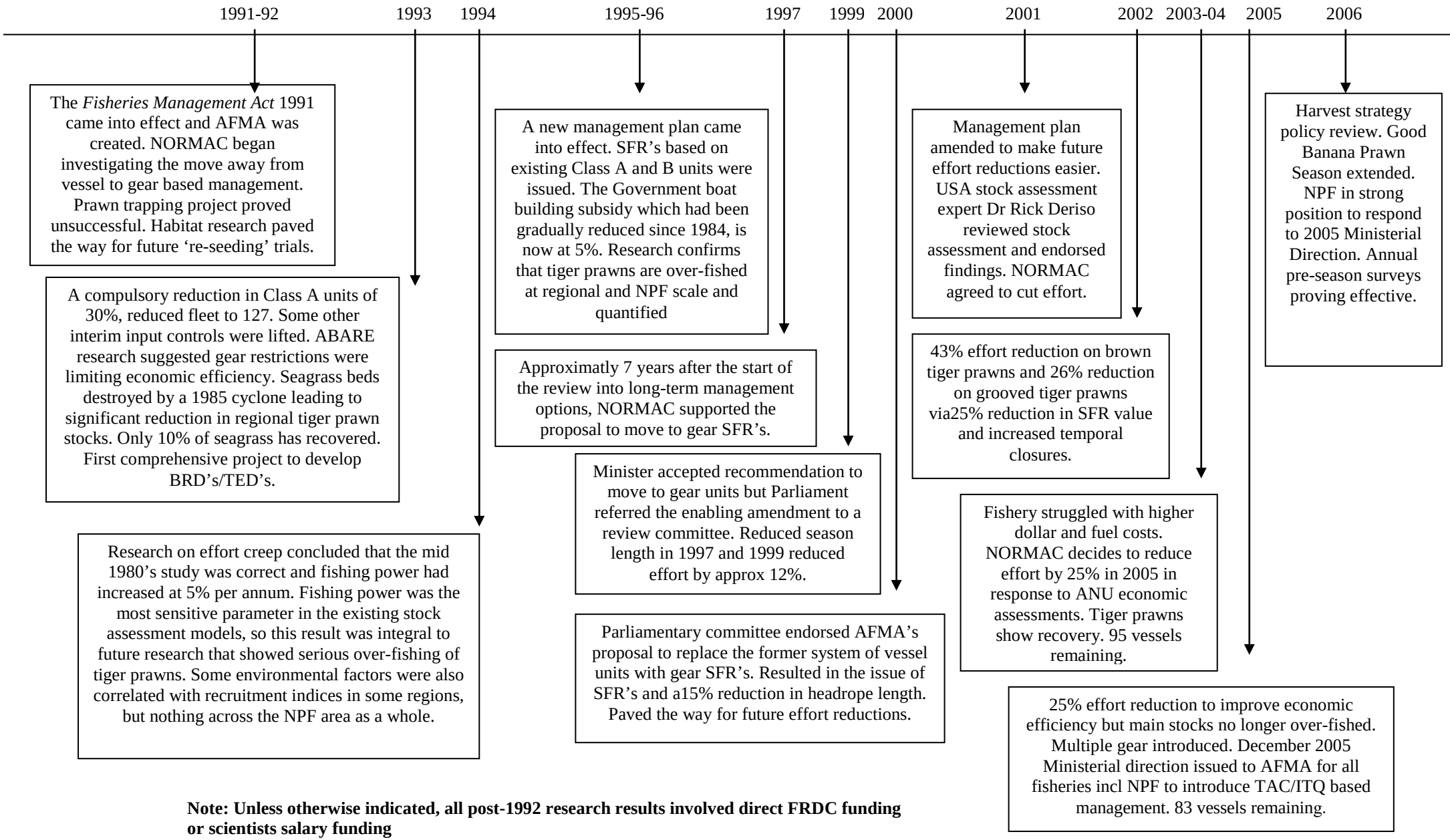
Appendix 1: Key research and management responses in the NPF 1960's – 2006/7





Note: Unless otherwise indicated, all post-1992 research results involved direct FRDC funding or scientists salary funding