Southern Bluefin Tuna Research Review

J. McKoy, S. Sen and M. Lack

FRDC Project No. 2002/103

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Non-Technical Summary

2002/103 Southern Bluefin Tuna Research Review

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OBJECTIVES:

(1) Analyse outcomes/expected outcomes of past, ongoing and current southern bluefin tuna (SBT) research projects in the wild fishery only.

(2) Identify gaps in current research.

(3) Assess the effectiveness and appropriateness of the processes for developing, prioritising, selecting and funding SBT research projects in the wild fishery only.

OUTCOMES ACHIEVED

The recommendations made in this review have the potential to: direct SBT research selection processes towards projects which yield higher returns; to improve the consistency and complementarity of SBT research priorities across a range of research funding agencies; to improve accountability and transparency associated with SBT research; and to improve the administration of SBT research projects.

If this potential is realised benefits will accrue to taxpayers and industry as contributors to SBT research by way of improved returns to research expenditure. In the longer term better-directed research will increase the likelihood of achieving sustainable management of the SBT resource. This will benefit groups reliant on the resource for income and recreation. The broader Australian and international communities will also benefit from the inherent value attaching to the conservation of the SBT stock.

Stakeholder comments on the draft of this report indicated that there is broad ranging support for the majority of the recommendations arising from the review. Provided that this support translates into actioning of the recommendations there is high probability that the potential outcomes will be realised.

Background

SBT has been the subject of extensive research using substantial research funds, over a long period. In the light of this and of changes in both domestic and international management and research arrangements for SBT the Department of Agriculture, Fisheries and Forestry - Australia (AFFA), the Australian Fisheries Management Authority (AFMA) and the Fisheries Research and Development Corporation (FRDC) commissioned this research review. The aim of the review is to ensure that:

- research is well targeted to the current and future needs of the fishery;
- the structures in place for determining research strategies, research projects and priorities and for delivering research are the most appropriate and effective;
- the research funded is that which delivers the highest returns to increasingly scarce research funds;
- research is driven by management needs; and
- Australia has the capacity to deliver and to articulate research results.

Costs and effectiveness of research

The review identified 149 SBT research projects and estimated that $25m (nominal dollars) have been spent on SBT research since 1985. The review assessed the effectiveness of this expenditure on the basis of the "uptake" of research results from a range of research programs. Much of the research undertaken has been focused on collecting data for, reducing uncertainties in and undertaking the SBT stock assessment which supports both domestic and international management.

The review acknowledges the difficulty of separating uptake/impact of research on domestic management arrangements and developing/supporting Australia's position in the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) (and its predecessors). Nevertheless, the review found that, in general, SBT management in Australia and in the international context has been well served by the nature, extent and quality of research that has been supported and carried out by Australian agencies. Australia has credibility in the global SBT management and research context. Stock assessments, and the research that underlies them, are widely recognised as having been instrumental in the 1988 reduction of the global quota and precluding increases in quota in the late 1990s. However, given the intractability of some negotiating positions at the CCSBT, there is likely to have been decreasing marginal benefit from the ongoing refinement and development of the stock assessment process in the late 1990s.

Domestically, the scientific advice from the SBT stock assessment process did contribute to the reduction of Australia's TAC in 1989 and to the decision to exclude joint venture boats from the Australian Fishing Zone in the late 1980s. However, since the early 1990s, the stock assessment advice provided to AFMA has not been reflected in changes in the domestic TAC. This is despite CSIRO assessments indicating that there is a low probability of achieving the global management objective of recovery to the 1980 level of the parental biomass by 2020. The review acknowledges Australian managers face a dilemma, as any reduction in the Australian TAC, without corresponding reductions in catch by other catching countries, may have little or no benefit to stock recovery. However, using the measure of effectiveness adopted in this review, the unavoidable conclusion is that, in the domestic context, the SBT stock assessment research since the late 1980s has not been taken up.

At the individual project level effectiveness varies. Some long-term, relatively high cost projects have had limited uptake in both the domestic and international arenas. Other projects, such as those to do with producing validated ageing techniques and estimating catch at age have made significant contributions to the scientific knowledge of the SBT stock and uptake has been good. The table below provides a generalised summary of the review findings on effectiveness for the significant programs/projects reviewed.

Research priorities and gaps

Domestically, SBT research priorities are predominantly developed by the SBT Management Advisory Committee consistent with the broader objectives of AFMA's Five-year Strategic Research Plan. The CCSBT has also established areas of priority research for the Scientific Research Program (SRP). The review found that current research is consistent with and driven by research priorities identified by the SBTMAC and the SRP. The review found, however, that there was scope for closer linkages between the Fisheries Resources Research Fund and the other components of the SBT research framework.

The review also identified a number of areas where research was either not being undertaken or was inadequate. These gaps related to specific aspects of stock assessment, biology/life history, ecologically related species and management.

Summary of uptake of programs reviewed

Program	Input to the Stock Assessment	Developing Domestic Management Arrangements	Developing and Supporting Australia's Position at CCSBT	Cost (Nominal Dollars)
Aerial survey under the RMP	Yes. No. 8 of 9 fisheries indicators reviewed by the CCSBT SAG to determine stock status – first 7 indicators are the main ones reviewed	No	Limited extent	Total cost: $8.4 million
Conventional tagging under the RMP	Yes	No	Yes	Australian contribution: $4.4 million
Archival tagging under the RMP	Very limited. Has improved knowledge about movements and behaviour of SBT	No	No	
Acoustic surveys under the RMP	No	No	No	
SBT Assessment and FAG	Yes	Yes: up until the late 1980's.	Yes	$2.9 million
Indonesian catch monitoring	Yes	No	Yes	$1.4 million
Age, growth and reproductive biology	Yes	No	Yes	$3.6 million
Genetics and stock structure	Yes	No	No	$470,000
Economic research	No	Yes	No	$132,000
Ecologically related species	No	Yes	Yes: in ERS Working Group	$120,000

Research coordination and administration

The introduction of the CCSBT SRP has largely overcome the lack of coordination of research at the international level. Within Australia, the review found that coordination of research projects has been impeded by:

- organisational complexity;
- poor communication and alignment between some funding and management agencies;
- lack of leadership by management agencies in establishing research priorities and managing to ensure that these needs are met; and
- a lack of adherence to specified process in some instances.

The review encountered difficulties in collating a comprehensive listing of research projects, in accurately determining costs associated with those projects, and in sighting final reports of all projects. The review team also found that there had been considerable delay in the reporting of results from some research projects and that this may have impeded uptake of research results.

Research capacity

The review found that Australia, largely through the efforts of the CSIRO, has developed a strong capacity to undertake and deliver SBT research. Internationally, such capacity is in short supply and the challenge for Australia will be to retain and increase, where possible, our current research capacity. The review did not identify any serious deficiencies in Australia's capacity to deliver SBT research either currently or in the future. However two areas where capacity needed to be developed were communication/extension of research results and understanding of management strategy evaluation. The need for capacity building in these areas extends to researchers, managers and industry.

Recommendations

The following recommendations are made to address the review's findings.

Research effectiveness

1. As the Australian SBT fishery is embedded within the CCSBT stock assessment process, there is a need to clearly define and specify the role and objectives of the SBTFAG and in particular to articulate the relationship between the domestic FAG and the CCSBT SAG. In defining this role, AFMA should consider the implications for other FAGs, such as the Eastern Tuna and Western Tuna FAGs, which will find themselves in similar positions as relevant regional fisheries management authorities develop their stock assessment capacity.
2. The outcomes from the aerial and acoustic surveys of the RMP do not support further expenditure on these projects from increasingly scarce Australian research funds.
3. In order to maximise the benefits from the SRP conventional tagging program, and in particular from Australia's contribution to that program, Australia should push within the CCSBT for sufficient SRP resources to be deployed to activities that reduce the non-reporting rate for example, increased observer coverage where appropriate.
4. The ongoing project on archival of hard parts should produce a clearer justification for the sampling design of the collection component and this should be related to the needs of the research which will utilise the archive.
5. When proven, techniques for improving catch monitoring and quality of data used in stock assessments, such as a stereo video system, should be implemented as soon as possible.
6. Other techniques should be developed to verify bycatch in the purse seine fishery as this is a gap identified in the draft strategic assessment for SBT.

Management of research results

7. Managers, policy makers, industry and scientists, as well as those responsible for making funding decisions need to devote more time to evaluating research outcomes.
8. Managers, policy makers, researchers and industry need to develop a mechanism for ensuring that research reports are not only provided to the relevant people but that these are read and discussed. Face to face delivery of research results should be encouraged and funding to provide for this should be incorporated as part of the extension budget in project proposals. The resurrection of liaison workshops should be considered using experienced science communicators as facilitators.
9. Industry needs to take a more constructive and pro-active role in informing themselves and to contributing to the development and, where relevant, implementation of research results.
10. A bibliography of SBT research and, in particular, a listing of SBT research in progress should be compiled and maintained. The information contained in this review would provide a basis for this work. One of the major funding agencies (AFFA, AFMA, FRDC) should accept responsibility for this role. The adoption of such an approach across all fisheries should also be considered. The inclusion of fisheries research projects on existing databases, such as the Australian Rural Research in Progress and the Agricultural Bibliography of Australia, as currently utilised by FRDC, should be investigated by other funding agencies.

Research planning

11. Managers, policy makers and industry need to be more pro-active in specifying the nature of the research required rather than identifying only the broad areas of the research.
12. There needs to be a clear enunciation of the purpose and objectives of some research activities (e.g. the SBT observer program) where there is potential for overlap between research and compliance activities.
13. The research gaps identified by stakeholders and listed in this review should be considered by SBTMAC and FRRF when research priorities are next reviewed.

14. A more targeted call for research to address particular priorities and for greater specification of the nature of the research being sought to address that priority is recommended. This approach may involve taking a longer term and more strategic approach to research. A clearly defined five-year strategic research plan for SBT, with sufficient time and resources allocated to its development, could play an important role in underpinning such an approach, as could the use of external reviewers.

Funding and processes

15. Given the international context for management of SBT, consideration needs to be given to the appropriateness of replacing some ARF funding for the stock assessment processes with FRRF funding. If the results of the stock assessment are not being used domestically because of the constraints imposed by international management, ARF funds should not continue to contribute approximately 50% of the stock assessment process and/or the development of a management procedure or management strategy evaluation. This consideration should be undertaken in a broader context of other migratory species increasingly coming under the management of regional fisheries management organisations. Issues regarding the overlap between domestic and international research which currently confront SBT research will inevitably emerge in relation to other species/fisheries. Under these circumstances it may be necessary to reassess the purposes for which FRRF research monies can be spent.
16. The Indonesian catch monitoring program relies on the on-going commitment of Australian research funds. The value of the information collected is acknowledged – but it is difficult to justify the use of scarce Australian domestic research funds to pay for it. A time frame should be established for the development of a capacity building project and the subsequent withdrawal of Australian support using core fisheries research funds for this monitoring project.
17. Processes for stakeholder consultation, priority-setting and project selection should be clearly specified in research fund documentation and adhered to. Where processes change, stakeholders should be advised. This is particularly relevant for the FRRF.
18. A mechanism for ensuring that jointly funded projects can be identified as such in the records of each funding agency should be implemented.
19. Funding agencies should consider their policy on confidentiality of research results and make that policy known to stakeholders. In developing that policy, agencies need to recognise that there are risks associated with both the release and the retention of sensitive information.
20. Research providers should be penalised for late delivery of research results unless there are valid mitigating circumstances. The track record of individual providers in delivering research outputs on time should be more closely scrutinised in selecting project proposals.
21. Mechanisms to ensure greater coordination between funding agencies and stakeholder input should be encouraged to maximise consistency and complementarity of research plans and priorities identified by the SBTMAC and the SRP.

KEYWORDS: Southern bluefin tuna, fisheries research, research effectiveness, research costs.

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Acknowledgments

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Funding for the review was provided by the Fisheries Research and Development Corporation, the Fisheries Resources Research Fund and the Australian Fisheries Management Authority Research Fund.

1. Background and Need

Southern Bluefin Tuna (SBT) has been the subject of extensive research, using substantial research funds, over a long period. Since 1985, an estimated $25 million (nominal dollars) has been spent on Australian and collaborative Australian/Japanese research.

In the light of this substantial research expenditure as well as changes in both domestic and international management and research arrangements for SBT, the Department of Agriculture, Fisheries and Forestry - Australia (AFFA), the Australian Fisheries Management Authority (AFMA) and the Fisheries Research and Development Corporation (FRDC) commissioned this research review. The aim of the review is to ensure that:

- research is well targeted to the current and future needs of the fishery;
- the structures in place for determining research strategies, research projects and priorities and for delivering research are the most appropriate and effective;
- the research funded is that which delivers the highest returns to increasingly scarce research funds;
- research is driven by management needs; and
- Australia has the capacity to deliver and to articulate research results.

2. Objectives

The broad objectives of this review (herein referred to as the review) are to:

(1) Analyse outcomes/expected outcomes of past, ongoing and current SBT research projects in the wild fishery only.

(2) Identify gaps in current research.

(3) Assess the effectiveness and appropriateness of the processes for developing, prioritising, selecting and funding SBT research projects in the wild fishery only.

The project team comprised:

- Dr John McKoy, National Institute of Water and Atmospheric Research, New Zealand
- Ms Sevaly Sen, Fisheries Economics, Research and Management P/L, Australia
- Ms Mary Lack, Shellack P/L, Australia

The full terms of reference of the review and a list of persons consulted are attached as Appendix 1.

Around 98% of the Australian SBT catch is taken by purse seine for grow-out in farm cages. This review only covers research in the SBT wild fishery, which is defined as including all fishing activity for SBT but excluding all activities after SBT is transferred to grow-out cages off Port Lincoln.

The Terms of Reference included a benefit cost analysis component, described as quantifying costs and wherever possible, benefits. In the case where benefits were non-quantifiable, a qualitative analysis was to be undertaken. In the course of the review, the reviewers found that only a qualitative analysis of benefits was possible and that there was overlap between the assessment of uptake and the assessment of qualitative benefits. For this reason, the reviewers combined these two components of the Terms of Reference.

3. Report Structure

This report is structured as follows:

- A description of the international and domestic SBT research environment including the activities, outputs and costs of past, ongoing and recently funded research projects.
- A description of the method used to estimate costs and effectiveness of research.
- An assessment of the effectiveness of selected, significant, research programs.
- A compilation of current research priorities and identification of gaps in research.
- An assessment of the effectiveness of current research prioritisation and coordination.
- An assessment of current research capacity to deliver future outcomes.
- Recommendations.

4. The SBT Research Environment 1985 - 2003

There have been significant changes to fisheries research arrangements both domestically and internationally since monitoring and research of the SBT stock began in Australia in the early 1960s. An overview of the evolution of the domestic and international research environment during the period covered by the review is provided below.

4.1 The domestic research environment

The major domestic changes have arisen from the Commonwealth Government's New Directions Policy Statement released in 1989[1]. As a result, the *Fisheries Management Act 1991* and the *Fisheries Administration Act 1991* established AFMA, and FRDC was established under the *Primary Industries and Energy Research and Development Act 1989*.

In addition to these changes in administrative arrangements, the scope of fisheries management, and hence research, has broadened significantly since 1991 to include ecologically sustainable development and, in particular, the need for sustainable use of both target and non-target species. The introduction of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) has had, and will continue to have, implications for the allocation of fisheries research funds as fisheries seek to ensure that they meet the requirements of the strategic assessment and export approval processes inherent in the legislation.

The Australian SBT fishery has also undergone major change during the review period with 98% of it's TAC of 5,265 tonnes now taken by purse seine for growing out in farm cages.

[1] Australia, Parliament, 1989. New Directions for Commonwealth Fisheries Management in the 1990s: A Government Policy Statement, AGPS, Canberra.

4.1.1 Funding

Over the review period there have been significant changes in the way fisheries research is funded. In the 1980s the Commonwealth government financed fisheries research by:

- direct Treasury appropriations to Commonwealth departments and agencies, notably the CSIRO and the then Department of Primary Industries (now AFFA);
- grants for specific research projects distributed through the Fisheries Development Trust Account and the Fishing Industry Research Trust Account; and
- Commonwealth Government's annual budgetary appropriations to assist university research. Most economic and marketing research conducted by the Commonwealth and some exploratory fishing and biological research was funded in this way.

The New Directions Policy Statement announced the following changes to fisheries research administration and funding:

- Research expenditure was to be directed toward areas likely to provide the highest level of benefit and beneficiaries would contribute to costs in proportion to the benefits received.
- Fishery managers were to be responsible for setting the priorities and administering the resultant research projects for management-related research.
- Commonwealth funding for fisheries research was to be made more effective:

  (1) unmatched Commonwealth funding for fisheries research was reduced from 1.0% of the gross value of fisheries production to 0.5% with the shortfall made up from research levies collected from the fishing and aquaculture industries. The Commonwealth was to match industry contributions up to 0.25% of the gross value of fisheries production;

  (2) management-related research in Commonwealth fisheries was to be primarily funded by direct industry levies supplemented by Commonwealth funding where necessary;

  (3) the existing funding arrangements of the Fisheries Development Trust Account were to be phased out; and

  (4) the roles of the Australian Bureau of Agricultural and Resource Economics (ABARE) and Bureau of Rural Resources (BRR, now BRS) in relation to fisheries research were enhanced. The Commonwealth would provide equivalent to a further 0.25% of the gross value of production for additional research to be undertaken or administered by ABARE, BRS and AFMA.

These arrangements took the Commonwealth Government's total contribution for fisheries research and development to a maximum of 1% of the gross value of production and the total funds available for fisheries research to 1.25% of gross value of production.

FRDC

The FRDC has three broad stated outcomes: natural resources sustainability; industry development; and human capital development[2]. As with all other fisheries, the FRDC provides funding support for SBT fisheries research programs on the basis of the following revenue[3]:

- the Commonwealth Government providing unmatched funds equivalent to 0.5% of the average gross value of production (AGVP) for the three preceding years
- state, territory and Commonwealth fishers and aquaculturists providing contributions of at least 0.25% of AGVP
- the Commonwealth Government matching contributions by state, territory and Commonwealth fishers and aquaculturists up to a maximum of 0.25% of AGVP.

Commonwealth fisheries contribute to the FRDC's funding base through fishing industry research levies collected by AFMA and passed on to the FRDC (this levy is separate from Management Advisory Committee (MAC) initiated research funds and management levies).

AFFA

The Fisheries and Aquaculture Branch (FAB) of AFFA administers funds for fisheries-related research from the FRRF. The FRRF was established in 1991 to support fisheries related research to be undertaken by ABARE, and the BRS in support of Commonwealth fisheries management. This research was to provide accurate independent assessments of the status of various fish stocks and of fisheries management priorities. The Fund was also intended to support limited management-related research categorised as being in the public interest, or where industry or other funds were unavailable or inappropriate.[4]

A 1994 review re-emphasised that the major role of the FRRF was to enable independent assessment of Commonwealth fisheries management performance including status of stocks and progress reports on fisheries. A significant proportion of FRRF funding is, therefore, devoted to ecological and economic assessments, by BRS and ABARE respectively, of fisheries management performance.

The FRRF initially received funding of 0.25% of the AGVP. This was subsequently reduced by budgetary restraint and productivity measures and a further $1m was allocated to AFMA to use autonomously.[5]

AFFA also manages Commonwealth Government funds contributed to the Scientific Research Program (SRP) of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). The Australian Government committed $3 million over three years as part of the 2002-03 budget to fund scientific research for SBT in line with the SRP designed by the external scientific panel to the CCSBT and adopted by the CCSBT. These funds are administered by AFFA, are independent of the FRRF, and are paid to the CCSBT to manage specific projects and limited national projects that support the SRP.

AFMA

AFMA's research strategy is to support management of Commonwealth fisheries resources in accordance with its legislative objectives[6].

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[2] FRDC, 2000. Investing for Tomorrow's Fish: the FRDC's Research and Development Plan 2000-2005.

[3] FRDC, 2001, Annual Report 2000-2001.

[4] AFFA, 2001. Fisheries Resources Research Fund Annual Report 2001/02.

[5] AFFA, 2000. FRRF Strategic Plan 2000-2002.

[6] AFMA, 2000. Strategic Research Plan (1999-2004).

Since 1995/96 AFMA has been provided with a lump sum of about $1m per year from the FRRF (known as the AFMA Research Fund (ARF)), to be spent in accordance with an AFMA five-year strategic research plan. The funds are primarily used to conduct management-related research including fishery and stock assessments, research in economically non-viable fisheries and research that does not generally fall within the established guidelines for funding by the FRDC.

In recent years, AFMA has also managed research funds for specific fisheries funded by industry contributions over and above FRDC research levies and management levies. Funds in these MAC initiated research funds (MIRFs) are quarantined for expenditure against specific research needs in the fishery from which the funds were derived. Such funds now contribute more than half of AFMA's research expenditure.

Research funds available to AFMA from the bilateral access fee paid by Japan up until 1998 have also been administered under the ARF for tuna fisheries research only. The annual amount varied but was substantial. For example, in 1995-96 AFMA received $680,000 from the access fee for research into tuna and billfish stocks and related species[7]. The exclusion of Japanese vessels from the AFZ since 1998, and the consequent loss of the access fee, has reduced significantly the funding available for tuna research. While no new bilateral funds have been received since 1997 some residual funds continued to be used for tuna research up until 2000/01.

AFMA may also use its discretion to direct Government-appropriated funding to research. This is a very limited avenue, and is used only for agreed priorities not funded by any other means.

Other funding sources

The other significant source of funding for SBT research is government appropriations to the CSIRO and, to a much lesser extent, the BRS. The Australian Centre for International Agricultural Research (ACIAR) also provides occasional support for SBT projects where they meet its charter.

4.2 The international SBT research environment

The international nature of the fishery imposes another layer of complexity on the SBT research arrangements which differentiates them from those in most other domestic fisheries.

Australia, Japan and New Zealand established informal trilateral management arrangements for SBT in the early 1980s. As part of these arrangements, meetings of scientists from the three countries were held annually. These trilateral management and scientific arrangements saw the introduction of total allowable catch (TAC) limits for the three countries in 1985 and a major reduction in the global TAC to 11,750 tonnes in 1989. The trilateral arrangements were formalised with the establishment of the CCSBT in 1994. Under the CCSBT, the trilateral scientific meetings were replaced by meetings of the Scientific Committee of the Commission, comprised of scientific and other representatives from the member countries.

The management objective of the Commission is to rebuild the parental SBT biomass to the 1980 level by the year 2020. The Commission's main management tools are the setting of a global TAC and allocation of that TAC among its members. Australia's 1995 SBT Management Plan established a clear link between decisions of the CCSBT on the global TAC and national allocations to members and the domestic TAC setting process.

In 1998 the Commission identified the need to separate the technical evaluation and advisory roles of its Scientific Committee. As a result the Stock Assessment Group (SAG) was established in 1998 to conduct the stock assessment and technical evaluation of data from the SBT fishery.

Over 1998 and 1999 considerable management and research effort was devoted by CCSBT member countries to the development of a joint experimental fishing program (EFP) that

[7] Joint Standing Committee on Treaties, 1996. Two International Agreements on Tuna, 3rd Report, AGPS, Canberra.

would contribute to reducing the uncertainty surrounding the CCSBT members' assessments of the chances of SBT stock recovery. Despite these efforts and considerable research resources, members of the Commission could not agree upon a joint program. In the absence of agreement Japan undertook a unilateral EFP in 1998 and 1999. This resulted, ultimately, in international legal action between Australia/New Zealand and Japan and consequently significant disruption to CCSBT scientific and management processes. The Scientific Committee did not meet in 1999 or 2000 and no stock assessments were carried out in those years. Despite this, monitoring and research programs carried out by the individual parties, and jointly, continued.

In 1998 the CCSBT commissioned a Peer Review Panel to review and report on the quality of the scientific analyses and methods used by the Scientific Committee. One of the recommendations of this review was that the CCSBT appoint a panel of three to five independent scientists. In accordance with this recommendation, the CCSBT established an Advisory Panel to provide external input to its stock assessment and scientific processes and has also appointed independent chairpersons to the SAG and Scientific Committee.

While members of the Commission undertook joint scientific research, such as the Real Time Monitoring Program (RTMP) and the Recruitment Monitoring Program (RMP), the Commission did not have an agreed research program until 2001 when the SRP was implemented. The development of the SRP is seen as a significant step towards resolving the impasse in the CCSBT in recent years and has implications for the direction of Australia's SBT research.

These changes, together with the admission of Korea and Taiwan to the CCSBT, have been positive for the workings of the Commission. However the Commission has failed to agree on a TAC or to set national allocations to its members since 1997. Given the link between the CCSBT TAC setting process and the domestic TAC this situation continues to have ramifications for the allocation of research funds and the provision of scientific advice to the AFMA Board for the purposes of setting a domestic TAC under the SBT Management Plan 1995.

5. Method

For the purposes of this review, any SBT project funded by the recognised research funding agencies or research providers is regarded as research. Details of the objectives and outputs associated with the projects to date are contained in Appendix 2. Many of the outputs of this research took the form of papers presented to CCSBT and related meetings. A list of these papers can be found in Appendix 3.

Project details are presented under four research themes:

1. Stock assessment

1. Recruitment monitoring
2. Stock assessment modeling
3. Data collection

2. Biology and life history

4. Ageing studies
5. Biology

3. Economics/management/communications

4. Ecologically related species

Within these categories there are a number of ongoing research programs. These include the various projects conducted as part of the RMP (e.g. aerial survey), monitoring of Indonesian catch of SBT, monitoring of the eastern sector of the Australian fishery, the archival hard parts collection, the development of mitigation measures for seabird bycatch and industry/management/science liaison.

5.1 Sources of information

The documentation of SBT research undertaken since 1985 was based initially on records of projects funded by:

- the Department of Primary Industries and Energy through the Fishing Industry Research Trust Account (1985-1991);
- AFFA through the FRRF (1991/92-2002/03);
- AFMA through the ARF (1995/96-2002/03); and
- the FRDC (1993-2002).

The sources of information from these agencies included, variously:

- annual reports of research funds;
- progress and final reports of projects;
- funding applications; and
- file documentation of project progress and outputs.

The information identified from these sources was supplemented by specific requests to:

- the BRS;
- the CSIRO;
- ABARE; and
- Environment Australia (EA).

A search of the AFFA library database also identified additional projects undertaken by agencies/researchers (e.g. universities).

5.2 Estimation of research costs

Rarely is a research project funded entirely from one source. In most cases funding is provided from at least one funding body together with a contribution from the applicant. In some cases funding may be derived from up to five sources. Quite often contributions to SBT research are in-kind, such as in the form of the cooperation/assistance of fishers in providing access to vessels, gear and expertise, to facilitate the research.

These arrangements make identification of accurate funding information on individual projects difficult. Each agency attributes their contribution to a project with a different project number and, depending on the component of the project they are a funding, a different project title from that used by other agencies. Under these circumstances there is a high potential for duplication when compiling lists of research projects. Appendix 4 contains a list of projects and the costs attributed to each funding agency. Every effort has been made to identify and remove such duplication in this analysis.

Another constraint to the accurate determination of costs of research related to confirming actual, rather than budgeted, expenditure. This was a particular issue in relation to the "applicant contribution" to research since there is no way of knowing whether the applicant actually contributed the estimated amount. The actual contribution could have been more or less than budgeted. For this reason the costs include elements of both actual and estimated expenditure. It should also be noted that the applicant contribution frequently includes expenditure on capital items. The full value of such items over their life may in many cases not be fully attributable to SBT research. It was not possible to account for this in the estimation of research costs.

When projects are not specific to SBT, attributing costs to SBT research is difficult. For example, the BRS research to develop status reports for fisheries includes a wide range of fisheries, not just SBT. Similarly projects such as those initiated by AFMA on best practice reference points and ecological risk assessments are relevant to all Commonwealth fisheries.

In addition, the appropriate level of attribution of some of the ongoing research projects has changed over the review period. In particular the research into seabird bycatch mitigation in longline fisheries has declined in its relevance to the domestic SBT fishery as the proportion of the quota taken by purse seining has increased. The appropriate level of attribution to SBT of the research projects identified in Appendix 2 has been determined in consultation with research providers.

The total value of SBT research in the review period 1985 to 2002 is estimated at $25 million (nominal) and $29.5 million at 2002 prices. This includes Australian and collaborative Australian/Japanese research.

A summary of funding by source for the review period is provided in Table 1. Funding for each year from 1985-2002 in nominal and real dollars is provided in Table 2. Both tables summarise the project information provided in Appendix 4.

Table 1 Estimates of SBT research funding 1985 – 2002, by source (Nominal $)

Source	Estimated funding $m	%
CSIRO	7.09	28.4
FRRF	3.49	14.0
Foreign	3.28	13.1
FRDC	3.00	12.0
SBTMIRF[1]	2.74	11.0
Other	1.99	8.0
ARF	1.42	5.7
BRS	0.65	2.6
Bilateral Fund	0.45	1.8
SRP	0.29	1.2
Industry[1]	0.22	0.9
Other MIRF	0.16	0.6
AFMA Reserves	0.13	0.5
ABARE	0.02	0.1
EA	0.02	0.1
TOTAL	**24.95**	**100**

[1]Industry contributions reflected under SBTMIRF and Industry categories do not include industry levies to FRDC

Table 2 Estimates of SBT research funding 1985 – 2002, by year (Nominal and real (2002) dollars)

Year	TOTAL $ Nominal	TOTAL $ Real (2002)
1985	258,273	505,914
1986	149,817	268,852
1987	343,062	567,657
1988	100,000	154,362
1989	557,293	799,443
1990	763,483	1,020,937
1991	406,400	527,842
1992	1,870,109	2,398,467
1993	4,292,249	5,409,409
1994	757,669	936,902
1995	631,578	746,214
1996	1,921,609	2,213,540
1997	2,341,926	2,690,972
1998	438,163	499,228
1999	3,177,526	3,567,930
2000	2,280,262	2,450,749
2001	2,861,779	2,947,206
2002	1,814,682	1,814,682
TOTAL	**24,965,880**	**29,520,306**

5.3 Determination of research effectiveness

Given that there were 149 research projects over the review period, the review had to select projects or programs for assessment of effectiveness. Effectiveness was determined on the basis of uptake of research results.

Three types of projects were selected: those which were annual ongoing projects such as the RMP and the SBT stock assessment; those projects where there had been or there was potential for a clear positive or negative outcome; and those projects highlighted as significant by stakeholders.

In assessing the effectiveness of past and current research, the review relied heavily on:

- The statements of objectives, and where available, the key reports from funded programs.
- Interviews with key stakeholders representing most of the agencies and organizations that have been involved with SBT research and management issues since 1985.

Uptake was defined in terms of use of results in:

- the stock assessment, and/or
- developing domestic management arrangements, and/or
- developing and supporting Australia's position in CCSBT.

6. Research Effectiveness: Stock Assessment

6.1 SBT assessment and Fishery Assessment Group report

From 1991 to 2002/03, just under $2.9 million (nominal) has been spent to carry out SBT stock assessments, provide background documents and papers to CCSBT and produce a report of the Fishery Assessment Group (FAG) to the AFMA Board (Table 3). SBTMAC and AFMA have agreed that the report from the CCSBT Scientific Committee constitutes the "FAG" report for SBT and as such SBTMAC does not under normal circumstances undertake a separate process[8]. The CCSBT Scientific Committee report is presented to the MAC and has formed the basis upon which the MAC has made its recommendations to AFMA and AFFA.

SBTFAG has, however, provided advice to the AFMA Board in circumstances where a report from the Commission's Scientific Committee has not been available. The last FAG report was produced in 2000. The complexity of the relationship between domestic and international management and research is highlighted by the SBT stock assessment process.

SBTFAG expenditure has been devoted to preparing stock assessments for CCSBT and/or the AFMA Board, undertaking management strategy evaluation (MSE) and providing Australian scientific advice to the CCSBT process. In the years where no stock assessments were carried out (1997, 1999, 2000 and 2002) the review questions the appropriateness of the use of FAG funds to carry out other activities, such as the development of the EFP and the development of management procedures, as this goes beyond the scope of FAG activities. Separate funding would have been more appropriate. Although, this can be partially attributed to the fact that FAG proposals have to be submitted before the annual CCSBT work plan is known – the review believes that this constraint could be overcome.

Table 3 Research and expenditure on SBT stock assessment and FAG report (Nominal $)

Year	Project	FRRF	ARF	CSIRO	Other	TOTAL
1991	Improved stock assessment of SBT 1991/2	88,000				88,000
1993	SBT assessment/meetings1993/4	62,000		264,200		326,200
1995	SBT stock assessment 1995/96		147,630	147,160		294,790
1997	SBT stock assessment		161,364	165,046		326,410
1998	SBT FAG 1998/99		185,992			185,992
1999	SBT FAG 1999/2000		186,555			186,555
2000	SBT FAG 2000/01		191,573	238,685		430,258
2001	SBT FAG 2001/02		196,907	382,150		579,057
2002	SBT FAG 2002/03		153,607	245,285	51,202	450,094
	TOTAL	**150,000**	**1,223,628**	**1,442,526**	**51,202**	**2,867,356**

The review also found it difficult to disentangle work carried out under the FAG and that carried out under individual projects. For example, to what extent does the FAG objective "development and evaluation of a management strategy for SBT in conjunction with CCSBT SC and Commission processes" overlap with the FRRF-funded project "Scientific support for policy development and implementation for the CCSBT" aimed at the development of a simulation framework for the evaluation of management strategies?

The review acknowledges that CSIRO scientific input into the CCSBT assessment process requires some kind of framework funding, as is the case of funding provided to BRS under the project, "Scientific Support for the Development of International Policy for Commonwealth Fisheries". To ensure no actual or perceived overlap of activities occurs between FAG activities and other projects, greater clarity in the FAG project objectives is required. The review notes that FAG activities may be under further scrutiny should the AFMA Board decide to increase industry's contribution to the FAG budget above its present 25% contribution up to 50% in future years, as is being considered.

[8] CSIRO/AFMA, 2000. SBT Fisheries Assessment Report, September 2000.

Uptake

Domestically, the scientific advice from the SBT stock assessment process did contribute to quota reductions in 1989 and the decisions to exclude joint venture boats from the Australian Fishing Zone in the late 1980s.

Stock assessments for the CCSBT process were produced by CSIRO in 1996, 1998 and 2001. These are commonly regarded by stakeholders interviewed by the review team as having made a significant contribution to the development and support of Australia's position at the CCSBT particularly in the late 1990s when there was pressure to increase the global TAC.

Since the early 1990s, the advice provided to AFMA by the SBTFAG has not been reflected in changes in the domestic TAC. This is despite Australian (and New Zealand) assessments indicating that there is a low probability (<14%) of achieving the CCSBT 2020 management objective if current catch levels are maintained[9] and the conclusions of the CCSBT Scientific Committee in 2001 that "There is a risk of further stock declines if current removals are maintained, and depending upon members aversion to this risk, differing levels of catch reductions would be appropriate forms of insurance for the sustainability of the current fishing industries". [10]

The public explanation from the AFMA Board for its decision to retain a TAC of 5,265t is that "the sustainable management of the stock relies on effective international cooperation by all catching countries and cannot be achieved by unilateral Australian action".[11]

Thus, although the AFMA Board appears to have considered the research outcomes they have chosen not to change the TAC due to the international management context of SBT. This is a decision that the review has no mandate to comment on. However, in terms of uptake, as defined by the review, stock assessment research since the early 1990s, has not been adopted domestically.

This raises two issues. Firstly, the rationale provided by the Board does not appear consistent with the Objectives, Measures and Performance Criteria specified in the SBT Management Plan 1995 as they relate to the uptake of research results. For example, Performance Criteria 6.1(d) reads as follows:

> "that appropriate research is carried out in the SBT Fishery and the results are:
>
> (i) used in assessing the stock of Southern Bluefin tuna; and
>
> (ii) incorporated into management programs relating to Southern Bluefin Tuna;…"

Secondly, in the absence of uptake of the results of the stock assessment domestically, it raises the question as to whether the expenditure on this research from funds earmarked for domestic research has been warranted and whether these funds should have been used in research areas which may have yielded a higher return domestically.

Although the cost-sharing between AFMA and CSIRO recognises that the assessments of SBT were necessary to meet both national and international management obligations, it is not clear to the review why AFFA, through the FRRF, does not make a financial contribution to the FAG process, given that the major influence on the nature of the stock assessment, and the management response to it, lies with CCSBT. This is particularly relevant if increasing resources are spent on the MSE as this fits well under Program 2, Sub-program 2 of the FFRF Programs and Strategies i.e. "Development, assessment and review of management strategies that support the sustainable utilisation of resources". AFMA's research funds could then be directed to areas where uptake of the results in the domestic fishery was likely to be higher.

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[9] CSIRO/AFMA, 2000. SBT Fisheries Assessment Report, September 2000

[10] CCSBT, 2001. Report of the Scientific Committee.

[11] AFMA News, Volume 4, Issue 7 November 2000 p.4.

6.2 Indonesian catch monitoring

From 1991-2002, CSIRO, in collaboration with the Indonesian Research Institute of Marine Fisheries (RIMF), has been monitoring SBT catches off Indonesia to collect catch data and investigate the reproductive biology of SBT in the fishery. Monitoring was initially set up on Port Muaru Baru in Jakarta and Port Benoa in Bali. From 1993, monitoring continued only in Bali, as SBT on vessels at Port Muaru Baru remained frozen on board and appeared to come from the southern Indian Ocean rather than the spawning grounds in Indonesia.

Data were collected from two processors using monitors employed by the project. Length and weight measurements, as well as gonads and otoliths were collected and the estimates of total SBT catch in Benoa were made using raising factors. Gaining unrestricted access to processors as well as having sufficient monitors to cover all processors has been an ongoing constraint facing the project. In 1999 coverage of the Benoa fishery began to run down for a number of reasons: the new monitor had difficulties gaining access to processors; processing operations were switching to other areas such as Sri Lanka; and the companies being monitored switched to other processors. As a result of an ACIAR funded workshop in 2000, a new joint project between the Indian Ocean Tuna Commission (IOTC), AFFA and ACIAR commenced in 2002 with the aim of covering 30% of all landings of tuna (including SBT) processed at all processors. The CSIRO/RIMF scheme was abandoned.

FRRF has been the main source of funding for this program since its inception in 1991 (Table 4). In most years CSIRO has also been a major contributor. The total cost of the program has been just under $1.4 million (nominal).

Table 4 Indonesian catch monitoring research and expenditure (Nominal $)

Year	Project	FRRF	SRP	ARF	CSIRO	OTHER	TOTAL
1990	SBT sampling in Indonesia 1990/91					8,300	8,300
1991	Spawning strategy of SBT from catch monitoring off Indonesia 1991/2	123,000					123,000
1992	Spawning strategy of SBT from catch monitoring off Indonesia 1992/3	101,800					101,800
1993	Monitoring SBT catches off Indonesia 1993/4	110,000			19,800		129,800
1995	Monitoring the longline catch of SBT landed in Indonesia 1995/96	60,300					60,300
1997	Monitoring the longline catch of SBT landed in Indonesia and Taiwan 1996/97			75,299	17,971		93,270
1997	Monitoring the longline catch of SBT landed in Indonesia 1997/98	74,980			29,508		104,488
1999	Monitoring the longline catch of SBT landed in Indonesia 1998/99	69,890			25,657		95,547
2000	Monitoring the longline catch of SBT landed in Indonesia 1999/2000	92,831			12,653		105,484
2001	Monitoring the longline catch of SBT landed in Indonesia 2000/2001-2001/2002	108,141	38,167		67,333		213,641
2002	Monitoring the longline catch of SBT landed in Indonesia 2002-2003	40,000	55,573		49,990	155,326	300,889
	TOTAL	**780,942**	**93,740**	**75,299**	**222,912**	**163,626**	**1,336,519**

Note: “Other” category in 2002 are ACIAR funds

Uptake

Characterisation of the SBT catch taken by all fleets is fundamental to the SBT stock assessment and is the highest priority research area for both SBTMAC and the CCSBT SRP. Data collected by this project have been used to estimate total catches of SBT in Indonesia, which is then used in the stock assessments. Estimated annual catches in Indonesia have ranged from 720 to 2160 tonnes over the period 1992 - 2001 and are therefore a significant proportion of the SBT catch. The estimates of monthly Indonesian catches and the proportion of longline catch that is SBT and age distribution of the spawning stock are the fourth and fifth indicators respectively of seven fisheries indicators assessed by the CCSBT SAG to determine stock status and the need for a full assessment.

Since 2001, the reliability (representativeness of samples, raising factors and procedures) of the CSIRO/RIMF estimates has been a source of dispute between Australia and Japan. CSIRO/RIMF estimates of total catch were always higher than Japanese import data by a factor of two or three which had an effect on uptake of the results within the CCSBT.

However, a recent CCSBT workshop[12] reviewing the Indonesian Catch Monitoring projects concluded that:

- Japanese import data should not be used to estimate Indonesian catches;
- although many of the possible sources of biases in past CSIRO/RIMF data were not well understood, there was insufficient data to quantify these biases; and
- the recent results of the IOTC program indicate that catches in 2002/03 were in the same order as those estimated by the CSIRO/RIMF for previous years and therefore "it seemed unlikely that previous estimates were in error by orders of magnitude[13]."

As this data is critical to the SBT assessment, the benefits are clear. In addition, data is collected for a relatively low cost. However the need for this data is ongoing. This raises a longer-term sustainability question regarding this data collection – basic monitoring of this kind should be the responsibility of Indonesia. Future funding may have to include a more substantive institutional capacity building component to ensure this data can be collected by the RIMF, without continued external support from Australian domestic research funds. Alternatively, the CCSBT could fund this project from SRP earmarked funds or seek alternative funding from research organisations with a focus on research capacity building in developing countries, such as ACIAR. The CSIRO, ACIAR and RIMF are currently developing a three year proposal with such an objective.

6.3 Recruitment monitoring program

The RMP, which began in 1993, is a collaborative project between CSIRO and the Japanese National Research Institute of Far Seas Fisheries (NRIFSF). The initial aim of the program was to develop absolute fishery independent indices of abundance for one or more of the young fish age groups (1-4 years). The Japanese government committed funds for a five-year program in line with their budget cycle. The Australian component required submission of project proposals tri-, bi-annually or annually. In 1998, Japan committed to a further five-year program, due to end in 2003. Even when relations between Australia and Japan in the CCSBT were strained, the RMP has provided a forum for scientists from both countries to cooperate.

Over the ten year period 1993-2003, the RMP has cost a total of $8.4 million (nominal) of which $4.8 million has been funded by Australian funds and $3.6 million has been provided by Japan. This includes not only the RMP itself but also any associated projects of the RMP, as detailed in Table 5. The costs exclude conventional tagging projects coordinated by CCSBT and tagging projects before 1993.

The main components of the RMP have been, and continue to be, aerial surveys, acoustic monitoring, conventional and archival tagging and the integration of this data into an individual-based model.

6.3.1 Aerial surveys

The aerial surveys were initially aimed at obtaining an absolute index of abundance but this was later changed to estimating a relative index when the limitations of the survey techniques were realised.

Developmental aerial surveys had been carried out prior to the RMP in 1991 and 1992.[14] Annual aerial surveys carried out under the RMP over the period 1993 – 2000 were full scale, using comparable protocols. The survey was suspended in 2001, following concerns about its effectiveness and to allow for completion of data analysis and a review of the survey. In

[12] Report of the Indonesian Catch Monitoring Review Workshop, 10-11 April 2003, Queenstown, New Zealand.

[13] Report of the Indonesian Catch Monitoring Review Workshop, 10-11 April 2003, Queenstown, New Zealand.

[14] According to CSIRO, funding and developmental work began in 1990 but there are no funding details of this research.

2002, a more limited survey recommenced based on commercial spotting data combined with a limited scientific aerial survey. Funding for this pilot survey, which plans to develop a Surface Abundance Per Unit of Effort (SAPUE) index, was continued in 2003 because it had been successfully argued that two years' data were required to enable a proper evaluation of the new survey. However, bad weather in 2003 has meant that a lower number of transects were flown than planned so that it may be argued that there is a need to run the survey again in 2004.

Uptake

The need for a fishery independent index of relative abundance of juveniles remains. The use of aerial surveys to develop such an index is, as the CCSBT Peer Review Panel observed, the "most expedient" method to develop such an index, provided such a survey was "satisfactorily developed[15]". In that sense the aerial survey under the RMP did respond to, and try to address, an urgent need.

A reliable relative index of abundance requires, as a minimum, a consistent time series. Despite having been run every year (except 2001) since 1991, there is only a consistent time series over the period 1993-1998. Aerial surveys in 1991 and 1992 had a different design and the surveys in 1999 and 2000 had observer calibration difficulties. Therefore, due to design and logistical reasons, from 1997 onwards, the survey has not developed an index of abundance which can be quantitatively used in the assessment process. This loss of continuity and changes in design have had an effect on the uptake of the aerial survey results as a relative index of abundance.

Although doubts about the utility of the survey have existed for some time, the response has been to tinker with the design and cost. This has eroded the value of the survey by breaking the time series developed over the period 1993-1998. The problems experienced in 1999 and 2000, and the design changes in 2002-2003, suggest that expenditure in these years is unlikely to yield any benefit. A re-analysis of the aerial survey in 2002 found that the most important limiting factor in the analysis is the difference between observers. It was concluded that if observers cannot be reliably calibrated then the survey should be discontinued.[16]

The review found that the most important input from the aerial survey was in the mid-1990's as it provided the only direct evidence that a recruitment collapse had not already occurred. The 1996 stock assessment used the results of the aerial survey to set lower bounds for the number of young SBT in the most recent cohorts in projections of the SBT stock.[17] Subsequent stock assessments (1998, 2001) have incorporated the aerial survey into the projections in the same way.

Since 2000 concerns have been expressed about the utility of the aerial survey. For example:

- The 2000 Aerial Survey Workshop concluded that it had become "apparent that the ability to detect changes in juvenile SBT abundance using scientific aerial survey index was limited".
- The proposal for the RMP submitted to the ARC in 2001 by CSIRO noted that "while the scientific aerial survey does provide a general indicator of SBT abundance in the GAB, it does not provide validation of the recruitment estimates generated by the CCSBT stock assessment models".

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[15] J. Maguire, P. Sullivan and S. Tanaka, 1999. Report of the Southern Bluefin Tuna 1998 Peer Review Panel, CCSBT.

[16] Bravington, M.V., 2002. "Further considerations on the analysis and design for aerial surveys for juvenile SBT in the GAB" in Development of a fishery independent index of juvenile southern bluefin tuna and improvement of the index through integration of environmental, archival tag and aerial survey data. Draft final report FRDC Projects 96/118 and 99/105.

[17] Davis, T.L.O., undated. Final Report of the Southern Bluefin Tuna Recruitment Monitoring Program (1993-1998).

- At its 2002 meeting, the CCSBT SAG noted the following: "the aerial index of 2-4 abundance is similarly [i.e. compared to the acoustic survey] considered of questionable utility but shows a slightly declining trend." [18]

Currently, the data from the aerial survey is indicator eight on a list of nine fisheries indicators considered by CCSBT SAG to determine the need for a full stock assessment. Although all nine indicators are considered, only the first seven indicators were reviewed in 2001/02[19] and will be reviewed in 2002/03. In reviewing the indicators, both Australian and Japanese scientists noted that recent changes in the aerial survey design meant that the data did not provide the basis for defining a trend, or comparing with other existing time series of aerial spotting data[20].

The review acknowledges that a relative index of juvenile SBT abundance is critical to reducing uncertainty in the assessments. However, unless the difficulties of observer calibration and the uncertainties surrounding the interpretation of survey results particularly with regard to environmental and behavioural factors can be effectively addressed, investing more money in the current survey is unlikely to be the best use of limited research resources.

6.3.2 Acoustic surveys

A Japanese research vessel, *Takei*, has carried out an acoustic survey every year since 1994 under the RMP. This research accounts for the bulk of Japanese funds to the RMP and although part of the RMP, it is quarantined from the remainder of RMP funding. The survey is aimed at the development of an index of abundance of juvenile SBT (mainly age 1) migrating into the survey area off Albany-Esperance as well as investigations on vertical and horizontal distribution. A full-scale survey only commenced in 1996 since it took two years to develop appropriate survey procedures and strategies.

Australian scientists have often questioned the benefit of this project and have had concerns that the survey would be very sensitive to changes in migratory patterns. This led, in 2000, to the implementation of a two year pilot acoustic monitoring project in Western Australia, under the RMP, to determine whether the lack of fish found by the acoustic survey was a survey design problem. Moored listening stations were deployed to detect acoustically tagged SBT within the GAB.

Uptake

The results of the acoustic survey have not yet been used in any stock assessment. The final report[21] of the first five years of the RMP (1993-1998) concluded:

"….at least several more years' estimates are required to determine whether the survey estimates are providing a reliable recruitment index that can be incorporated into the stock assessment."

Surprisingly, however, the results of the survey are included as the seventh of the nine fisheries indicators assessed by the CCSBT SAG to determine fishery status and the need for a stock assessment.

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[18] CCSBT, 2001. Report of the Second Meeting of the Stock Assessment Group, 19-28 August 2001,Tokyo, Japan.

[19] CCSBT, 2002. para 47, Report of the 9th Annual Meeting of the CCSBT , October 2002.

[20] Kolkody, D.et al, 2002. A Review of Recent Trends in Southern Bluefin Tuna Fishery Indicators, Report CCSBT-SC/0209/27 and Tsuji,S.,Interpretation by Japan on various fisheries indicators Report CCSBT-SC/0209/37.

[21] Davis, T.L.O., undated. Final Report of the Southern Bluefin Tuna Recruitment Monitoring Program (1993-1998).

Table 5 Recruitment monitoring program research and expenditure (Nominal $)

Year	Project	FRDC	FRRF	Bi-lat	SBT MIRF	CSIRO	Japan Govt.	Other	TOTAL
1993	Recruitment monitoring program 1993/94				123,000	192,400	629,100		944,500
1993	Development of a fishery independent index for juvenile SBT 1992/93		88,000		34,200	14,400	59,000		195,600
1994	Development of a fishery independent index of abundance for juvenile SBT	53,350				38,000		325,800	417,150
1996	SBT recruitment monitoring program 1995/96		90,000		111,600		465,000		666,600
1996	SBT recruitment monitoring 1996/97	175,036		191,960			465,000		831,996
1997	SBT recruitment monitoring 1997/8	178,892		136,748		173,565	388,888		878,093
1998	SBT recruitment monitoring program 1998/99	185,027			166,685	179,136	207,317		738,165
1999	Evaluate a surface abundance index based on commercial spotting data for juvenile SBT in the GAB				48,318	12,648			60,966
1999	Improved fishery independent estimates of SBT recruitment through integration of environmental, archival tag and aerial survey data	141,152				136,731		122,949	400,832
1999	SBT recruitment monitoring program 1999/00	78,200			199,607	165,827	356,140		799,774
2000	SBT recruitment monitoring program 2000/01				194,743	314,376	357,235		866,354
2001	SBT recruitment monitoring program 2001/02				189,980	300,261	352,627		842,868
2002	SBT recruitment monitoring 2002/03				199,269	213,565	300,865		713,699
	TOTAL	811,657	178,000	328,708	1,267,402	1,740,909	3,581,172	448,749	8,356,597

6.3.3 Conventional tagging

Conventional tagging commenced in 1990 and has been a key component of the RMP since its inception in 1993. Conventional tagging was aimed at estimating the absolute level of recruitment to the fishery, age, growth and movement studies and estimation of natural and fishing mortality rates by age. The number of recaptures by year and country are shown in Table 6**.** Interpretation of the return rates is highly confounded by the lack of data for estimating reporting rates for the longline fisheries since 1998.

Conventional tagging under the RMP ceased in 2002 after the CCSBT SRP initiated a conventional tagging program in November 2001. The CCSBT program has three elements:

- a pilot two year longline tagging program in the western Indian Ocean as part of a Japanese research cruise;
- a pilot two year longline tagging program off the east coast of Australia as part of a more general Australian tagging program in the region;
- an extensive five-year surface fishery tagging program off the southern coast of Australia to be coordinated by the CCSBT Secretariat. Over 3,000 SBT were tagged in 2001/02, which was below planned levels. It is intended that the target of 15,000 tagged fish per year will be achieved in the second year.

Table 6 The number of recaptures of conventional tags, by year and country, 1990-2002

Year	Australia	Japan	Taiwan	New Zealand	NZL Joint Venture	Korea	Total
1990	2	0	0	0	0	0	2
1991	172	52	0	0	0	0	224
1992	230	127	0	0	5	0	362
1993	280	234	0	0	3	0	517
1994	467	209	0	0	2	0	678
1995	913	258	2	9	6	0	1188
1996	1352	262	13	4	0	0	1631
1997	1810	287	48	8	6	2	2161
1998	578	85	32	4	10	0	709
1999	94	135	30	11	2	0	272
2000	36	35	11	9	3	0	94
2001	17	41	2	4	3	0	67
2002	6	0	0	10	9	0	25
Total	5957	1774	138	59	49	2	7930

Source: CCSBT-SC/0209/27

The pilot programs have proved the feasibility of tagging mature SBT, but the high cost of capturing mature SBT may indicate that the focus should address biological research questions using pop-up and archival tags rather than traditional tags.

Uptake

The review found that the majority of stakeholders considered conventional tagging to be the most beneficial component of the RMP. Tagging data have been used in the stock assessments to estimate cohort abundance and to estimate age-specific natural mortality rates. Tagging data have also provided critically important information, showing that growth rates of SBT have changed. In addition, tagging provided the first conclusive evidence for rapid movements of juvenile SBT between the surface and longline fisheries. However, the variation in tag reporting rates between countries and fisheries has been a major cause of uncertainty in estimating abundance, fishing mortality, natural mortality and migration rates from tagging experiments.

Tagging programs have been an important tool in understanding aspects of the biology and dynamics of SBT including growth rates, levels of recruitment, exploitation rate and interactions between surface and longline fisheries. However, these programs have had limited effectiveness because of non-cooperation, difficulties in estimating non-reporting of tags, and intermittent application. The lack of a continuous and coherent tagging program with supporting effective observer coverage represents a significant lost opportunity. Although, the SRP tagging program should improve coordination and continuity, the estimation of non-reporting rates will remain a significant challenge to the effectiveness of that program.

6.3.4 Archival tagging

The main objective of the archival tagging component of the RMP was aimed at examining the surfacing behaviour of fish in the aerial survey area to help interpret the aerial survey data. Other objectives have been to obtain information on patterns and movement rates of SBT including broad scale migrations. Since 1994, 520 archival tags on 2-4 year old SBT have been deployed under the RMP. The return rate has been just over 20% (Table 7). A change in tag manufacturer in 1998, and analysis of data obtained from the new tags indicated that tags used over the period 1993-1997 were less accurate.

Table 7 Archival tagging 1993-2001

Year Released	Number Released	Number Recovered	Percent Recovered	
			>1 year at liberty	Total
1993	28	2	7.1	7.1
1994	148	17	8.8	11.5
1995	137	45	29.2	32.8
1998	113	30	15.9	26.5
1999	61	9	11.5	14.8
2000	27	8	29.6	29.6
2001	5	0	-	0.0
Total	519	111	17.0	21.4

Source: CCSBT-SC/0209/27

Uptake

As changes in the proportion of SBT at the surface will potentially bias estimates of abundance, information on the proportion of time that fish spend at the surface is important to reduce uncertainties in the abundance models based on the aerial survey data.

Archival tagging has not yet made a significant contribution to the stock assessment in terms of reducing the uncertainties related to fishery independent juvenile abundance indices[22].

[22] 2002/3 RMP Project Proposal.

However, information obtained from the archival tagging has improved knowledge about the movements and behaviour of SBT and developed expertise and capacity within Australia on archival tagging. This has provided the impetus for the recent approval of a large (i.e. high cost) research project to "Determine the spatial interaction among juvenile SBT at the global scale to provide a more comprehensive understanding of their spatial dynamics" to be funded by FRDC, CSIRO and unspent Australian SRP funds. The project is complementary to a Japanese project proposal involving the release of archival tags and there has been an in-principle agreement to collaborate on joint sharing of data.

6.3.5 The future of the RMP

The Australian component of the RMP has received significant funding from CSIRO and MIRF funds - accounting for almost all MIRF research funding annually. Given that an AFMA proposal to introduce 50% FAG cost recovery is currently under consideration, industry has indicated that any increase in FAG costs combined with the costs of the recently established observer program will result in a reduction in industry's contribution to the MIRF. The implication of this is that fewer MIRF funds may be available for SBT research.

Members of the SBTMAC Research Sub-Committee (RSC) have argued that this will affect leverage of other research funds, particularly FRDC funds. An analysis of RMP funding shows that since the start of the RMP, FRDC and FRRF have given 60 cents for every dollar of MIRF/bilateral funding. However, in the last three years (2000-2003), the RMP has been entirely funded by MIRF with no other funding from other Australian research funds. Thus for the RMP at least, the leverage argument seems no longer valid.

The funding situation and the large-scale conventional tagging program initiated by the CCSBT in 2001 suggest that the funding future of the RMP is limited, irrespective of the findings of this review.

7. Research Effectiveness: Biology, Life History, Growth and Ageing

Projects funded in this general category have included studies on age and growth (including the establishment and maintenance of an archival hard part collection), studies of reproductive biology and age distributions on spawning grounds, genetics of spatial structure, and behaviour. Data to support these studies have been made available from a range of data collection projects including: (i) catch sampling in various parts of Australia (and Indonesia) for otoliths and length and weight composition of catches; (ii) the RTMP which in the 1990s collected catch, effort, length and weight data and biological samples on the high seas; and (iii) tagging programs.

7.1 Age, growth and reproductive biology

Knowledge of growth rates and an ability to establish the age composition of the catch are valuable tools in understanding the stock dynamics of SBT, particularly issues regarding year class strength, survivorship, production and spawning stock potential. Just under $3.6 million (nominal) has been spent in Australia on age and growth studies (Table 8).

Prior to 1992, attempts to establish a validated and reliable ageing technique for SBT met with little success. However, the 1992 FRDC/CSIRO project, "Direct estimation of age and growth of SBT" established a validated technique. This was accepted by the CCSBT Scientific Committee and prompted an agreement to introduce a fishery wide program of sampling and routine age estimation over the next few years.

The 1997 project, "Catch-at-age; age at first spawning; historical changes in growth; and natural mortality of SBT" was developed in response to concerns expressed by the CCSBT Scientific Committee about inadequate understanding of catch at age, age at maturity and natural mortality, and concerns about possible changes to growth rates of juvenile SBT over the past few decades. Age estimates from a large number of otoliths sampled from throughout the range of SBT highlighted differences between growth rates of males and females, changes in natural mortality with age and changes in growth rates of one - two year

Table 8 Research and expenditure on age and growth studies (Nominal $)

Year	Project Title	FRDC	Bi-lat	SBT MIRF	Other MIRF	CSIRO	other	TOTAL
1985	Study of the reproductive biology of the SBT (*Thunnus maccoyii* (Castelnau)) off the east coast of Australia	32,275						32,275
1985	Direct otolith ageing of SBT *Thunnus maccoyii* (Castelnau) exploited by the Australian fishery	82,528						82,528
1985	Otolith age determination of mature SBT	28,470						28,470
1987	Determination of the migration patterns of juvenile SBT and jackass morwong	172,649				165,703		338,352
1989	Age determination and assessment of variation in length at age of large SBT by means of analysis of otolith and vertebral chemical composition	186,853				211,440		398,293
1990	Analysis of Shoyo Maru larval samples						35,500	35,500
1990	Frequency of spawning of SBT						55,800	55,800
1990	Migration routes of SBT						15,300	15,300
1990	Conventional age determination for SBT						10,400	10,400
1992	Genetic analysis of the spatial structure within the SBT population	148,967				320,073		469,040
1992	The direct estimation of age and growth of SBT	262,260				514,072		776,332
1993	Ultrasonic tagging to determine surfacing behaviour of SBT 1993			32,500				32,500
1993	Use of bomb radiocarbon chronometer to validate fish age	12,169					17,145	29,314
1995	An archival hard part collection - a basis for routine ageing of SBT 1993/94 & 1994/95			38,400		30,400		68,800
1996	Age distribution of mature SBT on the NE Indian Ocean spawning grounds.			15,000		8,034		23,034
1997	Catch-at-age, age at first spawning, historical changes in growth, and natural mortality of SBT: an independent study of key uncertainties	211,338				209,991		421,329
1997	Archival hard part collection - a basis for routine ageing of tuna & billfish 1998/99			8,436	8,435	17,952		34,822
1998	Assessment of acoustics as a research tool to determine the distribution, biomass and behaviour of SBT schools and their prey in the GAB			53,252				53,252
1999	Archival hard part collection - a basis for routine ageing of tuna & billfish, 1999/2000		16,551			18,977		35,528
1999	An integrated analysis of the growth rates of SBT	154,400				158,608		313,008
1999	Size at first maturity and recruitment into egg production of SBT	146,094				87,560		233,654
1999	Archival hard part collection: a basis for routine ageing of tuna and billfish 2000/01			8,101	12,152	14,784		35,037
2000	Archival hard part collection - a basis for routine ageing of tuna and billfish			9,782	9,781			19,563
2001	Archival hard part collection - a basis for routine ageing of tuna and billfish			10,536	10,536	5,610		26,681
	TOTAL	**1,438,003**	**16,551**	**176,006**	**40,903**	**1,763,204**	**134,145**	**3,568,811**

olds in the late 1970s to early 1980s. The new population parameters were incorporated in the recent stock assessments and CCSBT analysis of stock indicators. The study also produced valuable observations on changes to the age composition of fish on the spawning grounds.

Growth-related data from a range of programs was incorporated in a 1999-2000 project "An integrated analysis of the growth rates of SBT for use in estimating the catch at age matrix in the stock assessment" which developed integrated models of SBT growth and documented changes in growth rate over the last 40 years. The results were utilised in the 2001 stock assessment, and made a significant contribution to understanding variation in growth and the dynamics of SBT populations.

The development by CSIRO, funded primarily by CSIRO and MIRF funds, of an archive of hard parts, primarily otoliths, from SBT and other large tunas from around Australia, was formalized in the mid-90s. This archive was the basis for a significant long-term collection to underpin projects on ageing and age validation. The value of the collection was proved in making possible the key 1997 project "Catch-at-age; age at first spawning; historical changes in growth; and natural mortality of SBT" which produced growth and mortality estimates which were very important in the stock assessment. As a result of this project, routine archiving of otoliths was adopted as a high priority, and eventually accepted as a formal responsibility, of CCSBT members. The funding of the archive was only partly attributable to SBT.

The collection of archival hard parts is an ongoing, annual activity but it was not clear to the review to what extent the funding incorporates collection activities specifically to populate the archive as compared to collections made as part of other projects. Although there is now a formal requirement within CCSBT for members to collect and age a "representative" sample of otoliths from their catch, it is not apparent in proposals for funding that this is an objective of the collection. Information on how such representativeness is to be achieved is also not available.

Basic studies of the reproductive condition of SBT in the mid-1980s were followed by research on the frequency of spawning and the composition of fish on spawning grounds. Reporting of some of the more recent work is not complete but the work completed so far has built a valuable understanding of spawning dynamics, including the size/age at first spawning, number of spawnings and numbers of eggs released at each spawning. The data have been used to infer a relative egg production as a function of fish length. These data form the basis for estimating total egg production, a useful base in investigating relationships between spawning stock and recruitment in the stock assessment model.

7.2 Genetics and stock structure

Several studies have been funded to examine spatial dynamics using otolith chemistry tools. The extent of uptake of these (mostly small) projects is difficult to determine since they supported the hypothesis of a single spawning area for the SBT stock.

In 1992 FRDC and CSIRO funded a project "Genetic Analysis of the spatial structure of the SBT population" which cost $469,000. The results reported from this high cost "pilot" study, like those on otolith microchemistry, failed to reject the null hypothesis of a single stock of southern bluefin tuna. This work supported a key assumption underpinning the stock assessment and suggested that it was appropriate to continue to consider the SBT resources as coming from a single stock. There has been no support for a larger study or the use of more sensitive modern genetic techniques. The project also attempted to address questions about relationships between African and Tasmanian SBT adults at the extremes of adult distribution. The study failed to reveal any differences, adding further weight to the single stock assumption.

8. Research Effectiveness: Economics, Management and Communication

8.1 Economic research

In recent years there has been no research in economics of the SBT fishery, reflecting the fact that there are currently no research priorities in economics either domestically or internationally. Most research carried out pre-1996 focused on optimising Japanese access arrangements to the AFZ and the effectiveness of individual transferable quotas (ITQs). Over the years 1986-1995, there were seven projects carried out looking at these issues (Table 9). The two projects on ITQs had a positive impact by giving greater confidence about the benefits of ITQ management and by contributing to the development of the 1989 "New Directions for Commonwealth Fisheries Management in the 1990s" policy statement. The results of the project on access fees made an important contribution to the increase in access fees for Japanese vessels. The project, "Alternative methods for determining appropriate bilateral access fees" provided support to Australia's negotiating position with Japan. The two projects ("Optimal Australian and Japanese harvesting of SBT" and "A game theory analysis of management strategies for the SBT industry") were primarily academic pieces of work with no practical management relevance.

Table 9 Expenditure on economic research (Nominal $)

Year	Project	FRDC	FRRF	ABARE	Other	Total
1986	Assessing the effectiveness of the SBT management scheme and its effect on those involved in the industry at the time of its introduction	62,017				62,017
1990	The value to Japan of access to the Australian fishing zone			Unknown		0
1991	Optimal Australian and Japanese harvesting of SBT				Unknown	0
1993	A game theory analysis of management strategies for the SBT industry				Unknown	0
1994	Use of individual transferable quotas in Australian fisheries			Unknown		0
1994	Benefits and costs of the venture agreement in the SBT industry			Unknown		0
1995	Alternative methods for determining appropriate bilateral access fees		69,741			69,741
	TOTAL	**62,017**	**69,741**	**0**	**0**	**131,758**

8.2 Management research

This category includes research on management issues, industry development as well as communication, extension and liaison. Since 1985, just under $5.2 million (nominal) has been spent on these issues (Table 10). Of this, less than $200,000 has been directly spent on extension, communication and liaison. A further $160,000 has been spent on the SBT component of the BRS Fisheries Status Reports.

8.2.1 Stereo video system

Currently, a 40 fish sample is taken from the cages to obtain weight and length frequency data on which to base estimation of "landings" of SBT from the Australian purse seine fishery. However, there are considerable doubts about whether this is a representative sample. In response to the need to improve the quality of length frequency data, the project, "Validation and implementation of a stereo video system for measuring length of SBT during transfers" was funded. It is aimed at testing the feasibility of using a stereo video system to count and measure lengths of SBT while they are being transferred into farm cages. The reviewers believes that this project was a response to two clear management needs, viz, improving Australia's capacity to monitor its domestic TAC and improving the quality of the data used in the stock assessment.

Table 10 Expenditure on management and communication research (Nominal $)

Year	Project Title	FRDC	FRRF	SRP	ARF	Bi-lat	SBT MIRF	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Other	Total
1985	Demonstration of the viability of a fishery for SBT and big eye tuna for the fresh sashimi market	115,000														115,000
1986	Establish the viability of a longline SBT operation based in Tasmania and establish a quality control mechanism for the Australian longline industry	87,800														87,800
1987	Tag lottery for SBT	4,710														4,710
1988	A preliminary review of the 1987-88 Australian SBT season										100,000					100,000
1989	The 1988-89 Australian SBT season										100,000					100,000
1990	SBT: scientific background to the debate										20,000					20,000
1990	The 1989-90 Australian SBT season										100,000					100,000
1992	Scientific monitoring of fishing		349,000													349,000
1992	Status of Australian fisheries		17,382								10,255					27,637
1993	Japanese speaking liaison personnel to visit longline vessels in Sydney, Brisbane and Cape Town						16,000			86,400						102,400
1993	Support for the AFZ observer program 1991/92 - 1994/95					3,975	19,140			13,909						37,024
1993	Research industry management liaison						21,000									21,000
1993	Japanese tuna fisheries to the year 2000						17,500									17,500
1993	Quantitative interpretation of fine-scale catch -per-unit-effort for SBT off south eastern Australia	290,692								1,360,981					136,000	1,787,673
1993	Status of Australian fisheries		14,940								8,815					23,755
1994	Development of comprehensive and integrated methods for including key uncertainties in the management advice for the SBT fishery		52,512													52,512
1994	Status of Australian fisheries		16,577								9,780					26,357
1995	Japan tuna fisheries						20,000									20,000
1995	Non destructive biomass estimation devices						10,000									10,000
1995	Trends in tuna fisheries; the republic of Korea and Taiwan consultancy proposal		19,351			20,000									19,351	58,702
1995	Scientific support for policy development and implementation for the CCSBT		54,880													54,880
1995	Status of Australian fisheries		18,000								10,620					28,620
1996	Industry management workshop publication						19,526			25,000						44,526
1996	Status of Australian fisheries		18,000								10,620					28,620

Table 10 cont.

Year	Project Title	FRDC	FRRF	SRP	ARF	Bi-lat	SBT MIRF	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Other	Total
1997	Scientific support for policy development and implementation for the CCSBT		199,978													199,978
1997	Status of Australian fisheries		19,404								11,448					30,852
1997	Scientific support for the development of international policy for Commonwealth fisheries 1998		51,030								30,618					81,648
1998	SBT conservation and trade		132,231											10,000		142,231
1999	Training video for longline fishermen					1,063										1,063
1999	Status of Australian fisheries		15,946								7,133					23,080
1999	SBT research/industry/management workshop		18,392			25,093										43,485
1999	Scientific support for the development of international policy for Commonwealth fisheries 1999		28,980								17,388					46,368
2000	Indonesian/Australian workshop on shark and tuna including SBT														11,531	11,531
2000	Conservation and optimum utilisation of SBT		183,850									20,000				203,850
2000	Scientific support for the development of international policy for Commonwealth fisheries		50,540								85,610					136,150
2000	Validation of accuracy of measurement of SBT						59,561									59,561
2001	Ecological risk assessment for Commonwealth fisheries												29,884			29,884
2001	Best practice reference points for fisheries									3,601			2,275	1,500		7,376
2001	Stereo video - the validation of the accuracy and precision of length measurements of SBT				112,900										40,000	152,900
2001	Scientific support for emergent international priorities (2001)		162,400								97,790					260,190
2001	Status of Australian fisheries		21,495								18,291					39,786
2001	The nature of SBT bycatch in the ETBF and determining the extent of mortality in SBT released alive: an integrated research and monitoring program		50,000	91,342			21,209	120,183	150,000	64,485						497,219
	TOTAL	498,202	1,494,888	91,342	112,900	50,131	203,936	120,183	150,000	1,554,376	638,368	20,000	32,159	11,500	206,882	5,184,867

Whilst the technical feasibility of the system has been proved, field trials on commercial farms have been impeded by lack of cooperation from industry. Industry argues that there may be alternative and more cost effective systems available "off the shelf". A feasibility study carried out by the project showed otherwise. The review believes that in terms of maximising the returns from research dollars spent, if the system developed by the project is proven to work, then it makes sense to implement that system. The benefits of using an appropriate stereo video are clear – data quality will be improved and catches monitored more accurately.

8.2.2 Management strategy evaluation

The projects entitled "Scientific support for policy development and implementation for the CCSBT" (1995 and 1997) were aimed at the development of a simulation framework for the evaluation of management strategies.

It is too early to determine uptake of this research, but indications are that such research clearly addresses management needs and has already developed and supported Australia's position at the CCSBT. Uptake would be further enhanced if information was also available in an accessible way to stakeholders who have limited or no scientific background. CCSBT has endorsed the development of a management procedure, and has commenced a series of three workshops. The MSE approach has the additional advantage of being able to identify which areas of uncertainty have the greatest impact on the management procedure thus identifying areas of future research.

8.2.3 Ecological risk assessment

Another project where it is too early to determine uptake is the Ecological Risk Assessment Project. Indications are that there needs to be considerable effort and resources in obtaining good iteration with industry and other key stakeholders both in terms of explaining the project and verifying/building upon information generated by the project.

8.2.4 Conservation and optimum utilisation of SBT

The 2000 project "Conservation and Optimum Utilisation of SBT", which cost just over $200,000 of FRRF funds does not appear to have been used in domestic management, the assessment process or in supporting or developing Australia's position at CCSBT. It is not clear how widely the report was distributed or how the research fitted in to Australia's negotiating strategy at CCSBT. Some key stakeholders interviewed could not remember the research at all.

8.2.5 Southern bluefin tuna conservation and trade

The 1998 project 'Southern Bluefin Tuna conservation and trade" examined the advantages and disadvantages of a management system implemented by CITES. The findings of this research were the subject of a substantial criticism from TRAFFIC Oceania for biased analysis. The policy impetus or rationale for commissioning this research is unclear.

8.3 Liaison, extension and communication

The earlier projects in this category were focused on tag recovery and improving liaison with Japanese fishers. The later projects cover a variety of subjects. The project entitled "Research/Management/Industry Liaison" was aimed at promoting effective communication between researchers, managers and industry by holding workshops (1993, 1997 and 1999) to discuss research results and obtain feedback from industry and other stakeholders. Although the concept was good, the review found that most stakeholders did not react very positively to the workshops themselves, especially in the later years. Since 1999, there is some liaison between researchers, industry, management and other stakeholders, but this is not carried out in a workshop format. Whilst fully supporting the concept of these workshops, the review could see no actual benefit of these workshops, in terms of a better understanding of research results or generally improved communication between the researchers, managers and industry. This can be attributed partly to ineffective communication skills of both

researchers and industry and partly to a forum which did not facilitate the effective exchange and discussion of complex information.

The Indonesian/Australian workshop held in 2000 is considered by the review to have been effective in improving co-ordination and planning for future monitoring work in Indonesia.

9. Research Effectiveness: Ecologically Related Species (ERS)

As the fishery for SBT developed in Australia longlining was an important technique for this and other tuna and billfish species. The increased recognition of the importance of ecosystem-wide impacts of fishing resulted in funding of around 12 projects looking at catch and catch rates of seabirds, estimation of seabird interactions with longline fishing, seabird population dynamics and modeling, and development of seabird bycatch mitigation measures. Because this research has broader implications across longline fisheries, and because of the declining share of Australia's SBT TAC taken by longlining, most of the research in this category has been only partly attributable (2.5% to 9%) to SBT fisheries. Total costs attributed to SBT have been estimated at just under 120,000 (Table 11). Despite this there appears to be good uptake of the research done on seabirds. For example, the research underpinned the definition of areas where seabird mitigation measures should be used and made a significant contribution to the widespread use of tori poles.

No work appears to have been done on other bycatch taxa. Although there are likely to be relatively fewer bycatch issues in the purse seine fishery, the absence of data may have implications for the strategic assessment of the fishery under the EPBC Act. Whilst the recent observer program in the purse seine fishery may address some of the bycatch data needs, the review believes that this may not be sufficient to verify bycatch and other approaches to dealing with bycatch issues should be considered.

Table 91 Expenditure on ERS research (Nominal $)

Year	Project Title	FRRF	ARF	Bi-lat	SBT MIRF	Other MIRF	Industry	CSIRO	EA	Other	Total
1995	A population modelling assessment of the effects of longline on seabird populations				7,500						7,500
1995	Status and conservation of albatross and their interactions with fisheries			6,750					7,500		14,250
1995	Effects of fishing on non-target species 1995/96 and 1996/97	40,485									40,485
1996	Seabird longline interactions		7,500							24,543	32,043
1997	The effects of longlining on seabird populations: by catch estimation and population modelling assessment			4,486				1,294			5,780
1997	Albatross longline interaction - seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988-1996 trends		2,250						1,800		4,050
1997	The effects of longlining on seabird population: by catch estimation, archival tagging & population modelling assessment			1,340							1,340
1997	Construction & evaluation of underwater setting device to prevent accidental capture of seabirds			4,140						1,080	5,220
1998	Development of a design and implementation program for a fisheries observer program to monitor seabird bycatch rates in domestic longline fisheries			1,688							1,688
1999	Seabird by-catch assessment in the AFZ & further mitigation measure development for longline fisheries			1,391							1,391
2000	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries			1,103			113		1,285		2,500
2001	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries			800		247	247				1,294
2001	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries	2,188									2,188
	TOTAL	**42,673**	**9,750**	**21,698**	**7,500**	**247**	**360**	**1,294**	**10,585**	**25,623**	**119,729**

10. General conclusions concerning the effectiveness and uptake of research

The review acknowledges the difficulty of separating uptake/impact of research on domestic management arrangements and developing /supporting Australia's position in CCSBT (and its predecessors) – given the international nature of the fishery and its management. A relatively simple fisheries biology situation is "offset" by complex externalities and complex organisational arrangements and responsibilities within Australia.

In general, SBT management in Australia and in the international context has been well served by the nature, extent and quality of research that has been supported and carried out by Australian agencies. Australia has credibility in the global SBT management and research context.

Much of the research undertaken has, appropriately, been devoted to developing and supporting Australia's position at the CCSBT and as input into the CCSBT stock assessment. Many stakeholders interviewed by the review team felt that without this research, the pressure from Japan to increase the global TAC would have been successful. This would have had a deleterious effect on the stock and in the longer term compromised the sustainability of the Australian SBT fishery and the industry it supports. In the context of the inherent value attaching to conservation of the fish stock, the justification of precaution, and the high economic returns the fishery delivers, this research must be considered as being very effective.

However, the relative effectiveness of projects varies. Table 12 provides a generalised summary of the review findings on effectiveness measured by uptake for the specific programs/projects reviewed. Management research has been excluded because it covers such a wide range of activities/projects.

10.1 CCSBT

Given the current impasse in establishing the TAC within CCSBT, the recent stock assessment and modelling could be seen as having had little impact on the international arrangements for the management of SBT. Nevertheless, the Australian research contribution is widely recognized as having been instrumental in:

- the 1988 reduction of quotas, and
- precluding global increases in quota in the late 1990s.

Given the intractability of some negotiating positions at CCSBT, there is, however, likely to have been decreasing marginal benefit from further refinement and development of the stock assessment process.

The review found that the main factors which appear to have limited research uptake or contributed to perceptions of limited value for money in the CCSBT context include:

- Tensions between Australian and Japanese participants limiting the effective uptake of some research and perhaps diverting energy and resources to less productive areas.
- A perception by other international SBT scientists of "excessive thoroughness", "more work being done than necessary by Australian participants in some stock assessment discussions" and; the development of "unnecessarily" complex models.
- A lack of effective external scrutiny and review. This has been rectified to a significant degree since 1998 with the introduction of the CCSBT's panel of external scientists.
- Consensus decision-making at CCSBT.
- A lack of a common CCSBT research program. This has now been rectified by the SRP.

Table 12 Summary of uptake of programs reviewed

Program	Input to the Stock Assessment	Developing Domestic Management Arrangements	Developing and Supporting Australia's Position at CCSBT	Cost (Nominal Dollars)
Aerial survey under the RMP	Yes. No. 8 of 9 fisheries indicators reviewed by the CCSBT SAG to determine stock status – first 7 indicators are the main ones reviewed	No	Limited extent	Total cost: $8.4 million
Conventional tagging under the RMP	Yes	No	Yes	Australian contribution: $4.4 million
Archival tagging under the RMP	Very limited. Has improved knowledge about movements and behaviour of SBT	No	No	
Acoustic surveys under the RMP	No	No	No	
SBT Assessment and FAG	Yes	Yes: up until the late 1980's.	Yes	$2.9 million
Indonesian catch monitoring	Yes	No	Yes	$1.4 million
Age, growth and reproductive biology	Yes	No	Yes	$3.6 million
Genetics and stock structure	Yes	No	No	$470,000
Economic research	No	Yes	No	$132,000
Ecologically related species	No	Yes	Yes: in ERS Working Group	$120,000

10.2 Australian Domestic Management

Despite CSIRO assessments indicating that there is a low probability of recovery to the 1980 level of the parental biomass by 2020[23], there has been no uptake at the domestic level since the late 1980s. National TACs have not changed since 1989. The review acknowledges Australian managers face a dilemma as any reduction in the Australian TAC, without corresponding reductions in catch by other catching countries, may have little or no benefit to stock recovery. It is not the role of this review to make a judgement on that issue. However the review must comment on the effectiveness of research judged by its uptake as defined in section 5. It is undeniably true that in the domestic context, the SBT stock assessment research since the late 1980s has not been taken up.

The review also identified a number of other factors that are likely to have limited research uptake in the domestic context:

- Policy-makers and managers do not have a good understanding of the key uncertainties in the stock assessment and the implication of these to management. Researchers have had to make assumptions about these management needs which has led to a lack of ownership of research results by industry, managers and policy-makers.

[23] CSIRO/AFMA, 2000. SBT FAG Report, September 2000.

- There has often been poor communication between industry, managers, policy-makers and researchers on research results. Sometimes the poor communication is due to the communication skills of the researchers, sometimes managers and policy-makers do not have the skills to understand and act on the results. Also, sometimes industry has met the science with derision. Although the reasons are not clear, they probably include personalities, the nature of the fishery, 'unpalatable' results and political positions.

- A powerful industry lobby resistant to change.

- Industry is reluctant to support some research due to suspicions that compliance is being carried out under the guise of research e.g. the SBT observer program.

- Policy-makers and managers believing that, within the global SBT management context, there is a more urgent need to control non-CCSBT member SBT catches than to further constrain the SBT mortalities incurred by CCSBT member countries.

11. Current research priorities and gap identification

11.1 Research priorities

Current research priorities are clearly driven by the international context of CCSBT management and the research priorities of the SRP. The research priorities of SBTMAC and of the SRP are listed in Appendix 5.

The domestic research priority setting agenda is established in line with both AFMA's corporate objectives and CCSBT objectives. The agenda focuses on reducing uncertainties in the SBT stock assessment. Prior to the introduction of the SRP the major influencing factor on these research priorities was the RMP. Currently both programs have a dominant influence on domestically set priorities for SBT research which the review considers appropriate given the international context of SBT management. The proposed changes to the SBT Management Plan 1995 include much more specific references to the role of research in management of the fishery. This should provide a stronger framework for management-driven research.

SBT stakeholders have opportunities to input into the AFMA research priority-setting process through the SBTMAC that in turn relies on the advice of their RSC. AFMA produces a five-year strategic research plan[24], which outlines the strategic research outcomes, and strategies that AFMA intends to pursue over the period. The Plan commits AFMA to research strategies that support its management of Commonwealth fisheries resources in accordance with its legislated objectives. Underlying the Strategic Research Plan are meant to be five-year research plans for individual fisheries. However the SBT Strategic Research Plan 2000-2005 has not been finalised and was not referred to by any of the stakeholders interviewed during the review. The review therefore did not consider the draft plan a working document.

Current research programs and the SBTMAC and CCSBT priorities they address are summarised in Table 13. They represent ongoing and recently funded research and exclude projects that have been completed but for which the final report is pending. The analysis supports the view that current research is consistent with and driven by identified research priorities.

[24] AFMA, 2000. Strategic Research Plan 1999-2004, AFMA, Canberra.

Table 13 Fit of current research projects to SBTMAC and CCSBT SRP priorities

Project Title	SBTMAC	CCSBT SRP
SBT fishery monitoring program for the eastern sector of the Australian fishery 2002/03	Priority 1: Catch and effort data collection system	Priority 1: Characterisation of the SBT catch
An archival hard part collection – a basis for routine ageing of SBT	Priority 1: Catch and effort data collection system	Priority 1: Characterisation of the SBT catch
	Priority 5: Determination of SBT biological parameters needed for the SBT stock assessment	Priority 5: Direct ageing
Collection of SBT otolith and length data by Protec Marine for archiving by CSIRO	Priority 1: Catch and effort data collection system	Priority 1: Characterisation of the SBT catch
	Priority 5: Determination of SBT biological parameters needed for the SBT stock assessment	Priority 5: Direct ageing
Collection of SBT otolith and length data by Protec Marine for archiving by CSIRO	Priority 1: Catch and effort data collection system	Priority 1: Characterisation of the SBT catch
	Priority 5: Determination of SBT biological parameters needed for the SBT stock assessment	Priority 5: Direct ageing
Southern bluefin tuna stock assessment and FAG report 2002/03	Priority 2 – Provision of SBT stock assessment for CCSBT	
Evaluation of complex population models used for the assessment and management of migratory fish stocks	Priority 2 – Provision of SBT stock assessment for CCSBT	
Monitoring SBT catches off Indonesia 2002/03	Priority 3 : Monitoring and biological sampling of the Indonesian, Taiwanese and Korean SBT catch	Priority 1: Characterisation of the SBT catch
SBT Recruitment Monitoring 2001/02	Priority 4: Development of fishery independent indices	Priority 7 Recruitment Monitoring Program
CCSBT tagging for SBT - Australian contribution to SRP surface fishery tagging component	Priority 4: Development of fishery independent indices	Priority 4: Conventional tagging program
Validation and implementation of a stereo video system for measuring length of SBT during transfers	Priority 5: Determination of SBT biological parameters needed for the SBT stock assessment	Priority 1: Characterisation of the SBT catch
Estimation of mortality rates from tagging data for pelagic fisheries: analysis and experimental design	Priority 5: Determination of SBT biological parameters needed for the SBT stock assessment	Priority 4: Conventional tagging program
Spatial interactions among juvenile SBT at the global scale: a large scale archival tag experiment	Priority 6: Spatial dynamics of SBT and implication for assessment and management	Priority 6: Archival and pop-up tagging
Understanding the nature of SBT bycatch in the ETBF and determining the extent of mortality in SBT released alive; an integrated research and monitoring program	ERS Priority 1: Assessment of the level of bycatch in the AFZ	
Ecological risk assessment for Commonwealth Fisheries	ERS Priority 1: Assessment of the level of bycatch in the AFZ	
A review of byproduct interactions and economics in Australia's tuna and billfish fisheries	ERS Priority 1: Assessment of the level of bycatch in the AFZ	

11.2 Identification of gaps

The review has used a general working definition of "gaps". Gaps are related to perceived or stated needs from the management framework. They can be defined as:

- the *absence* of research on a particular question, or
- an *inadequate level of effort* or resources in a particular area, and/or;
- *inadequate quality* of research.

Assessment or identification of gaps is further complicated by the absence of clearly stated management objectives in this fishery. The only stated objective in the CCSBT context is that of rebuilding the stock to the 1980 parental biomass by 2020[25]. At the domestic level, the current SBT Management Plan contains no clearly stated management objectives.[26]

Therefore, the approach of the review to identifying gaps was to gather the perceptions of stakeholders and assess these suggestions against current research strategies, statements of priorities and current research programs. Many of these gaps have already been identified in SBTMAC documents, strategic research plans and, especially the CCSBT documents that contributed to the SRP development.

They include research questions and activities:

N = not included in current plans/priorities

P = in current plans but not research in progress

C = in current plans but being inadequately addressed

The review does not attempt to suggest relative priorities, or even to define research questions better, since this task should be done through the appropriate consultative processes. Moreover, the list is not exhaustive. The scope of these gaps as expressed varies from research questions, to data collection, to actual tasks.

Stock Assessment

- Stock structure and mixing - especially between Australia and South Africa. The initial tagging on SBT gave some clues about the lack of mixing between Australia and South African waters, supported by some evidence from when small fish were heavily fished in Australia in the 1970s. This is related to questions about the extent to which changes in the abundance of juveniles counted off southern Australia are representative of the abundance of the population as a whole. (C)
- Quantification of recreational catches. Quantification would address allocation issues between the recreational and commercial sectors as well as improve estimates of Australia's annual SBT catches by more effectively accounting for all SBT landings. This need was accorded varying degrees of importance by stakeholders. (P)
- Factors influencing catch per unit effort (CPUE) – catchability, fleet dynamics. These questions are still very important as long as CPUE continues to be used as a major index of abundance. (C)

[25] Before the CCSBT, the management objective had been to rebuild the stock to the 1980 level by 2010. However, this was extended by a further 10 years, sometime in the early 1990s and the first formal reference to it can be found in the report of the First CCSBT meeting.

[26] However, draft amendments to the Plan currently under consideration do incorporate significant new management objectives and performance criteria.

- Assessment based on a full age-length analysis. This supports the suggestion of the SBT 1998 Peer Review Panel[27] that the feasibility of deriving the age composition of the catch by direct aging of a random sample of the catch rather than using age/length keys should be investigated. (C)
- SBT catches and biological information from non-CCSBT member fishers. (C)
- Documentation of changes to data collection procedures. This is critical to meaningful analysis/interpretation of time series data. (N)

Biology/Life history

- Spawning stock dynamics and evaluation of the effects of fishing on or "protecting" the spawning area. (N)
- Understanding of recruitment at low stock levels. Recent observations suggest that the SBT stock may be relatively productive of recruits at very low stock levels – but the behaviour of, or limits to, spawning stock biomass (SSB) at low levels and the impact of environmental variation on recruitment success, are not understood. The capacity for the SSB to be reduced is still high and may be increasing. (N)
- Better estimation of abundance, growth, mortality/exploitation rates. (C)
- Estimation of recruitment. (C)

Ecologically Related Species

- Consider SBT in an ecosystem context – for example, what are the effects of reductions in large predator abundance on stocks of pilchard in the Great Australian Bight? (N)
- Estimation/knowledge of bycatch in the Australian purse seine fishery for SBT. (C)

Economics/Management/Communication

- Impact of a reduction of Australian catches on the global stock in particular the effect of reducing catches of juvenile SBT compared to a reduction in catches of older fish. (N)
- Evaluation of the effects of a possible shift to SBT from bigeye tuna targeting to SBT in the Indian Ocean by non-CCSBT parties. (N)
- Identification of important areas of uncertainty as a guide to setting the research agenda – for example, spatial dynamics, recruitment. (C)
- Long term data collection arrangements. (C)
- Communications strategy development to effectively communicate stock assessment information and other research results. (C)

[27] J. Maguire, P. Sullivan and S. Tanaka, 1999. Report of the Southern Bluefin Tuna 1998 Peer Review Panel, CCSBT.

12. Research prioritisation and coordination

The Terms of Reference of the review state that assessment of existing processes, structural arrangements and means and extent of coordination for developing and prioritising research should only be carried out up to the point where SBTMAC makes recommendations on project funding. This was primarily to avoid addressing broader issues of research prioritisation at the level at which SBT research is competing for other funds.

However, in the course of discussions with stakeholders, the review team found that the SBTMAC was not the only clearinghouse for research projects submitted for domestic research funding. Therefore this section not only assesses the prioritisation/selection process up to SBTMAC level but also comments on the prioritisation/selection process of some SBT research projects which occurs outside of the SBTMAC process.

12.1 Prioritisation/Selection within the MAC process

As discussed in section 4, SBTMAC research priorities derive largely from the stock assessment needs identified in the international context of SBT management. There are ten broad MAC priorities for 2003/04 (see Appendix 5) and within each of these a number of specific sub-priorities are identified. An examination of these suggests that, within the framework of international stock assessment needs, domestic research requirements are also identified. These relate, for example, to research that facilitates the accurate monitoring of Australia's catch of SBT to ensure that its TAC is not exceeded.

After establishing its research priorities the MAC calls for research proposals that are consistent with those priorities. Project proposals submitted are then assessed by the RSC and the MAC and a priority ranking attached to each. The MAC's ranking of proposals is then forwarded to the AFMA Research Committee (ARC/COMFRAB) for a decision on funding from AFMA funding sources or for a recommendation to FRDC for funding.

The review identified a number of aspects of the prioritisation/project selection process that are less than ideal:

(1) **A tendency for research priorities to reflect to some degree the professional capacity and expertise of research providers**. It is not possible to be specific about the extent to which this influences the priority setting process. However it was apparent that the scientific input to priority setting is disproportionate to that of managers. Under these circumstances it is possible that the areas of interest/expertise of the scientists involved may be unduly influencing the priority setting processes. The reviewers acknowledge, however, that in the absence of a management procedure in the CCSBT and the relatively poor definition of management objectives and measures in the SBT Management Plan 1995, there has been a relative lack of management-driven research priorities. In this environment it is not surprising that scientists domestically and in the CCSBT have responded by taking the lead in prioritising research.

(2) **Limited time and stakeholder involvement in the SBTMAC RSC.** The reviewers believe there would be benefits from improving the operation of the RSC, both in terms of amount of time dedicated to its activities (in and out of session) and the active participation of a representative group of stakeholders.

(3) **The desire to leverage, through the RMP, Japanese research funds, may have influenced domestic research priority setting**. However, it is unclear to the reviewers whether, in the absence of management-directed research, this has adversely influenced the priority setting/project selection process.

(4) **The participation of research providers in both the setting of research priorities and the ranking of proposals.** This leaves the way open for, at the minimum, a perception of conflict of interest. The review acknowledges that the relatively small number of research providers means that such a situation is largely unavoidable and that decisions on successful proposals are ultimately taken further up the research selection chain. However the perception of conflict of interest might be addressed by greater use of external reviewers, particularly in the ranking of proposals.

(5) **Potential conflicts between research needs and commercial interests.** Where research outcomes may be seen as a threat to commercial interests, there is a potential for this to be reflected in the prioritisation and selection process. Again, greater use of external reviewers, particularly in the ranking of proposals, might address this.

(6) **Some tactical selection of projects** based on the priorities and interests of the targeted funding agency rather than necessarily the most significant research needs of the fishery.

(7) **The absence of a current Five-year Strategic Research Plan for SBT**. This Plan should act as the basis for priority setting and project selection of SBT projects in the AFMA/FRDC network. In addition it should have been the basis upon which this review assessed the extent to which research conducted was consistent with agreed priorities. The absence of a Plan affects both the effective conduct and assessment of SBT research. The reviewers acknowledge that finalisation of the draft Plan for 2000-2005 was in part a response to the fact that this review of SBT research was underway. However it is unacceptable that the delays in getting this review underway were allowed to stall finalisation of at least an interim Strategic Plan.

(8) **The current process of calling for research submissions to address the identified priorities**. The process involves a number of risks. There is no guarantee that any of the proposals received will address the highest ranked priorities. Where only one proposal is received in response to an identified priority there is no basis for comparison to ensure that the proposal is the most cost-effective approach to addressing the priority. The review sees some merit in a more targeted call for research to address particular priorities and greater specification of the nature of the research being sought to address those priorities. This approach may involve taking a longer term and more strategic approach to research. The review notes that a clearly defined five-year strategic research plan for SBT could play an important role in underpinning such an approach.

(9) **Poor communication and a lack of analysis and, evaluation of results from previous research.** This affects the capacity of members of the RSC and the MAC to assess the need for and nature of further research in specific areas.

The review notes that most of the identified deficiencies in the SBT research selection process were likely to be equally apparent in other fisheries because they reflect the overall research structure and environment applying to fisheries research rather than individual fishery traits. The issues may therefore need to be addressed at a holistic rather than a fishery specific level.

12.2 Prioritisation/Selection outside the MAC process

As mentioned in Section 4, all research funding agencies are able to access discretionary funding to undertake research which falls within their own research priorities but outside those of SBTMAC or CCSBT. This review is a good example of the use of such funding.

The links between the SBTRSC, MAC, ARF and FRDC processes ensure that project selection reflects the priorities identified by the MAC. However the FRRF and SRP processes are not formally part of that framework.

FAB produces a Strategic Plan[28] and an Annual Operational Plan (AOP) for the FRRF. The latest Strategic Plan is for the period 2000-2002. This is currently under review. The Plan outlines the programs and sub-programs of the FRRF. The AOP specifies annual priorities within these programs and sub-programs. According to the Strategic Plan these priorities are determined by a research priority workshop which should be held in May each year. The most recent workshop was held in November 1999 although some *ad hoc* and less inclusive meetings of some stakeholder groups have been held subsequently to discuss various aspects of the FRRF. An AOP has not been published since 1999 although AFFA continues to develop an AOP internally.

The FRRF Strategic Plan[29]outlines three processes which should provide a mechanism to ensure that the priorities identified through the AFMA/FRDC framework and the views of other stakeholders will be taken into account when assessing research proposals for FRRF funding. These processes are:

- the annual research priority workshop,
- the preparation of an AOP which builds on the views identified at the workshop to establish annual priorities, and
- inclusion of representatives from AFMA and FRDC on the FRRF Advisory Committee.

While AFFA continues to include AFMA and FRDC on its FRRF Advisory Committee the annual research priority setting and AOP processes appear to have become largely internalised within AFFA. The current AOP does not appear to have been distributed outside AFFA. As one stakeholder put it:

"There may as well not be an AOP if no one has access to a copy".

The document indicates that "it is intended to meet priority issues and desired policy outcomes identified by the Fisheries and Aquaculture Branch (FAB), which will assist as inputs to the AFFA outputs, *Industry Development and Adjustment, Market Access and Trade and Natural Resources Access and Management*."[30]

AFFA has, however, advised that it is planning to hold a FRRF workshop in mid 2003. This workshop should provide a forum for maximizing consistency and complementarity with priorities identified in the AFMA MAC/FRDC processes.

While the review acknowledges AFFA's discretion for FRRF expenditure, stakeholders, especially research providers, have a right to know the project selection process. If the processes have changed stakeholders should be advised. If the Strategic Plan relies on the use of an AOP, that Plan should be developed and made available to stakeholders. This is critical for transparency and accountability.

Of further concern to the review team is the current process for prioritisation of projects for the first year of SRP Australian research funds. The approach is not sufficiently accountable and although this can be partially attributable to the "use it or lose it" nature of the annual allocation requiring projects to be submitted quickly at financial year-end if funds have not been spent, there is a danger that commissioned research may not deliver the highest returns because they have not been properly assessed. The review team notes that this will be rectified in the future by use of the independent review panel of CCSBT to review and evaluate all Australian SBT research proposals against the requirements and priorities of the CCBST SRP.

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[28] AFFA, 2000. The 2000-2002 Strategic Plan for AFFA's Fisheries Resources Research Fund, AFFA, Canberra.

[29] AFFA, 2000. The 2000 - 2002 Strategic Plan for AFFA's Fisheries Resources research Fund, AFFA, Canberra.

[30] AFFA, 2002. Fisheries Resources Research Fund Annual Operating Plan 2002-2003, AFFA, unpublished.

12.3 Coordination of research

Effective coordination of research projects does not seem, until recently, to have been a strong feature of SBT research in the international context. The introduction of the SRP has overcome this to a large extent.

Within Australia, the review found that coordination of research projects has been impeded by:

- Organisational complexity (domestic funding arising from the management agency (AFMA), the policy agency (AFFA) and the overarching funding agency (FRDC) together with external funds emanating from overseas agencies, notably Japan, and through the CCSBT's SRP).
- Poor communication and alignment between some funding and management agencies.
- The lack of leadership by management agencies in establishing research priorities and managing to ensure that these needs are met.
- A lack of adherence to specified process in some instances (development of Strategic Plans, AOPs, stakeholder consultation).

12.3.1 Information on past and current projects

The process of compiling information on SBT research projects for this review was time-consuming and therefore costly. The main reasons for this are:

- The evolving nature of research funding arrangements over the review period and the consequent lack of continuity in information recording;
- The range of research recording systems used by the main funding agencies (AFFA, AFMA and FRDC) and the main research provider (CSIRO);
- The failure to use a unique identifier for individual research projects across agencies;
- The absence of an easily accessible set of final project reports for SBT projects;
- Some confusion about the status of research reports with respect to their confidentiality;
- The difficulty in obtaining accurate figures on actual as compared to budgeted expenditure; and
- Access issues. A number of FRRF projects which appear in published lists of FRRF projects do not appear to have been made available for public distribution. Many stakeholders had no knowledge of these projects.

It is acknowledged that the extent of these problems varies across agencies and that information on more recently funded projects (over the last five years or so) is generally more consistent and more readily accessible largely as a result of improved information recording systems in the major agencies.

As with other findings of this review these findings may be equally relevant to other fisheries.

Three innovations would significantly improve research coordination and access to information on SBT research:

(1) The adoption of a single project identifier across agencies. In order to avoid disrupting internal systems this identifier would probably best be used in addition to the internal project numbering arrangements currently in place.

(2) The compilation and maintenance of a bibliography of SBT research and, in particular a listing of SBT research in progress. The information contained in this review and the AFMA Tuna Section's spreadsheet of current SBT research could provide a basis for this work.

(3) A statement of the circumstances under which any funding agency will determine a research report to be confidential should be incorporated in the relevant documentation of the operations of the fund. The review believes in developing such a statement, the risks of confidentiality need to be weighed against the benefits of confidentiality. For example, a decision not to release the results may affect the quality of data available for the stock assessment.

Responsibility for the first and second of these tasks would need to be accepted by one of the major funding agencies (AFFA, AFMA, FRDC)

12.3.2 Timely reporting of research results

The review team found that there had been considerable delay in the reporting of results from some research projects. For example:

- The draft final report of FRDC projects 96/118 and 99/105, which ended in June 1999 and June 2001 respectively, was produced in November 2002.
- The draft final report of FRDC project 97/111, which ended on June 2000, was finalised in February 2003.

Reporting appears to be more focused on producing papers for CCSBT. Whilst to some extent this is understandable, the delay in producing final reports does mean that research results may not reach domestic users and decision makers in a timely manner, having a potential impact on uptake.

13. Research capacity to deliver future outcomes

In general, the review found that there were no clear, major gaps in research capacity to deliver future outcomes.

The review did note however that the area of MSE was one where expertise/knowledge may be lagging behind demand. Whilst CSIRO has taken a significant lead in this area, both managers and industry and other stakeholders lack sufficient expertise. Also, effective input into the development of a management procedure in the CCSBT will be crucial to the long-term sustainability of the fishery. Managers, policy-makers and industry representatives will need to ensure that they are up to the task.

The review also identified a lack of capacity to communicate scientific uncertainties, research methods and research outcomes to managers/policy makers and industry. While the personality/communication skills of the researcher are important, successful communication is not a function solely of these characteristics. Effective communication capacity also requires processes/fora that prioritise and facilitate communication and an audience prepared to be informed and to devote time and effort to understanding the objectives and the outcomes of the research.

The review also identified a number of issues which largely relate to the management of research capacity, namely:

- The relatively small number of researchers with appropriate skills has meant that there is little capacity for critical review within Australia of research needs and proposals. The review notes, however, that the publication of results in the international literature and the processes of the CCSBT SAG and Scientific Committee result in rigorous review of science outputs.
- Retaining and developing existing expertise is dependent on the research providers' capacity to manage that capacity efficiently to ensure continuity through succession planning. This is not only the responsibility of the research providers but also that of the agencies funding research within Australia, particularly FRDC, which has human capital development as one of three research outcomes.

Finally, the review notes that CSIRO clearly provides the major skill base and capacity for much of the SBT related research required. They have made serious and significant investments in developing and maintaining appropriate capacity and have committed to continue to do so over the next five years within CSIRO's Sustainable Fisheries Focus Area. However, it is important to realise that the ability of research institutions worldwide to deliver outcomes based on quantitative fisheries science is threatened by limited capacity in this field. CSIRO note that they have, over recent years, been in the fortunate position of having several "world class" quantitative fisheries scientists on staff. These people are now moving on or have reached the end of their careers and are not easy to replace.

14. Recommendations

The assessment of research effectiveness carried out by this review has identified a number of research areas where further expenditure does not appear warranted or where there is a need to refine or better define the nature of the research. In addition, this review has identified a number of deficiencies in SBT research priority setting, project selection and administration processes. Recommendations are made below to address these findings. A reference to the relevant section of the report follows each recommendation.

14.1 Research effectiveness

(1) As the Australian SBT fishery is embedded within the CCSBT stock assessment process, there is a need to clearly define and specify the role and objectives of the SBTFAG and in particular to articulate the relationship between the domestic FAG and the CCSBT SAG. In defining this role, AFMA should consider the implications for other FAGs, such as the Eastern and Western Tuna FAGs, which will find themselves in similar positions as relevant regional fisheries management authorities develop their stock assessment capacity. (section 6.1)

(2) The outcomes from the aerial and acoustic surveys of the RMP do not support further expenditure on these projects from increasingly scarce Australian research funds. (sections 6.3.1 and 6.3.2)

(3) In order to maximise the benefits from the SRP conventional tagging program, and in particular from Australia's contribution to that program, Australia should push within the CCSBT for sufficient SRP resources to be deployed to activities that reduce the non-reporting rate for example, increased observer coverage where appropriate. (section 6.3.3)

(4) The ongoing project on archival of hard parts should produce a clearer justification for the sampling design of the collection component and this should be related to the needs of the research which will utilise the archive. (section 7.1)

(5) When proven, techniques for improving catch monitoring and quality of data used in stock assessments, such as a stereo video system, should be implemented as soon as possible. (section 8.2)

(6) Other techniques should be developed to verify bycatch in the purse seine fishery as this is a gap identified in the draft strategic assessment for SBT. (section 9)

14.2 Management of research results

(7) Managers, policy makers, industry and scientists, as well as those responsible for making funding decisions need to devote more time to evaluating research outcomes. (section 10.2)

(8) Managers, policy makers, researchers and industry need to develop a mechanism for ensuring that research reports are not only provided to the relevant people but that these are read and discussed. Face to face delivery of research results should be encouraged and funding to provide for this should be incorporated as part of the extension budget in project proposals. The resurrection of liaison workshops should be considered using experienced science communicators as facilitators. (section 10.2)

(9) Industry needs to take a more constructive and pro-active role in informing themselves and to contributing to the development and, where relevant, implementation of research results. (section 10.2)

(10) A bibliography of SBT research and, in particular, a listing of SBT research in progress should be compiled and maintained. The information contained in this review would provide a basis for this work. One of the major funding agencies (AFFA, AFMA, FRDC) should accept responsibility for this role. The adoption of such an approach across all fisheries should also be considered. The inclusion of fisheries research projects on existing databases, such as the Australian Rural Research in Progress and the Agricultural Bibliography of Australia, as currently utilised by FRDC, should be investigated by other funding agencies. (section 12.3.1)

14.3 Research planning

(11) Managers, policy makers and industry need to be more pro-active in specifying the nature of the research required rather than identifying only the broad areas of the research. (section 10.2)

(12) There needs to be a clear enunciation of the purpose and objectives of some research activities (e.g. the SBT observer program) where there is potential for overlap between research and compliance activities. (section 10.2)

(13) The research gaps identified by stakeholders and listed in this review should be considered by SBTMAC and FRRF when research priorities are next reviewed. (section 11.2)

(14) A more targeted call for research to address particular priorities and for greater specification of the nature of the research being sought to address that priority is recommended. This approach

may involve taking a longer term and more strategic approach to research. A clearly defined five-year strategic research plan for SBT, with sufficient time and resources allocated to its development, could play an important role in underpinning such an approach, as could the use of external reviewers. (section 12.1)

14.4 Funding and processes

(15) Given the international context for management of SBT, consideration needs to be given to the appropriateness of replacing some ARF funding for the stock assessment processes with FRRF funding. If the results of the stock assessment are not being used domestically because of the constraints imposed by international management, ARF funds should not continue to contribute approximately 50% of the stock assessment process and/or management strategy evaluation and the development of a management procedure. This consideration should be undertaken in a broader context of other migratory species increasingly coming under the management of regional fisheries management organisations. Issues regarding the overlap between domestic and international research which currently confront SBT research will inevitably emerge in relation to other species/fisheries. Under these circumstances it may be necessary to reassess the purposes for which FRRF research monies can be spent. (section 6.1)

(16) The Indonesian catch monitoring program relies on the on-going commitment of Australian research funds. The value of the information collected is acknowledged – but it is difficult to justify the use of scarce Australian domestic research funds to pay for it. A time frame should be established for the development of a capacity building project and the subsequent withdrawal of core Australia research funds for this monitoring project. (section 6.2)

(17) Processes for stakeholder consultation, priority-setting and project selection should be clearly specified in research fund documentation and adhered to. Where processes change, stakeholders should be advised. This is particularly relevant for the FRRF. (section 12.3.1)

(18) A mechanism for ensuring that jointly funded projects can be identified as such in the records of each funding agency should be implemented. (section 12.3.1)

(19) Funding agencies should consider their policy on confidentiality of research results and make that policy known to stakeholders. In developing that policy, agencies need to recognise that there are risks associated with both the release and the retention of sensitive information. (section 12.3.1)

(20) Research providers should be penalised for late delivery of research results unless there are valid mitigating circumstances. The track record of individual providers in delivering research outputs on time should be more closely scrutinised in selecting project proposals. (section 12.3.2)

(21) Mechanisms to ensure greater coordination between funding agencies and stakeholder input should be encouraged to maximise consistency and complementarity of research plans and priorities identified by the SBTMAC and the SRP. (sections 12.1 and 12.2).

APPENDIXES

Appendix 1 - Terms of Reference and People Consulted

1. a) document completed research (since mid 1980s), ongoing research and research in progress funded by all agencies (FRDC/AFFA/AFMA);

   b) identify the outputs of completed projects and determine the uptake of results by stakeholders (impacts)

   c) undertake a benefit cost analysis of significant ongoing research projects and suggest modifications or redirections where appropriate

   d) assess research in progress for consistency with current statements of research needs and priorities.

2. Identify future research needs

3. Evaluate fishery strategic research plans with respect to whether domestic management needs, industry development, environmental assessment; and domestic and international assessment requirements are adequately addressed.

   - Identify significant gaps in current and proposed future research plans and projects, including reference to needs arising from strategic assessments of the fishery under the EPBC Act and bycatch action plans under the Commonwealth Bycatch Policy

4. Make recommendations on whether existing structural arrangements and scientific committees are optimum for:

   (a) identification of research needs and gaps, and

   (b) delivery of research outcomes.

5. Make recommendations about the attribution of research costs and funding to industry and government and other sources, taking account of national and international obligations and current government cost recovery policy.

6. Comment on research provider capacity to deliver research outcomes.

People consulted

- Peter Dundas-Smith, FRDC
- Patrick Hone, FRDC
- Sam Nelson, AFMA Research
- Bruce Wallner, AFMA Research
- Andy Bodsworth, AFMA, Manager, Southern Bluefin Tuna Fishery
- Glenn Hurry, AFFA
- Mary Harwood, AFFA
- Brian Jeffriess, TBOA
- Rob Lewis, Chair SBTMAC and Chair AFMA Research Committee
- Tony Kingston, Executive Officer, SBTMAC
- Mario Valcic, Industry Member SBTMAC
- Terry Romaro, Industry Member SBTMAC
- Darren Tressiter, Australian Fishing Enterprises Pty Ltd
- Ric Kolega, Sekol Farm Tuna Pty Ltd
- Tom Polacheck, CSIRO
- John Gunn, CSIRO
- Ian Poiner, CSIRO
- Keith Sainsbury, CSIRO
- Anna Willock, TRAFFIC
- Glenn Sant, TRAFFIC
- Brian Macdonald, CCSBT
- John Kalish, BRS
- James Findlay, BRS
- Albert Caton, BRS
- John Annala, Chair, CCSBT Stock Assessment Group
- Doug Butterworth, University of Cape Town

Appendix 2 – Details of Research Projects: objectives and outputs

The following summary of research projects provides a snapshot of SBT research conducted since 1985. "Project Number" references relate to individual projects as listed in Appendix 4. In many cases the individual projects listed in Appendix 4 form part of an ongoing generic project, for example, SBT Recruitment Monitoring. These projects are grouped here under the generic title. Up until the early to mid-1909s projects under some funding arrangements were not given a specific project number. In these cases the year in which they were funded has been used as the project number.

Funds represent a mixture of actual expenditure and committed expenditure depending on both the detail available on the project and whether the project has been completed or is underway. Where projects are relevant to fisheries/species other than SBT, funds represent the proportion of the project considered attributable to SBT rather than the total funding of the project. The level of attribution varies across projects and where applicable the proportion is indicated in brackets following the Funds heading.

A. STOCK ASSESSMENT

(i) Recruitment Monitoring

1. Title: **Development of a fishery independent index for juvenile SBT 1989/90 – 1992/93**

Researcher(s): A. Cowling (CSIRO)

Project Number: FIRDC 1989/90, 1990/91; AFMA 1993/0058;

Funds: $118,333 (FIRDC); $34,200 (SBTMIRF); $88,000 (FRRF); $59,000 (JAMARC); $14,400 (CSIRO)

Objectives:

The aerial survey project was established as one of the main projects within the recruitment-monitoring program established in June 1993.

1. To conduct an aerial survey for juvenile SBT in the GAB in order to develop an index of recruitment.
2. To conduct research, which will contribute to the development of methods for reducing the variability, associated with the aerial survey indices.

Outputs:

- Papers presented to Recruitment Monitoring Workshops. See Appendix 3.
- Aerial survey has continued under the Recruitment Monitoring Program (RMP)

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2. Title: **Tagging of SBT in 1990/91**

Researcher(s): W. Hearn, W. Whitelaw & K. Williams (CSIRO)

Project Number: NR

Funds: $213,900 (Environment Statement Grant)

Objectives:

1. To estimate growth rates of juvenile SBT.
2. To estimate current levels of recruitment.
3. To estimate the current exploitation rate of the surface fishery.
4. To assess the interactions of surface and longline fisheries.

Outputs:

- Tagging conducted off WA and SA and recoveries allowed estimates relating to objectives 1-3 to be used in the stock assessment.

****

3. Title: **SBT Recruitment Monitoring 1993/94 – 2001/02**

Researcher(s): T. Polacheck; T. Davis; A. Cowling, J. Gunn, A. Hobday (CSIRO)

Project Number: AFMA 1993/0063; 1994/149; 1996/0448; 1996/0772; 1997/1483; 1999/0172; 1999/1496; 2000/1182; 2001/1298; 2002/03

Funds: $1,493,689 (SBTMIRF); $328,708 (Bilateral Fund); $3,547,107 (JAMARC); $90,000 (FRRF); $670,505 (FRDC); $1,363,565 (CSIRO)

Objectives:

The RMP is a longer-term collaborative research project involving CSIRO and the NRIFSF of Japan. The principal objective of the project is to monitor the abundance of juvenile SBT including the development of a fishery independent index of juvenile abundance to be used in the assessment of the SBT resource.

1. The project combines 4 interrelated sub-projects, which are part of an ongoing collaborative research program between Australia and Japan.

- Conventional tagging.
- Aerial survey.
- Archival tagging.
- Integrated environmental analysis of SBT abundance and movement based on GIS.

Outputs:

- New growth model was developed and new methods of estimation were devised. All available data on SBT growth were assembled and analysed using the new methods and estimates of the growth of SBT were produced for fish born in each of the 10-year periods between 1960 and 2000.

Outputs have taken the form of papers presented to the annual RMP Workshop (See Appendix 3). Latest results presented to SBT RMP Workshop, 18-20 December 2001:

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4. Title: **An integrated analysis of the growth rates of southern bluefin tuna for use in estimating the catch at age matrix in the stock assessment**

Researcher(s): T. Polacheck, G.M Laslett, J.P Eveson (CSIRO)

Project Number: FRDC 1999/104

Funds: $154,400 (FRDC); $158,608 (CSIRO**)**

Objectives:

1. To develop an integrated method for modelling SBT growth that combines growth increment data from tagging experiments, length measurements and direct ageing estimates from otoliths, length frequency modal information and otolith growth increments.
2. Using this integrated method, to develop models for the historical changes in SBT growth that can be used to estimate the expected length of SBT at age and the associated variance for the entire period of the commercial fishery.
3. To produce appropriate estimates of growth rate parameters for direct input into length based assessment models.

4. To develop a set of alternative hypotheses for the factors underlying changes in SBT growth that are consistent with the observed growth data.
5. Based on these alternative hypotheses, to develop models for changes in the length at age that can be used in SBT stock projections.

Outputs:

- Draft report:
- New growth model was developed and new methods of estimation were devised. All available data on SBT growth were assembled and analysed using the new methods and estimates of the growth of SBT were produced for fish born in each of the 10-year periods between 1960 and 2000.

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5. Title: **Improved fishery independent estimates of SBT recruitment through integration of environmental, archival tag and aerial survey data**

Researcher(s): A. Cowling, A. Hobday, J. O'Reilly, J. Gunn, M Bravington (CSIRO)

Project Number: FRDC 1999/105

Funds: $141,152 (FRDC); $136,731 (CSIRO); $122,949 (other)

Objectives:

1. To conduct a range of statistical analyses of data from the archival tags, and environmental and oceanographic archives to determine whether there are common responses in surfacing behaviour to environmental conditions through space and time.
2. To conduct a range of statistical analyses of aerial survey data on surface distribution and surface abundance of juvenile SBT and of environmental and oceanographic archives to develop a spatial model of abundance which allows for environmental variation through space and time. This would include analyses of how environmental conditions affect the detectability of surface schools from planes.
3. To develop an integrated analysis of abundance of SBT in the GAB incorporating the surfacing behaviour, surface abundance and spatial distribution models developed above.

Outputs:

- The combination of aerial surveys (conducted under the RMP) and the analysis conducted under this project has developed and improved a fishery-independent index of abundance for juvenile SBT in the GAB.

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6. Title: **Evaluate a surface abundance index based on commercial spotting data for juvenile SBT in the GAB**

Researcher(s): N. Klaer, A.Cowling and T. Polacheck (CSIRO)

Project Number: AFMA 1999/0376; 1999/1498

Funds: $48,318 (SBTMIRF); $12,648 (CSIRO)

Objectives:

1. To evaluate the potential usefulness of the commercial spotting data for calculating an index of surface abundance, and to enter the relevant available data into data bases.
2. To calculate a preliminary time series of indices of surface biomass density.

3. To evaluate the preliminary indices and, if there is overlap with the indices derived from aerial surveys, give a preliminary comparison.

Outputs:

- The historical commercial spotting data are not likely to yield an age or size specific index of abundance.

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(ii) Stock Assessment Modelling

7. Title:	**Southern bluefin tuna stock assessment and fisheries assessment groups (FAG) report 1991/92 –2002/03**
Researcher(s):	SBTFAG
Project Number:	AFMA 1993/1994; 1996/0212; 1997/0167; 1998/99; 1999/00; 2000/336; 2001/1144; 2002/0067
Funds:	$1,223,628,3081 (ARF); $1,240,326 (CSIRO); $142,000 (FRRF); $51,202 (SBT management levy)

Objectives:

1. To prepare a comprehensive population assessment of the SBT, incorporating all recent data, for the 1996 and 1997 CCSBT Scientific Committee meetings.
2. In the absence of a report from the CCSBT's Scientific Committee since 1998, to review all information that had become available since 1998 and provide advice on the status of the SBT stock, noting that a full stock assessment would not be possible as updated data from, the Japanese longline fishery were not available.
3. To produce a report for consideration by SBTMAC and the AFMA Board for use in setting the domestic TAC for 2000/2001.
4. Analysis in support of CCSBT Stock Assessment Groups and Scientific Committee meetings in 2001, 2002 and 2003.
5. Development and evaluation of management strategy for SBT in conjunction with the CCSBT Scientific Committee (SC) and Commission processes.
6. Completion of preparation work for the 2003 stock assessment anticipated to be presented at the August 2003 CCSBT SAG and SC meetings.
7. Refinement of the SCALIA length based stock assessment models.
8. Updating of software for estimating trends in parental biomass and recruitment SBT stock status relative to agreed reference points, and of the probability of recovery for the SBT stock based on different catch scenarios for the 2003 stock assessments.
9. Design of the CCSBT Scientific Research Program (SRP) components.
10. Analysis of initial data generated by the SRP (eg tagging and observer data).

Outputs:

- Outputs presented as papers to all meetings of Stock Assessment Group and Scientific Committee of the CCSBT (See Appendix 3).
- The FAG produced a report to SBTMAC and the AFMA Board in 2000 as the source of advice for the setting of the 2000/2001 domestic TAC.

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8. Title: **Evaluation of complex population models used for the assessment and management of migratory fish stocks**

Researcher(s): D. Kolody,. A. Preece, T. Polacheck (CSIRO)

Project Number: AFMA 2000/833; FRRF 2001/2138

Funds (75%): $45,000 (SBTMIRF); $105,938 (CSIRO); $97,579 (FRRF)

Objectives:

1. To evaluate the performance of Statistical Catch–at-age/length integrated Assessment (SCALIA) models in relation to the advice and stock status parameters needed for the formulation of management policies.
2. To evaluate performance of these models with respect to robustness, accuracy and precision given data of varying quality and levels of model complexity.
3. To provide advice on the appropriateness and implications of those models for application in the provision of stock status advice in an RFMO context on SBT specifically and tuna in general.
4. To provide a non-technical description of the key scientific issues and critical assumptions in SCALIA assessments that managers will have to deal with in negotiations and formulation of policy in the CCSBT and other tuna RFMOs.

Outputs:

- Final report due 2003.
- An interim description of the generic operating model software was produced in June 2002.

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(iii) Data Collection

9. Title: **SBT fishery monitoring program for the eastern sector of the Australian fishery (1990/91 – 2002/03)**

Researcher(s): BRS/WW Fisheries

Project Number: FRRF 1991/92, 1992/93, 1993/94; AFMA 1992/0437; 1995/1014; 1997/1423; 1998/1350; 1999/1655; 2001/1300

Funds: $623,900 (FRRF); $490,400 (SBTMIRF); $102,450 (Environment Statement Grant)

Objectives:

The principal objective over the duration of this project has been to undertake physical sampling of longline SBT catch on the East Cost of Australia and Port Lincoln in order to collect scientifically acceptable data for analytical purposes. This involved:

(i) Physical sampling of the surface catch landed in Port Lincoln and any longline catch there during the seasons.

(ii) Either direct physical sampling and/sampling organised by the coordinator to ensure scientifically acceptability, of other SBT catches (longline and surface) landed to processing establishments in E. Australia.

(iii) Otolith sampling if and where possible.

(iv) On-shore assistance for the tagging programs.

(v) Onshore assistance in tag data entry.

(vi) Liaison with Hobart base staff.

(vii) Assistance with collection and verification of SBT surface logbook data.

(viii) Participate in meetings and preparation of reports in consultation with AFMA, BRS, and CSIRO to do with length frequency monitoring program and the fishery in general.

(ix) Participate in meetings and workshops to do with the conduct of the tagging programs.

(x) General liaison with CSIRO, BRS and AFMA.

(xi) Extensive liaison/training with Protec in Port Lincoln.

Outputs:

- Length/weight data collected, edited and forwarded to BRS. Otoliths collected and provided for storage.
- In recent years objectives have been achieved to the extent that the availability of fish for sampling allowed. The number of fish available for sampling has declined in recent years as the proportion of SBT caught by the purse seine method has increased and the availability of quota for longline operators has declined. The nature of the monitoring program has been scaled back to reflect this.

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10. Title:	**Monitoring SBT catches off Indonesia 1991/92 – 2002/03**
Researcher(s):	Tim Davis
Project Number:	FRRF 1990/91; 1991/1992; 1992/1993; 1993/1994; 1997/0096; AFMA 1997/0166; FRRF 1999/2172; 2000/983; 2001/2194; 2002/4774
Funds:	$780,942 (FRRF); $75,299 (ARF); $ 222,912 (CSIRO); $93,740 (SRP); $8,300 (Environment Statement Grant); $155,326 (ACIAR)

Objectives:

The principal objective of this ongoing project has been to monitor landing of SBT caught by Indonesian/Taiwanese longliners and to investigate the reproductive biology of SBT in this fishery. While the principal objective has remained the same the nature of the project has evolved since 1991/92. Following on from an ACIAR funded workshop in 2000 a collaborative project between AFFA/IOTC and ACIAR has been developed to review Indonesia's Indian Ocean tuna fisheries and extend catch monitoring to all the key off-loading ports (Maura Baru, Cilacap and Benoa. The objectives are:

1. To monitor the Indonesian longline fishery operating out of Benoa, Bali, Maura Bra – West Java, and Cilacap – Central Java, including species composition of landings and the measurement of length and weight of a representative sub-sample of the key species caught.

2. To monitor changes in the spawning population of SBT including size and age distribution, and temporal patterns of abundance on the spawning ground and provide this information to CCSBT stock assessment scientists.

3. To evaluate accuracy of the Provincial Fisheries Service, Bali data on export tuna to address discrepancy between CSIRO estimates of Indonesian SBT exports and Japanese import statistics.

4. To provide CCSBT with an estimate of the Indonesian SBT catch.

Outputs:

- This monitoring program was initiated in 1992 as a collaborative research program between CSIRO and the Research Institute of Marine Fisheries (Indonesia). The program has successfully monitored the catch of SBT caught by the Indonesian longline fishery since that time. The results have been accepted and adopted into CCSBT stock assessments and annual papers have been tabled at the CCSBT Scientific Committee meetings since 1993 (see Appendix 3).

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11. Title: **SBT scientific quota**

Researcher(s): CSIRO

Project Number: 1997

Funds: $32,446

Objectives:

To augment the recruitment monitoring program, in particular the support vessel charter costs for acoustic tracking.

No further information available.

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12. Title: **CCSBT tagging for SBT**

Researcher(s): Clive Stanley (CSIRO)

Project Number: AFMA 2002/0163; CCSBT 2001

Funds: $150,000 (SBTMIRF); $100,000 (AFMA reserves); $302,696 (SRP)

Objectives:

As part of the CCSBT Scientific Research Program funds were provided directly to CCSBT to place up to 20,000 tags on 10000 SBT in WA in the 20001/02 season.

A CCSBT tagging program commenced in November 2001. The program has three elements:

1. A longline tagging program in the western Indian Ocean as part of a Japanese research cruise;

2. A longline tagging program off the east coast of Australia as part of a more general Australian tagging program in the region; and

3. An extensive five-year surface fishery tagging program off the southern coast of Australia to be coordinated by the CCSBT Secretariat.

Outputs:

- The first two elements are being conducted as pilot projects and will continue for a second year in 2002/03. The pilots have proved the feasibility of tagging mature SBT, but the high cost of capturing mature SBT suggests the focus might be on biological research using pop-up and archival tags rather than traditional tags.

- The five-year surface fishery tagging program enters its second year in 2002/03. Over 3,000 SBT were tagged in 2001/02, which was below planned levels. It is intended that the target of 15,000 tagged fish per year will be achieved in the second year.
- The first tag recovery from this program was obtained in July 2002.

****

13. Title: **Analysis of length frequency data**

Researcher(s): G. Leigh (CSIRO)

Project Number: NR (1990/91)

Funds: $28,800 (Environment Statement Grant)

Objectives:

To analyse catch records and length frequency data from the Australian fishery to estimate the average length of each age class of SBT in the Australian fishery and quantity of fish caught from each age class each year.

Outputs:

- The total catch by age group for ages up to 5 years was calculated each from 1965 to 1989 for use in the stock assessment.

****

14. Title: **Analysis of CPUE of WA surface fishery**

Researcher(s): R. Campbell CSIRO

Project Number: NR

Funds: $113,700 (Environment Statement Grant)

Objectives:

1. To develop an index of abundance of 2 year old SBT off WA from the catch per unit effort data of the surface fishery.
2. To compare the time series of this index with the recruitment estimates obtained from the stock assessment calculations (Virtual Population Analysis).

Outputs:

- The limitations of the data prevented development of a reliable index.

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15. Title: **Support for the high seas Real Time Monitoring Program (RTMP) 1991/92 – 1994/95**

Researcher(s): Wade Whitelaw (CSIRO)

Project Number: 1993/0061

Funds: $67,445 (SBTMIRF); $42,438 (CSIRO)

Objectives:

The RTMP was initiated in 1991 as a cooperative scientific data collection program involving industry, scientists and management. The purpose of the program was to provide up-to-date reliable and accurate data on catch and effort in the high seas fisheries for SBT. The objectives of the scientific observer component of the RTMP were:

1. To collect detailed catch and operational information needed for improving indices of abundance based on catch rates.

2. To improve the accuracy and verify the catch, effort, length and weight data.
3. To collect scientific biological samples for improving the biological basis for SBT assessments (eg growth, ageing, stock structure and reproduction).
4. To assist in the collection of tag returns and associate data.

Outputs:

- The RTMP observers were deployed on Japanese vessels. All samples required were collected. All observers debriefed to ensure full utilisation of the information obtained and to obtain anecdotal information. All data was entered onto the database.

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16. Title: **A pilot study to examine the potential for using pop up satellite transmitting archival tags and determining the feasibility of using pop-up satellite archival tags to determine the movement & habitat preference of adult SBT**

Researcher(s): J. Gunn (CSIRO)

Project Number: AFMA 1999/1499 & 2000/786

Funds: $112,712 (SBTMIRF); $31,458 (CSIRO); $70,000 (Industry in-kind)

Objectives:

1. To determine the feasibility of using PATs to determine patterns and routes of migration of SBT within and out of the Tasman Sea.
2. To determine the feasibility of using PATs to determine residence times of SBT in the Tasman Sea, Southern Ocean and Indonesian spawning grounds.
3. To determine the feasibility of using PATs to determine the frequency of spawning migrations in adult SBT.
4. To commence collation of data with which to describe the habitat preference of adult SBT, to be used in the standardization of CPUE indices in the SBT assessment process.

Outputs:

- Tagging work did not commence until September 2001. Report pending November 2002.

****

17. Title: **Examining Taiwanese fishing activities and catches of SBT 1998/99 -2000**

Researcher(s): J. Gunn & J. Farley (CSIRO)

Project Number: FRRF 1999/2177 & 1999/7580

Funds: $84,511 (FRRF); $20,499 (CSIRO)

Objectives:

1. Through a port monitoring program in Mauritius (Port Louis) and South Africa (Cape Town) and collaboration with Taiwan's Overseas Fisheries Development Council estimate the catch and catch rates of SBT and other tuna species by Taiwanese longliners in the Indian and Atlantic Oceans.
2. Provide intelligence and data on seabird bycatch by the Taiwanese longline fleet, and document mitigation measures taken to minimise seabird bycatch.

Outputs:

- Paper presented to CCSBT Scientific Committee meeting 2001 (See Appendix 3).

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18. Title: **Foreign longline data: its quality and relevance to stock assessment**

Researcher(s): BRS

Project Number: 1997/98

Funds: $42,400 (FRRF)

Objectives:

No further information available.

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19. Title: **Feasibility of CPUE-based SBT abundance indices: Identification and documentation of data held in WA**

Researcher(s): N. Klaer, K. Donohue, J. Robins

Project Number: 1991

Funds: $40,000 (est.) (Environment Statement Grant)

Objectives:

1. To examine all available sources of catch and effort data by boat and/or area where possible, details of boat attributes, scientific catch monitoring data, documented important historical events affecting SBT fishing practices, and pertinent anecdotal information from fishermen and government officials.
2. First phase of a 1990 BRR project to assess the suitability of available SBT data for the development of SBT recruitment indices.

Outputs:

- BRR Working Paper No. WP/7/91 Feasibility of CPUE-based SBT abundance indices: Identification and documentation of data held in WA, 1991.

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20. Title: **Consolidated SBT database**

Researcher(s): CSIRO

Project Number: FRRF 1991/1992, 1993/1994

Funds: $170,000 (FRRF); $73800 (CSIRO)

Objectives:

No further information available.

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21. Title: **Development of a database network for use in the assessment of the SBT fishery**

Researcher(s): A. Betlehem, A. Preece, T. Polacheck, C. Millar (CSIRO)

Date: September 1998

Project Number: FRDC 1994/150

Funds: $76,650 (FRDC); $95,000 (CSIRO); $90,000 (FRRF)

Objectives:

To develop a database system that integrates and allows for the efficient access to the diverse sets of data necessary for the assessment of the SBT fishery.

Outputs:

- An extensive Oracle database, holding fishery and research data from Australia, Japan, New Zealand and Indonesia among others was established. The database includes: CSIRO tagging 91965); CSIRO aerial survey (1991); AFZ domestic logbook (1976); AFZ foreign fleet logbook (1979); AFZ observer program on foreign vessels (1980); New Zealand domestic and foreign logbook (1980); Australian length weight sampling (1951); CSIRO domestic observer (1994); Indonesian sampling (1993); Japanese aggregated global fleet (1952); Japanese RTMP High seas monitoring (1991); and Japanese RTMP high seas observer (1992).

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B. BIOLOGY/LIFE HISTORY

(i) Ageing

22. Title: **Direct otolith ageing of SBT *Thunnus maccoyii* (Castelnau) exploited by the Australian fishery**

Researcher(s): T. Davis & K. McLoughlin (CSIRO)

Project Number: FIRC 1984/71

Funds: $82,528 (FIRC)

Objectives:

1. To validate otolothic ageing techniques developed by CSIRO for SBT.
2. To determine the timing and periodicity of otolithic check formation and hence the growth season of SBT at different ages and in different geographic areas.
3. Validation of otolithic ageing was to be achieved by:
   - examination of oxytetracycline marks on the otoliths of recaptured, tagged fish.
   - measurement of marginal increments on the otoliths sampled throughout the year.

Outputs:

No otoliths collected in NSW due to lack of tuna caught there. Thirty-one fish that had previously been marked with oxytetracycline were recovered, however, the injection had failed to produce a mark. This rendered the prime method of validation unworkable and the study was reduced to a seasonal study of otolith marginal increments to validate ageing.

- However, the techniques for the analysis of marginal increments were found to be inadequate. The project was terminated until more elaborate techniques were developed to accurately identify the position of checks and measure the marginal increment.

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23. Title: **Otolith age determination of mature SBT**

Researcher(s): J. Thorogood (CSIRO)

Project Number: FIRC 1985/76

Funds: $28,470 (FIRC)

Objectives:

1. To fund the collection and examination of otoliths from SBT in the 7+ age group in order to:
   - determine the timing and periodicity of otolith band formation, providing information relating to the seasonal and yearly growth rates of SBT;
   - validate otolithic age determination methods developed in studying juvenile SBT, for large, mature SBT; and
   - to provide a method of age determination independent of model analysis and that derived from growth curves generated from tagging data.

Outputs:

- Planning and organisation proved more complex than anticipated. One thousand collection kits were assembled. The possibility of sampling otoliths using a drill and hole saw was explored with excellent results.
- Thorogood J. 1987 "*Age and Growth rate determination of southern bluefin tuna, Thunnus maccoyii using otolith banding*, J. Fish Biol 30: 7-14.

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24. Title: **Age determination and assessment of variation in length at age of large SBT by means of analysis of otolith and vertebral chemical composition**

Researcher(s): R. Thresher, J. Gunn, C. Proctor, T. Carter (CSIRO)

Project Number: FIRC 1989/30

Funds: $186,853 (FIRC); $211,440 (CSIRO)

Objectives:

1. To determine whether SBT can be aged by counting the number of regular variations in the composition of their hard parts, by testing the hypothesis that such variations derive from annual cycles in the deposition of different elements along the margins.
2. To compare growth rates, maximum ages and precision of age estimates as determined by microanalysis with published values based on traditional ageing techniques.
3. To quantify variation in length at age for large SBT.

Outputs:

- Results suggested that SBT are far from an ideal species against which to test the broader potential of age determination by means of enumerating elemental peaks across otoliths.

****

25. Title: **Conventional age determination of SBT**

Researcher(s): C. Proctor, R. Thresher and J Gunn CSIRO

Project Number: NR

Funds: $10,400 (Environment Statement Grant)

Objectives:

1. To evaluate methods for age determination in SBT and in particular, to:

(i) obtain the otolith held by Thorogood (FIRC 1985/76), and

(ii) compare the ages given by different readings of the whole otoliths with those obtained from otolith microchemistry analysis (FIRC 1989/30).

Outputs:

- The ageing method developed by Thorogood, based on whole otoliths is not reliable.
- Otolith microchemistry shows cycles in some elements that could be annual and so form the basis of an ageing technique.

****

26. Title: T**he direct estimation of age and growth of SBT**

Researcher(s): J. Gunn (CSIRO)

Project Number: FRDC 1992/042

Funds: $262,260 (FRDC); $514,072 (CSIRO)

Objectives:

This project responded to a need identified by the SBT trilateral scientific meeting for the development and validation of techniques for the direct estimation of age and growth of SBT in order to reduce uncertainty in the stock assessment. Specific objectives were:

1. To develop techniques appropriate for the direct ageing (ie interpretation of banding patterns in calcified tissues such as otoliths, scales and vertebrae) of juvenile and adult SBT. In the future the techniques would allow the Central Ageing Facility at the Victorian Marine Science Laboratories to undertake routine assessment of the age composition of SBT catches.
2. To validate estimates of age for as many year classes as possible using calcified tissues from fish injected with oxytetracycline or strontium chloride during CSIRO's 1983/84, 1990/91 and 1991/92 tagging projects and through the integration of data from direct ageing, tagging and length frequency analyses.
3. To produce an age-length key for SBT populations exploited by domestic and high seas fisheries using data from direct ageing, length frequency and tagging analyses.
4. To compare length at-age and growth rates of fish caught during the 1960s, 1980s and 1990s to examine the hypothesis that these parameters have changed in response to changes in population levels.
5. To determine age-at-recruitment to the southern Western Australian fishery and the distribution of spawning dates for fish recruiting into the fishery each year.
6. In conjunction with studies of the reproductive biology of SBT currently under way at CSIRO, to estimate age at maturity of SBT and the distribution of ages of spawners.

Outputs:

- Project met all of its objectives. Revealed serious errors in the historical data used in stock assessments and the new data produced has had an immediate and significant impact on both the assessment process and our understanding of the SBT population. The new techniques and data were accepted by the CCSBT Scientific Committee prompting an agreement at the 1996 CCSBT meeting to introduce a fishery wide program of sampling and routine age estimation over the next few years.

****

27. Title: **Use of bomb radiocarbon chronometer to validate fish age**

Researcher(s): J. Kalish (ANU)

Project Number: FRDC 1993/109

Funds (5.5%): $12,169 (FRDC); $17,145 (ANU)

Objectives:

1. To validate ages of SBT (*Thunnus maccoyii*), redfish (*Centroberyx affinis*), blue *grenadier (Macruronus novaezelandiae*) school shark (*Galeorhinus gale*us);
2. To determine suitability of the radiocarbon chronometer for age validation of oreo species;
3. To determine other species suitable for age validation via the bomb radiocarbon chronometer in collaboration with other Australian researchers and fisheries managers.

Outputs:

- For some species, notably SBT, the findings have resulted in significant changes in estimates of stock productivity and sustainable yields. Therefore the outputs improve stock assessments and provide greater certainty for the sustainable management of key fisheries resources.
- The data agree generally with accepted models of SBT growth, but show that these fish live longer than was previously believed. Comparison between otolith section and bomb radiocarbon age estimates indicates that reading otolith sections is an effective method to estimate the age of larger SBT.
- The techniques developed in this project were utilised in FRDC project 1992/042.

****

28. Title: **An archival hard part collection – a basis for routine ageing of SBT**

Researcher(s): J. Gunn, N. Clear, R. Bailey, J. Young & C. Stanley (CSIRO)

Project Number: AFMA 1995/0096; 1997/1484; 1999/0171; 1999/1497; 2000/773; 2001/1158

Funds (50%): $75,253 (SBTMIRF); $40,902 (ETMIRF); $87,722 (CSIRO); $16,551 (Bilats.)

Objectives:

1. To collect, clean, dry and catalogue hard parts from SBT and other large pelagic species (yellowfin, bigeye tuna and broadbill swordfish) caught off the east coast of Australia, in the GAB, in the Indian Ocean and in waters off Indonesia. Develop and curate an archive of hard part that will be available for routine ageing.
2. To develop and maintain an archive of hard parts that will be available for routine ageing.

Outputs:

- Around two-thirds of the 20,000 samples archived are from SBT.

****

29. Title: **Collection of SBT otolith and length data by Protec Marine for archiving by CSIRO**

Researcher(s): Protec Marine Pty Ltd

Project Number: AFMA 2000/406

Funds: $9,200 (SBTMIRF)

Objectives:

To collect 360 sets of otoliths from fish caught in the purse seine fishery for farming purposes in order to meet the shortfall in data arising from the reduction in catch in the pole and line sector.

Outputs:

- Collections of 360 sets of otoliths completed; otoliths and relevant length and age information provided to CSIRO for inclusion in CSIRO's established archive and data based.

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(ii) Biology

30. Title: **Study of the reproductive biology of the SBT (*Thunnus maccoyii* (Castelnau) off the East Coast of Australia**

Researcher(s): J. Thorogood (Uni. of Sydney)

Project Number: FIRC 1984/56

Funds: $32,275 (FIRC)

Objectives:

1. To determine the age at first maturity, for SBT from Australian waters.
2. To update and enlarge upon present knowledge and expertise relating to examination of SBT gonads.
3. To further the present knowledge and understanding of the pattern and process of development of male and female gonads, the strategy of female spawning and the fecundity in relation to age/size.

Outputs:

- J. Thorogood, *Aspects of the Reproductive Biology of the Southern Bluefin Tuna (Thunnus maccoyii)*, Fisheries Research 4 (1986) 297-315

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31. Title: **Determination of the migration patterns of juvenile southern bluefin tuna and Jackass Morwong**

Researcher(s): CSIRO

Project Number: 1987/15

Funds: $172,649 (FIRDC); $165,703 (CSIRO)

Objectives:

1. To determine whether or not all juvenile SBT migrate down the coast of Western Australia and hence, whether the Australian fishery is based on all or only part of each cohort;
2. To validate aging techniques for adult SBT; and
3. To determine whether or not bays and estuaries in southern Tasmania are the sole nursery grounds of the Jackass Morwong in Australia.

Outputs:

- The study concluded that analysis of otolith composition is consistent with the current hypothesis of a single spawning area for T. maccoyii. The stock should be managed on the conservative assumption that all recruitment derives from this spawning ground and that adults migrate to this single ground to spawn.

****

32. Title: **Genetic analysis of the spatial structure of SBT population**

Researcher(s): P. Grewe, T. Polacheck (CSIRO)

Project Number: FRDC 1992/031

Funds: $148,967 (FRDC); $320,073 (CSIRO)

Objectives:

1. To assess the genetic variability in juvenile SBT collected from the SW coast of Australian, adults collected off S Africa, and adults collected from the east coast of Tasmania;
2. The genetic variation present among the sample locations will be used to test the hypothesis that the two length modes present in a single year class of juvenile SBT (either 1 or 2 year old fish, collected from the south-west coast of Australia) relate to at least 2 generally different components of the population' and
3. Genetic variation between the African and Tasmanian adult samples will help determine whether genetic differences observed in juvenile fish are related to their spatial distribution as adults.

Outputs:

- The null hypothesis that two groups of fish taken from a single year class were drawn from a single gene pool could not be rejected with allozyme or the mtDNA data.
- There was no evidence of selection operating to change gene or mtDNA haplotype frequencies as fish age.

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33. Title: **Analysis of Shoyo Maru larval samples**

Researcher(s): T. Davis (CSIRO)

Project Number: 1990/91

Funds: $35,500 (Environment Statement Grant)

Objectives:

To analyse larval SBT and hydrographic data collected by the Shoyu Maru in 1983, 1985 and 1987 to determine the area and time of spawning, and the hydrographic conditions associated with spawning.

Outputs:

- The Japanese and CSIRO data gave a consistent picture of the distribution of larvae with respect to oceanographic features. Feasibility of developing an efficient sampling design for SBT larvae, and in turn conducting egg and larval surveys to determine SBT spawning stock abundance required further research.

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34. Title: **Frequency of spawning of SBT**

Researcher(s): R. Thresher and C. Proctor (CSIRO)

Project Number: NR

Funds: $55,800 (Environment Statement Grant)

Objectives:

1. To test procedures for determining reproductive history from the chemical composition of otoliths; and
2. To apply these techniques to SBT to determine the frequency of spawning of individuals and the variation in the age of first reproduction.

Outputs:

- Results inconclusive but suggest that SBT usually spawn each year but sometimes miss a year.

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35. Title: **Migration routes of SBT**

Researcher(s): R. Thresher, C. Proctor and J. Gunn (CSIRO)

Project Number: NR

Funds: $15,300 (Environment Statement Grant)

Objectives:

1. To obtain otoliths from SBT off South Africa; and
2. To determine whether there were differences in the michrochemical composition of the otoliths of fish from New Zealand, Australia and South Africa that could be interpreted as being caused by differences in the migration path of fish from each region.

Outputs:

- Results suggest fish from all regions derive from a single spawning ground.

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36. Title: **Ultrasonic tagging to determine surfacing behaviour of SBT**

Researcher(s): CSIRO

Project Number: AFMA 1993/0060

Funds: $32,500 (SBTMIRF)

Objectives:

No further information available.

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37. Title: **Age distribution of mature SBT on the NE Indian Ocean spawning grounds. A pilot study comparing otoliths collected from the Indonesian fishery in 1994 and 1995**

Researcher(s): J. Gunn, T. Davis, J. Farley, N. Clear and K. Haskard (CSIRO)

Project Number: AFMA 1996/0493

Funds: $15,000 (SBTMIRF); $8,034 (CSIRO)

Objectives:

1. To estimate and compare the distributions of ages from samples of otoliths collected from fish caught by the Indonesian longline fishery over three spawning seasons – 1993/94, 1994/95 and 1995/96.
2. To use the distributions of ages within the otolith samples to estimate the age distribution of populations on the spawning grounds and determine whether there are significant differences between years in these distributions.
3. To compare the distributions of ages of fish caught on the spawning grounds with those caught on feeding grounds in the Southern Ocean.

Outputs:

- Limited sample size did not allow for conclusive results

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38. Title: **Catch at age, age at first spawning, historical changes in growth, and natural mortality of SBT: an independent study of key uncertainties in population biology and dynamics of SBT, based on direct estimates of age from otoliths**

Researcher(s): J. Gunn (CSIRO)

Project Number: FRDC 1997/111

Funds: $211,338 (FRDC); $209,991 (CSIRO)

Objectives:

1. To estimate and compare the age composition of catches in each of the major SBT fisheries; the three major Japanese fisheries in the southern Ocean, the Indonesian fishery on the spawning grounds, the Australian surface and longline fisheries in the AFZ, the New Zealand Troll and longline fisheries and Taiwanese fishery in the Indian Ocean.
2. To compare growth rates of fish collected from each fishery.
3. To develop an age-length key for the population. Or, of there is an indication in the growth data of spatial heterogeneity in growth rates, develop age-length keys for discrete units within the population.
4. To estimate the age of SBT at first spawning from otoliths collected on spawning grounds
5. Using otoliths from fish spawned in each of the four decades in which the SBT fishery has operated, to examine the hypothesis that growth rates have changed in response to population size and or environmental conditions.
6. To use otolith-based age data to estimate the natural mortality rate for mature age SBT.

Outputs:

- Draft Final Report February 2003.
- Papers presented to CCSBT Scientific Committee (see Appendix 3).
- New population parameters (life expectancy, growth, age at maturity) were included in the recent SBT stock assessments and CCSBT analysis of stock indicators.
- Findings on the proportion of 10-15 years olds in the Indonesian longline fishery on the SBT spawning grounds and the nature and extent of Taiwanese catch on the central and SW Indian Ocean have played a major role in the CCSBT stock assessment and in the design of the CCSBT SRP in 2001.

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39. Title: **Assessment of acoustics as a research tool to determine the distribution, biomass and behaviour of SBT schools and their prey in the GAB**

Researcher(s): CSIRO

Project Number: AFMA1998/0009

Funds: $53,252 (SBTMIRF)

Objectives:

No further information available.

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40. Title: **Size at first maturity and recruitment into egg production of southern bluefin tuna**

Researcher(s): T. Davis (CSIRO)

Project Number: FRDC 1999/106

Funds: $146,094 (FRDC); $87,560 (CSIRO)

Objectives:

1. To determine the mean size at first maturity of SBT on the spawning grounds.
2. To determine the relationship between spawning frequency and size.
3. To determine the relationship between batch fecundity and size.
4. 4. To model the recruitment dynamics of population egg production.

Outputs:

- Draft Final Report submitted April 2003.
- Study confirms and improves previous understanding of the spawning dynamics of SBT. Size dependent trends in spawning frequency, the number of spawning and the number of eggs released each spawning were identified. Data were used to infer relative per capita egg production as a function of fish length. Total egg production is preferable to spawning stock biomass as the "stock" variable for stock recruit modelling. Report provides a template for incorporating an improved spawning stock biomass series in stock assessment and prediction based on total egg production.

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C. ECOLOGICALLY RELATED SPECIES

41. Title: **Effect of fishing on non-target species**

Researcher(s): A. Harris & P. Ward

Project Number: FRRF 1995/96

Funds (15%): $40,485 (FRRF)

Objectives:

1. To bring together published and unpublished scientific information on the catch of non-target species in Commonwealth fisheries.
2. To examine issues related to non-target species from a fisheries viewpoint and more broadly, from the perspective of ecologists.
3. To identify what is known, what is not known, the issues raised and the actions that could be taken to remedy problems.

Outputs:

Report: A. Harris & P. Ward (1999) Non-target species in Australia's Commonwealth Fisheries : A critical review, BRS

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42. Title: **A population modelling assessment of the effects of longline on seabird populations**

Researcher(s): Geoff Tuck (CSIRO)

Project Number: AFMA 1995/0386

Funds (15%): $7,500 (SBTMIRF)

Objectives:

1. To review the literature on seabird population modelling assessments, and assess the available data (seabird and fisheries) for its suitability to incorporate into the modelling framework. Determine the key uncertainties that are critical in order to enhance our knowledge of the effects of longlining;
2. To initiate the development of a range of population models for Wandering Albatrosses (and possible other seabird populations) that investigate fishing impacts on the population;
3. Preliminary analysis of the models will be used to explore the spatial and temporal aspects of both the bird population (breeding colonies, migration) and the fishery (changes in effort over time and space). The models will be used to evaluate whether historical changes in seabird abundance can be explained by the estimated seabird mortality attributed to the longline fishery to help in the assessment of the status of impacted seabird populations and the effects of different levels of seabird mortality on the future dynamics of the populations;
4. To explore the relevance of these models for other seabird populations; and
5. To develop an international network of experts to facilitate the analysis and input of data for the models and provide ecological expertise necessary for modelling the seabird populations.

Outputs:

- Papers to first meeting of CCSBT ERSWG 1995 (See Appendix 3).
- An ad hoc international working group of seabird biologists and modelling experts was formed and provided biological input for this study.

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43. Title: **Status and conservation of albatross and their interactions with fisheries**

Researcher(s): N. Brothers, R. Gales (Tas. Dept. Env. and Land Management.)

Project Number: AFMA 1995/0460

Funds (15%): $6,750 (Bilateral Fund); $7,500 (ANCA)

Objectives:

1. To examine the management of interactions between albatrosses and fisheries;
2. To acquire data on relevant species breeding in Australia (particularly Shy albatrosses) pertinent to measuring the effect of demonstrated interactions and to assist in circumventing the onset of anticipated future problems for these and other species' and
3. To provide solutions and management information resulting from investigations into interactions between albatrosses and fisheries.

No further information available.

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44. Title: **Seabird longline interactions**

Researcher(s): N. Brothers, R. Gales.

Project Number: 1996/0593

Funds: $7,500 (ARF); $7,293 (TPWS); $17,250 (Other)

Objectives:

1. To examine all relevant available data (obtained between 1988 to 1995 inclusive) regarding number of seabirds caught on longline vessels and report on trends in seabird catch rates;
2. To analyse all available data (obtained between 1988 to 1995 inclusive) regarding influence of varying fishing practices on seabird catch rates and report on efficacy of mitigation measures;
3. To examine all available seabird carcasses retrieved from longline vessels since 1988 and report on the species and where possible, provenance, age, and sex of birds killed;
4. To analyse and report on distribution data of Shy Albatrosses at sea, as determined from colour sightings, band returns and satellite tracking information;
5. To survey the size of the three Shy Albatross breeding populations and report on the status of thee populations (assessed from population information obtained since 1985 where possible);
6. To undertake preliminary investigations into the diving behaviour of Shy Albatrosses and compare this information with sink rates of hooks on longlines; and
7. To provide 1000 copies of the fishing handbook 'Catch Fish not Birds'.

Outputs:

- Papers presented to the third meeting of the CCSBT ERSWG, 1998 (see Appendix 3).

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45. Title: **The effects of longlining on seabird populations: by catch estimation and population modelling assessment:**

Researcher(s): G. Tuck (CSIRO)

Project Number: AFMA 1997/0401

Funds (9%): $4,486 (Bilateral Fund); $1,294 (CSIRO)

Objectives:

Consistent with key areas of research identified by the First meeting of the CCSBT ERSWG the objectives were:

1. To estimate the seabird catch and catch rates and their associated variances within the AFZ by area and season for 1995 and 1996;
2. Using information gathered from archival tags (both currently deployed and to be deployed) to complete an evaluation of the potential for this technology to resolve the current uncertainty about the spatial distribution of albatrosses;
3. Based on data collected from the pilot deployment of archival tags, to provide estimates of the temporal/spatial distribution for those birds from which tags were recovered;
4. In collaboration with CEBC/CNRS, to expand the current model formulation to include the Crozet Islands Wandering Albatross population; and
5. To provide projections on the effects of different levels of longline fishing effort for different hypotheses for the spatial/temporal overlap of the seabirds and the fishery.

Outputs:

- Catch and catch rates for Japanese vessels operating within the AFZ were updated for the 1996 season and the influence of the environmental factors and mitigation measures on the incidental capture of seabirds by Japanese vessels in the Australian region was analysed. Results were presented in a report to the second meeting of CCSBT's ERSWG, 1997 (see Appendix 3).

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46. Title: **Albatross longline interaction - seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988-1996 trends**

Researcher(s): N. Brothers, R. Gales and Tim Reid (TPWS)

Project Number: AFMA 1997/1466

Funds (9%): $2,250 (ARF); $1,800 (Environment Australia)

Objectives:

1. To examine all available and relevant data from the 1996 SBT Japanese fishing effort in the AFZ regarding number of seabirds caught and report on trends in bird catch rates;
2. To analyse all available data regarding influence of carrying fishing practices on seabird catch rates and report on efficacy of mitigation measures. Make recommendations on how to reduce deficiencies in seabird bycatch data if appropriate;
3. To supplement the 1988-1995 Japanese AFZ bird bycatch data with integration of 1996 data;
4. To examine all available seabird carcasses retrieved from longline vessels since 1988 and report on the species and, where possible, provenance, age and sex of birds killed;
5. To monitor the three Shy Albatross breeding populations on Macquarie Island; and
6. Update the Australian domestic longline fishery data base and analysis of this to provide an improved assessment of bird catch rate.

Outputs:

- Report: *Seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988-1996 trends*, Wildlife Report Series. Also presented to third meeting of CCSBT ERSWG meeting, 1998.

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47. Title: **The effects of longlining seabird population: by catch estimation, archival tagging & population modelling**

Researcher(s): D. Heinemann, N. Klaer, T. Polacheck; G. Tuck, T. Davis (CSIRO)

Project Number: AFMA1997/1481

Funds: $1,340 (Bilateral Fund)

Objectives:

1. To update estimates of the seabird catch and catch rates and their associated variances within the AFZ by area and season for 1996 and 1997;
2. Analyse of the effectiveness of various mitigation measures used to reduce seabird bycatch. Explore the consequences of night setting on SBT catch rates, and evaluate the potential for wider adoption of night setting as a mitigation measure;

3. Continue work on the deployment and analysis of data from archival tags;
4. Update the wandering albatross population model in collaboration with BAS and CEBC/CNRS, and explore additional hypotheses regarding the impact of longlining on wandering albatross populations; and
5. To extend the albatross model to include other species of Southern Ocean albatrosses.

Outputs:

- Objectives 1 and 2 achieved. Objectives 2,3 and 5 either not achieved or only partially achieved. (Only partial funding paid).

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48. Title: **Construction & evaluation of underwater setting device to prevent accidental capture of seabirds**

Researcher(s): M. Smithy; J. Molly, N. Brothers (TPWS)

Project Number: AFMA 1997/1491

Funds (9%): $4,140 (Bilateral fund); $180 (TPWS); $900 (MS Engineering)

Objectives:

1. To redesign and construct an improved capsule setting device which is capable of achieving a 5 second cycle time at a setting depth of 3m, and is safe for crew to use in all conditions;
2. To determine the effectiveness of the capsule setting device in preventing seabirds from taking bait during setting;
3. To evaluate the impact of the capsule setting device on catch of target species; and
4. To define optimum installation configuration and deployment strategy of capsule setting device in relation to the influence of propeller and hull turbulence.

Outputs:

- AFMA funded Objective 1. Objectives 2,3 and 4 addressed subsequently under project 2000/469.
- The design and function of the device were amended significantly to provide an improved landing platform, greater control over capsule movement, increased safety for crew and simplicity of operation. Further testing was required to find the maximum depth baits can be delivered.

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49. Title: **Development of a design and implementation program for a fisheries observer program to monitor seabird bycatch rates in domestic longline fisheries**

Researcher(s): CSIRO

Project Number: AFMA 1998/0700

Funds (9%): $1,688 (SBTMIRF)

Objectives:

No further information available.

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50. Title: **Seabird by-catch assessment in the AFZ & further mitigation measure development for longline fisheries**

Researcher(s): N. Brothers, R. Gale and T. Reid (TPWS)

Project Number: AFMA 1999/0024

Funds(2.5%): $1,391 (Bilateral Fund**)**

Objectives:

1. Continue evaluating the effectiveness of mitigation measures;
2. Further improve the suitability of mitigation devices and their use – specifically bird scaring lines and appropriate line weighting along with the relationship between line weight and its position (relative to hook) to sink rate performance of baits and their accessibility to seabirds;
3. Asses the degree to which crew are at risk of injury from line weighting and the role that weighting configuration (amount and position) plays in this;
4. Continue to assess levels of seabird mortality in domestic longline fisheries with emphasis upon determining the factors responsible; and
5. Process carcasses of seabirds caught in longline fisheries.

Outputs:

- Report: Seabird interactions with longline fishing in the AFZ: seabird mortality estimates and 1988-1998 trends, presented to CCSBT ERSWG (see Appendix 3).

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51. Title: **A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries**

Researcher(s): Nigel Brothers, D. Chaffey, T. Reid

Project Number: AFMA 2000/469

Funds (2.5%): $1,103 (Bilateral Fund); $1285 (EA); $113 (Thylacine Tuna Fisheries)

Objectives:

1. To test and refine the design and installation protocols for the underwater setting chute so that an approved design can be implemented in a multi-vessel field trial south of latitude 30 South; and
2. To refine the installation protocols for the underwater setting capsule so that it is at the stage where it represents a viable alternative to the underwater setting chute for operators considering fitting an underwater setting device.

Outputs:

- Final report “Performance assessment and performance improvement of two underwater line setting devices for avoidance of seabird interactions in pelagic longline fisheries” presented to CCSBT Ecologically Related Species (ERS) Working Group meeting No. 4, November 2001 (see Appendix 3).

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52. Title: **A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries**

Researcher(s): Nigel Brothers

Project Number: AFMA 2001/0254; 2001/0600

Funds (2.5%): $800 (Bilateral Fund); $247 (ETMIRF); $247 (WTMIRF); $2,188 (FRRF)

Objectives:

1. To construct and test 10 underwater setting chutes in order to demonstrate that the chutes are an effective seabird mitigation measure under normal pelagic longline fishing operations as they are currently conducted in the southern part of the AFZ;
2. To assess and evaluate the technology use in the trial of the chutes for use as a management tool for sustainable use of resource;
3. To increase scientific rigour of trial with the collection of data and information which can assist in developing policy and making management decisions for the sustainable use of the resource and to prove chutes are reducing seabird bycatch;
4. To ensure that the 10 vessel trial provides clear outcomes which (assuming the chutes are successful) will enable fisheries managers, industry and policy makers to develop appropriate strategies to ensure that underwater setting chutes are taken up by the domestic industry;
5. To provide supporting information to assist Australia's case in international fora for promotion of the methodology in reducing seabird bycatch; and
6. To help promote policy outcomes by increasing public awareness about the issues facing fishers, the need for the mandatory measures and the performance of the industry to date.

Outputs:

- Ten chutes were constructed. Final report not available.

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D. ECONOMICS/MANAGEMENT/COMMUNICATION

(i) Management/policy/economics

53. Title: **Assessing the effectiveness of the SBT management scheme and its effect on those involved in the industry at the time of its introduction**

Researcher(s): G. Geen and M. Nayar (BAE)

Project Number: FIRDC 1986/52

Funds: $62,017 (FIRDC)

Objectives:

1. To determine the effectiveness of the management scheme by examining the changes in the fishery since the introduction of quotas; and
2. To assess the effect of the scheme on both outgoers from the SBT fishery and other fisheries.

Outputs:

- G. Geen and M. Nayar (1989) *Individual transferable quotas and the southern bluefin tuna fishery,* ABARE occasional paper.
- Geen, G and Nayar, M (1988) *Individual transferable quotas in the southern bluefin tuna fishery: an economic appraisa*l, Marine Resource Economics Vol. 5 No. 4.

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54. Title: **Review of the Australian SBT season 1987/88 – 1989/90**

Researcher(s): BRS

Project Number: NR

Funds: $300,000 (est.) (BRS)

Objectives:

To provide an outline of catch and effort in the Australian SBT fishery initially to the trilateral management and scientific committee meetings and later to the CCSBT.

Outputs:

- Annual reports prepared and delivered to meetings (See Appendix 3

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55. Title: **Japanese tuna fisheries to the year 2000**

Researcher(s): Unisearch

Project Number: AFMA 1993/0065

Funds (50%): $17,500 (SBTMIRF**)**

Objectives:

No further information available.

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56. Title: **Japan Tuna fisheries**

Researcher(s): ADFA

Project Number: AFMA (1995)

Funds (50%): $20,000 (SBTMIRF)

Objectives:

No further information available.

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57. Title: **Non destructive biomass estimation devices (NBED)**

Researcher(s): A. Smart & S. Clarke (SARDI)

Project Number: AFFA 1995/0387

Funds: **$**10,000 (SBTMIRF)

Objectives:

1. To evaluate the most suitable technique for encouraging fish to pass through frames in a controlled manner;

2. To ascertain the minimum size frame through which tuna can be transferred in a satisfactory manner and whether the PIT tag antenna can be used to further subdivide the frame;
3. To determine the range of swimming speeds which transferred-tuna and farm-tuna exhibit;
4. To determine the strength of the relationship between easily measured tuna morphological characteristics and fish weight so as to determine the potential accuracy that can be achieved;
5. To evaluate the response time and detection range of suitable PIT tags and antenna underwater if the appropriate equipment will be supplied for the necessary trials by the manufacturer, and if the results are positive; and
6. To put together a project team and proposal to obtain funding to build an appropriate non-destructive biomass estimation device.

Outputs:

- The relatively slow swimming speed of tuna, combined with regular behaviour and orientation were considered to be advantageous for biomass measurements.
- Good relationships were found between various morphometrics such as lengths between fins. Visual or optical technology appeared to be the best system to integrate with a PIT tag identification system and thereby offers the greatest potential for our needs.
- The local technology (SBec Marine (WA) in conjunction with the results from the work with SBT and internal frames in sea pontoons, indicates the potential to integrate with existing PIT tag antenna ranges to develop a suitable NBED for SBT.

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58. Title: **Validation and Implementation of a stereo video system for measuring length of SBT during transfers**

Researcher(s): E. Harvey (UWA), M. Shortis (U of Melb.) J. Seager (Colour Vision Systems), Mike Cappo (AIMS)

Project Number: AFMA 2000/1181; 2001/1299

Funds: $59,561 (SBTMIRF); $112,900 (ARF); $40,000 (UWA)

Objectives:

1. To construct an underwater stereo-video system for measuring lengths of SBT while they are being transferred into farm cages, and to determine the stability and robustness of the configuration of the stereo-video system and refine the system so that it is suitable for counting and measuring the lengths of SBT during transfers;
2. To validate the accuracy and precision of stereo-video measurements of the length of SBT under field conditions;
3. To evaluate performance of the stereo-video measurement system under field conditions during an actual transfer to determine the feasibility of utilising the system on a routine basis for obtaining accurate and precise estimates of the length frequency distribution of the SBT catch;
4. To familiarise representatives from the finfish aquaculture industry, management agencies and research organisations with the use of such a stereo-video system;
5. To test the stability and robustness of the configuration of the stereo-video system; and

6. To develop a protocol to optimise the number of SBT to be sampled for length frequency during a transfer.

Outputs:

- The feasibility of the system has been proven. As at September 2002 the system was operational but further modifications needed to be made. Delays had meant that the validation using SARDI research farm harvest was not possible in 2002; it was proposed to validate using cage cultured freshwater fish in WA in October 2002. The system will be trialed during the 2002/03 SBT season. Final report of project 2001/1299 due mid 2003.

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59. Title: **Understanding the nature of SBT bycatch in the ETBF and determining the extent of mortality in SBT released alive; an integrated research and monitoring program**

Researcher(s): J. Gunn, T. Carter (CSIRO)

Project Number: FRRF 2000/2197

Funds: $50,000 (FRRF); $91,342 (SRP); $64,485 (CSIRO); $120,183 (ETMIRF); $21,209 (STBMIRF); $150,000 (industry in kind)

Objectives:

1. Determine the level of SBT bycatch taken by a range of vessels within the ETBF over the June-September period;
2. Describe the extent to which bycatch varies with geographical location, time and targeting practices (gear, bait time of set etc);
3. Determine the life status of the SBT caught by ETBF longliners and in particular what proportion of the catch is dead when brought to the vessel; and
4. Through conventional tagging of all SBT released alive, determine the extent of post-release mortality in the SBT after capture by longline and within the limits imposed by small sample sizes, examine whether this varies with life status and set time.

Outputs:

- Progress report produced. Final report due June 2003.
- Project delayed by length negotiations with ECTBOA regarding access to vessels operating in the seasonal closure. Agreement reached in early August – 2 months into the seasonal closure. Very few operators continued to fish in the closed area after this time. Those who did were unable to take observers either due to concerns about survey requirements for their vessels, bad weather or problems with availability of quota. The bulk of this year's data was therefore collected from a small number of vessels the operators of which had agreed to cooperate before the agreement was signed.

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60. Title: **Ecological risk assessment for Commonwealth Fisheries**

Researcher(s): T. Smith, I Stobutzki and A. Hobday (CSIRO)

Project Number: AFMA 2001/0934

Funds (5%): $29,884 (AFMA reserves)

Objectives:

1. To consolidate/develop ecological risk assessment methods that will meet the requirements for strategic assessment for Commonwealth fisheries;
2. To undertake ecological risk assessments for Commonwealth fisheries, as prioritised by AFMA; and
3. To determine the relative sustainability risks in Commonwealth managed fisheries, considering target, byproduct, bycatch and broader ecological impact where possible.

Outputs:

- Project due to be completed December 2003. Description of the approach and methods developed by the project for assessing the ecological risks of fishing produced 24 October 2002.

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61. Title: **Best practice reference points for Commonwealth fisheries**

Researcher(s): Keith Sainsbury , T. Smith (CSIRO)

Project Number: AFMA 2001/0999

Funds (5%): $2,275 (AFMA); $1,500 (EA); $3,601 (CSIRO)

Objectives:

1. To review and summarise recent developments of reference points for the major classes of management objective in Australian and international fisheries;
2. To identify current world's best practice reference points for each class of management objective and provide guidance on their applicability in different management circumstances;
3. To conduct stakeholder workshops to review and, as far as possible, build consensus on best practice reference points for Australian Commonwealth fisheries. Stakeholders would include fishing industry interests, conservation interests and regulating agencies (EA and AFMA); and
4. Produce a final report that addresses significant issues raised at the workshops and recommends best practice in relation to reference points and their use in the context of Commonwealth managed fisheries and the guidelines of the ecologically sustainable management of fisheries under the EPBC Act.

Outputs:

- Final report due December 2002 but project running behind schedule.

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62. Title: **Conservation and optimum utilisation of SBT**

Researcher(s): Dominion Consulting/ABARE

Project Number: FRRF 2000/10710

Funds: $183,850 (FRRF); $20,000 (ABARE)

Objectives:

1. Define optimum utilisation and conservation both generically and with respect to the CCSBT;
2. Develop a framework (quantitative and qualitative) which can apply the results of (1) with respect to a number of areas of contention:

- Harvesting strategies – what is the optimum method/age to harvest fish?
- Are Japan's proposals for an increased TAC valid?
- Quota/alternative management arrangements – what is the optimum allocation of quota?

Outputs:

- ABARE reviewed the existing bioeconomic models of the SBT fishery and developed an adapted model. This new model is implemented in General Algebraic Modelling systems to allow for greater transparency and so that it can be run over a longer time horizon with a shorter computation time.

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63. Title: **Southern bluefin tuna conservation and trade**

Researcher(s): A. Cox and L. Davis (ABARE)

Project Number: FRRF 1998/9684

Funds: $132,231 (FRRF); $10,000 (EA)

Objectives:

To examine, from an economic perspective, the effectiveness of listing SBT on Appendix II of CITES.

Outputs:

- Cox, M. Stubbs, L Davies Southern bluefin tuna and CITES: an economic perspective, Report for the FRRF and Environment Australia, ABARE research report 99.2, Canberra.
- Cox, M. Stubbs, L. Davis (ABARE), Economic issues in the international management of southern bluefin tuna: paper presented to Conference on the Management of Straddling Fish Stocks and Highly Migratory fish stocks and the UN Agreement, Bergen, Norway, 19-21 May 1999.
- J. Kennedy (La Trobe) l. Davis & A. Cox (ABARE) *Joint rent maximisation and open access competition in the southern bluefin tuna fishery – results from a bioeconomic model*, paper to Australian Agricultural and Resource Economics Society Conf. 1999).

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64. Title: **Development of comprehensive and integrated methods for including key uncertainties in the management advice for the SBT fishery**

Researcher(s): BRS

Project Number: 1994/95

Funds: $52,512 (FRRF)

Objectives:

No further information available.

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65. Title: **Optimal Australian and Japanese Harvesting of SBT**

Researcher(s): J. Kennedy and H. Pasternak

Project Number: NR

Funds: Unknown (ARC/ La Trobe Uni.)

Objectives:

1. To explore what harvesting strategies through time would appear to be optimal for the two major harvesting nations.
2. To determine whether quotas on harvest levels should continue to be cut back or be relaxed.

Outputs:

- J. Kennedy and H. Pasternak (1991) *Optimal Australian and Japanese Harvesting of SBT*, Economics Research Report , La Trobe Uni. No. 91.2, July 1991

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66. Title: **Scientific support for policy development and implementation for the Commission for the Conservation of SBT (1995/96 and 1996/97)**

Researcher(s): T. Polacheck, N. Klaer, C. Millar, A. Preece (CSIRO)

Project Number: FRRF 1995/1996, 1997/0041

Funds: $254,858 (FRRF)

Objectives:

1. To provide a simulation framework for the evaluation of management strategies to the October 1997 management strategy workshop;
2. To provide final evaluations and input on the Australian initiative for a mid-term management strategy to the 1998 CCSBT Scientific Committee meeting; and
3. To develop and apply a framework to evaluate management strategies for SBT both conventional fishery management and experimental fishery management, including the use of reference points and management triggers to achieve management objectives

Outputs:

- CSIRO Report, *Development and Evaluation of Management Strategies for the SBT Fishery,* was published and presented to the first meeting of the CCSBT Management Procedure Workshop, 2002 (see Appendix 3)

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67. Title: **Scientific support for the development of international policy for Commonwealth fisheries, 1997/98 – 2001/02**

Researcher(s): BRS

Project Number: FRRF 1997/98; 2001/2190; 2000/1083; 1999/7045; /1997/1998;

Funds (50%): $292,950 (FRRF); $231,406 (BRS)

Objectives:

The project funds BRS scientific and advisory activities, and participation in fora relevant to Australia's developing fisheries on highly migratory and deepwater fisheries resources. Project work varies from year to year. In 2000/2001 for example, the project included BRS staff preparation and participation in meetings of the CCSBT, IOTC, Prepcon for the Commission for the Conservation and Management of highly Migratory Fish Stocks in the Western and Central Pacific, meetings relevant to the demersal resources in the Tasman Sea and Southern Indian Ocean and a range of associated and relevant fora. The project aims to:

1. Promote the development of regional research and monitoring programs to support ecologically sustainable development of the fisheries;

2. Ensure that Australia's contributions to management initiatives in regional fishery developments and stock assessments are based on sound scientific advice so that they may be integrated in management policies for Commonwealth fisheries;

3. Meet Australia's international obligations for providing fishery statistics to regional bodies; and

4. Provide scientific advice for foreign access negotiations.

Outputs:

- Outputs included travel reports, briefings, reviews of fisheries, scientific and data inputs to various regional bodies and development of stock assessments and scientific research programs and projects. The project continues to develop Australia's position as a key player in initiating, carrying out and directing research in the Indian and Pacific Oceans. Some of the highlights in relation to international management of SBT over 2001/2002:

  - Establishment of an SRP;

  - Significant progress on a management strategy;

  - Development of a baseline operational model;

  - Development of a CCSBT Secretariat database (including the large data exchange completed to establish the database); and

  - Agreement on a set of standards and laboratory manual for age estimation of SBT.

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68. Title: **Trends in tuna fisheries; the republic of Korea and Taiwan consultancy proposal**

Researcher(s): Unitas

Project Number: AFMA 1995/1012

Funds (50%): $19,351 (FRRF); $20,000 (Bilateral Fund); $19,351 (Unitas)

Objectives:

1. To identify the principal political, legal and economic influences on distant water tuna operations in both the Republic of Korea and Taiwan;

2. To provide an analysis of likely pressures (internal and external) facing each country in the next decade and the effect of these pressures on their approach to SBT; and

3. A subsidiary objective is to examine the implications of developments in the Republic of Korea and Taiwan for the management of SBT and Australia's position on future action by the CCSBT.

Outputs:

- Report produced.

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69. Title: **Use of individual transferable quotas in the Australian fisheries**

Researcher(s): D. Campbell, T. Battaglene, D. Brown (ABARE)

Project Number: NR

Funds: Unknown (ABARE)

Objectives:

To assess the short and long-term impact of ITQs in the SBT fishery.

Outputs:

- D. Campbell, T. Battaglene, D. Brown *Use of Individual transferable quotas in the Australian Fisheries*, Marine Policy, Vol. 24, pp. 109-117.

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70. Title: **The value to Japan of access to the Australian Fishing Zone**

Researcher(s): G. Geen (ABARE)

Project Number: 1990

Funds: Unknown (ABARE)

Objectives:

To increase economic information on foreign fishing available to the Australian Fisheries Service by estimating the profits earned by the Japanese longline fleet fishing for SBT in the waters of the Australian fishing zone.

Outputs:

- G. Geen, The value to Japan of access to the Australian Fishing Zone Report to the Australian Fisheries Service June 1990.

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71. Title: **Benefits and costs of the venture agreement in the SBT industry**

Researcher(s): P. Lal, M Haque, & T Battaglene (ABARE)

Project Number: NR

Funds: Unknown (ABARE)

Objectives:

To assess the benefits and costs of the joint venture agreement in its first three years, 1991-1994, and those that may accrue if the joint venture was to be extended for a further 3-year period.

Outputs:

- P. Lal, M Haque, & T Battaglene, *Benefits and costs of the venture agreement in the* SBT industry, Report to Fisheries Policy Branch, DPIE, 1994.

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72. Title: **Alternative methods for determining appropriate bilateral access fees**

Researcher(s): L. Hogan, K van Landeghem, V. Topp (ABARE)

Project Number: NR

Funds: $69,741 (FRRF)

Objectives:

To undertake an economic assessment of various possible bilateral access fees arrangements in response to Japan's proposal for an alternative approach based on a per vessel fee.

Outputs:

- L. Hogan, K van Landeghem, V. Top, *Access fee arrangements for Japanese fishing vessels in the Australian Fishing Zone*, Report to FRRF, October 1997.

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73. Title: **Quantitative interpretation of fine-scale catch per unit effort for southern bluefin tuna off south eastern Australia**

Researcher(s): V. Lyne, R. Scott, R. Gray and R. Bradford (CSIRO)

Project Number: 1993/077

Funding source: FRDC/CSIRO

Funds: $290,692 (FRDC); $1,360,981 (CSIRO); $136,000 (other)

Objectives:

1. To conduct quantitative exploratory analyses of how catch rates of SBT are affected by environmental factors such as temperature patterns and water depth for the region south of Tasmania up to the southern half of NSW.

Outputs:

- The study showed that there are substantial temporal and spatial variations in CPUE as well as the size of SBT. Spatial temperature variations in the study zone, in association with bathymetry, appear to influence the general spatial distribution of CPUE and size of SBT. Catch rates and size of SBT are significantly correlated with the Southern Oscillation Index (SOI), opening the possibility of predicting catch rates through forecasts of the SOI.

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74. Title: **Southern Bluefin Tuna: Scientific Background to the Debate**

Researcher(s): A. Caton, K. McLoughlin, M.J. Williams

Project Number: NR

Funds: $20,000 (est.) (BRS)

Objectives:

1. To better inform the public debate surrounding the decline in the SBT fishery.

Outputs:

- Caton, K. McLoughlin, M.J. Williams, *Southern Bluefin Tuna: Scientific Background to the Debate*, BRR Bulletin No. 3.

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75. Title: **Fishery status reports: Resource assessments of Commonwealth fisheries**

Researcher(s): BRS

Project Number: FRRF 1992/1993; 1993/1994; 1994/95; 1995/96; 1996/97; 1997/98; 1999/2174; 2000/1082; 2001/2192;

Funds (6%): $160,443 (FRRF); $89,452 (BRS)

Objectives:

The principal objective is to assess and report on the status of Commonwealth-managed fish stocks.

The nature of the work undertaken in this project varies from year to year but the core activities include:

- Participation on AFMA Fishery Assessment Groups (FAGs) and other appropriate fora;
- Analysis of catch and effort data, modelling and analysis in support of stock assessment; and
- Production of the Fishery Status Reports covering Commonwealth –managed fisheries.

Outputs:

- FRRF-funded 'Status of Australian Fisheries' projects have been undertaken since 1992. The main 'public' manifestations of their outputs have been the *Fishery Status Reports* publications.
- The report is a compilation of data collected from each individual fishery's assessment group and is presented in a form readily accessible for government policy makers, fisheries managers, industry and the community. Annual fishery by fishery reports on status provide a basis for a comparison of the essential time series of assessments needed to fully assess trends in fisheries and hence the appropriateness of, or need for, management action.
- *Fishery Status Reports* coverage of Commonwealth-managed fisheries currently involves the integration of assessment outputs from core BRS activity and from additional assessments. The latter might include, eg, analyses of catch-and-effort data and population modelling. It also involves participation in AFMA FAGs and other appropriate fora to review fishery trends, assessments and conclusions about stock status.
- The reports were intended as an annual publication. However, while the less-public background fishery-assessment and advisory work underpinning the reports is continuous, the formal publications have followed a cycle requiring more than a year for completion.

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76. Title: **Demonstration of the viability of a fishery for SBT and big eye tuna for the fresh sashimi market**

Researcher(s): Ulladulla Fishermen's' Co-op.

Project Number: FIRC 1985/17

Funds: $115,000 (FIRDC)

Objectives:

1. To provide assistance with the purchase of Japanese style longlines and for fuel;
2. To investigate the accessibility to Australian fishermen of the SBT and bigeye tuna off the coast of NSW and Tasmania during the months of May, June, July and August; and
3. To compare the effectiveness of Japanese equipment and Australian monofilament equipment.

Outputs:

No further information available.

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77. Title: **Establish the viability of a longline SBT operation based in Tasmania and establish a quality control mechanism for the Australian longline industry**

Researcher(s): Tas Fisheries & Aust. Tuna Fisheries Pty Ltd

Project Number: FIRC 1986/111

Funds: $87,800 (FIRDC)

Objectives:

1. To demonstrate to operators of other vessels in Australia that the future of the tuna fishery will be dependent upon longline operations and that profitability will not be jeopardised by changing from the current methods to the longline method.
2. To establish acceptability of a system whereby the freezing process of each fish is recorded and available for inspection by the buyers in Japan.

Outputs:

Longline fishing conducted in the 1987 and 1988 season but at that time was not able to demonstrate the viability of an Australian longline operation.

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(ii) Liaison/extension/communication

78. Title: **Tag lottery for SBT**

Researcher(s): CSIRO

Project Number: FIRC 1987/113

Funds: $4,710 (FIRDC)

Objectives:

1. To maintain the interest of tuna fishermen in the tagging program so as to encourage the returns of tags from SBT caught in 1986/87; and
2. To flush out tags from fish that were caught in previous years, but for some reason were not returned

Outputs:

- The tag lottery was successful in flushing out tags that had been retained but not returned and increased the benefits of the 1983 and 1984 tagging of 10,179 SBT off WA and SA.

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79. Title: **Research/Industry/Management liaison**

Researcher(s): CSIRO

Project Number: AFMA 1993/0064; AFMA 1996/0827; FRRF 1999/5384

Funds: **$**40,526 (SBTMIRF); $18,392 (FRRF); $25,093 (CSIRO)

Objectives:

1. To promote effective communication between researchers, industry and managers involved with the SBT fishery;
2. To take research results to industry and obtain research guidance from industry;
3. To hold a workshop between scientists, industry and managers; and
4. To produce a report of the workshop for distribution to relevant SBT fisheries (Australian and International).

Outputs:

- Workshops held in 1993, 1997 and 1999 and report of proceedings published and disseminated to stakeholders.

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80. Title: **Training video for longline fishermen**

Researcher(s): N. Brothers

Project Number: AFMA 1999/0025

Funds (2.5%): $1,063 (Bilateral Fund)

Objectives:

1. To raise awareness in the fishing industry of the plight of seabirds which are endangered or threatened by longlining practices;
2. To clearly demonstrate methods of reducing seabird capture; and
3. To solicit feedback from industry on methods of reducing seabird capture including technical innovations, improvements and modifications to existing practices.

Outputs:

- Video produced and distributed. Generated significant interest from overseas.

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81. Title: **Australia/Indonesia Workshop on Shark and Tuna, including SBT (March 2000)**

Researcher(s): CSIRO/FAB/AFMA/ACIAR/Indonesian fisheries agencies

Project Number: FRRF 2000/11824

Funds (75%): $11,531 (ACIAR**)**

Objectives:

1. To consider and discuss cooperative research with Indonesia into shark and tuna (including SBT); and
2. To discuss opportunities for joint research and management of resources of mutual interest.

Outputs:

- Identified the following areas for potential collaboration:
  - Research collaboration on shark stocks shared between Australia and Indonesia.
  - Research collaboration on tuna species including SBT that are shared between the parties.
  - Assisting in the institutional capacity building.
  - Assisting with the development of mariculture in the eastern Indonesian archipelago including the establishment of pilot sites.
  - Capacity development in fish health management and living aquatic resources conservation.
  - Developing and improving appropriate post harvest technology to increase the returns on the Indonesian catch.

- Agreed to present proposals to respective governments and seek agreement to developing a long-term process for a formal dialogue process and a program of initiatives as outlined above.

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82. Title: **Support for the AFZ observer program**

Researcher(s): W. Whitelaw (CSIRO)

Project Number: AFMA 1993/0063 (for the years 1991/92 – 1994/95)

Funds (75%): $19,140 (SBTMAC); $3,975 (Bilateral Fund); $13,909 (CSIRO)

Objectives:

1. To further enhance the scientific value obtained from the AFZ observer program by providing more opportunity for interaction between observers and scientists.
2. To improve CSIRO scientists understanding of the fishery by allowing greater involvement of CSIRO staff in the AFZ observer field operations.

Outputs:

- Pre-season workshops held to train observers in scientific sampling techniques and to inform them of the various scientific and biological requirements of the organisations involved in the foreign pelagic fisheries in the AFZ. Workshops provided opportunity for cross flow of information and expertise between the observers and the scientists involved in the fisheries.

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83. Title: **Japanese speaking liaison personnel to visit longline vessels in Sydney, Brisbane and Cape Town**

Researcher(s): W. Whitelaw (CSIRO)

Project Number: 1993/0062

Funds: $16,000 (SBTMIRF); $86400 (CSIRO**)**

Objectives:

1. To improve tag return rates from Japanese longliners.
2. To improve our understanding of Japanese longline fisheries.
3. To promote better cooperative relationships between vessel operators and fishery scientists.

Outputs:

- Liaison conducted and effective.

Appendix 3 – Published research outputs delivered to CCSBT-related meetings and RMP workshops

1. Documents/papers presented to CCSBT-related meetings

Papers Presented by Australian participants to Trilateral Meetings of Scientists (1985 – 1994), CCSBT Scientific Committee (1995 – 2002), the CCSBT ERS Working Group (1995-2001) and various CCSBT Workshops (1995-2002)

A. Papers presented to Trilateral Meetings of Australian, Japanese and New Zealand Scientists on Southern Bluefin Tuna, 1985 - 1994

1. Fourth meeting, 15-18 July 1985, Fisheries Research Centre Wellington, New Zealand

SBFWS/85/1A	Size composition monitoring in the Australian southern bluefin tuna fishery, A. Caton
SBFWS/85/2A	Population dynamics studies on southern bluefin tuna. (a and b) Research report for 1984/85 and proposals for 1985/86 work ,J. Majkowski
SBFWS/85/3A	Assessment of the southern bluefin tuna (*Thunnus maccoyii*) population and the determination of optimal exploitation levels, J. Hampton
SBFWS/85/4A	Southern bluefin tuna off north-eastern Australia, A. Caton
SBFWS/85/5A	Situation report, Australian southern bluefin fishery 1984/85, A. Caton
SBFWS/85/6A	Robust estimation of natural mortality in a completed tagging experiment with variable fishing intensity, W.S. Hearn, R.L. Sandland and J. Hampton
SBFWS/85/13A	Extract from “A view from the ocean”, F.R. Harden Jones. From: “Mechanisms of Migration in Fishes” 1984, McLeave, J.D., Arnold, G.P., Dodson, J.J. and Neill, W.M. (eds)

2. Fifth meeting, 10-14 June 1986, Far Seas Fisheries Research Laboratory Shimizu, Japan

SBFWS/86/1A	Notes on development of the Australian southern bluefin tuna fishery and its management, A. Caton
SBFWS/86/2A	SA tuna season, A. Caton
SBFWS/86/3aA	Population dynamics studies on southern bluefin tuna (SBT), J. Majkowski
SBFWS/86/3bA	From Australia to Africa - by bottle!, A. Caton
SBFWS/86/4A	Assessment of the southern bluefin tuna (Thunnus maccoyii) population and the determination of optimal exploitation levels, J. Hampton
SBFWS/86/5A	A new approach to virtual population analysis and its application to southern bluefin tuna (Thunnus maccoyii), J. Hampton
SBFWS/86/6A	Exploitation of southern bluefin tuna passing through the Australian fishing grounds J. Majkowski and G.J. Eckert
SBFWS/86/7A	A tag release-recapture method for predicting the effect of changing the catch of one component of a fishery upon the remaining components J. Majkowski and W.S. Hearn
SBFWS/86/8A	A tag release-recapture approach for determining interactions among fisheries J. Majkowski and W.S. Hearn

3. Sixth meeting, 17-21 August 1987, CSIRO Marine Laboratories Hobart, Australia

SBFWS/87/2A	1986-87 Australian southern bluefin tuna season review A. Caton
SBFWS/87/3N	Data on southern bluefin tuna (*Thunnus maccoyii* (Castlenau)): Australian, Japanese and New Zealand systems for collecting, processing and accessing catch, fishing effort, aircraft observation and tag release/recapture data J. Majkowski and G. Morris
SBFWS/87/4A	Population dynamics studies on southern bluefin tuna (SBT); Research report for 1986/87 J. Majkowski

SBFWS/87/5A	Lottery for southern bluefin tuna tags W. Hearn and J. Majkowski
SBFWS/87/6A	Fishermen recapture 40% of tagged southern bluefin tuna (SBT) G.J. Eckert and J. Majkowski
SBFWS/87/7A	An indexed bibliography of southern bluefin tuna (*Thunnus maccoyii* (Castlenau, 1872)) G.J. Eckert, J. Kalish, J. Majkowski and R. Pethebridge
SBFWS/87/8A	Assessment of the southern bluefin tuna fishery J. Hampton and W. Hearn
SBFWS/87/11A	Growth of southern bluefin tuna (*Thunnus maccoyii*) W. Hearn
SBFWS/87/12A	Growth of southern bluefin tuna J. Hampton
SBFWS/87/13A	Application of tag-release/recovery method for predicting interactions among and size limits for the Australian southern bluefin tuna fisheries W. Hearn and J. Majkowski
SBFWS/87/15A	Distribution and ecology of southern bluefin tuna larvae (Factors affecting the horizontal and vertical distribution in early stages of the life history of southern bluefin tuna) CSIRO Division of Fisheries Research, Hobart

4. Seventh meeting 15-19 August 1988, Fisheries Research Centre Wellington, New Zealand

SBFWS/88/1A	A preliminary review of the 1987-88 Australian southern bluefin tuna season A.E. Caton
SBFWS/88/4A	A note on Japanese southern bluefin tuna fishing area definitions and the quality of 5 degree square and length frequency data P Young
SBFWS/88/5A	Population dynamics studies on southern bluefin tuna; research report for 1987/88 J. Majkowski
SBFWS/88/6A	Estimates of numbers of SBT, which were tagged in 1983/84, that should be caught and reported by Japanese longliners W. Hearn
SBFWS/88/7A	Number of southern bluefin tuna caught by Australian fishermen each year from those tagged off Esperance, Albany and South Australia during 1983-84 (Table) W. Hearn
SBFWS/88/8A	Fishermen recapture 40 per cent of tagged southern bluefin tuna W. Hearn
SBFWS/88/9A	A tag-release/recovery method for predicting the effect of changing the catch of one component of a fishery upon the remaining components J. Majkowski and W. Hearn
SBFWS/88/10A	Interactions among effects of introducing size limits for the Australian southern bluefin tuna fisheries: predictions from a modified tag release/recovery method W. Hearn and J. Majkowski
SBFWS/88/11A	Assessment of the southern bluefin tuna stock, CSIRO Division of Fisheries
SBFWS/88/13A	Estimation of the number of SBT recruits from tag-release/recovery and commercial catch data, W. Hearn

4. Eighth meeting, 4-10 September 1989, Far Seas Fisheries Research Laboratory Shimizu, Japan

SBFWS/89/1A	A preliminary review of the 1989-89 Australian southern bluefin tuna season, A.E. Caton
SBFWS/89/2A	Longline catches of southern bluefin tuna (SBT) and other species within SBT fishing areas for 1987, J. Majkowski and M. Ryba
SBFWS/89/3A	Assessment of the southern bluefin tuna stock using virtual population analysis, G. Kirkwood, J. Majkowski, W. Hearn and N. Klaer
SBFWS/89/5A	SBT otolith microchemistry - status of research and requirements for support R.E. Thresher, C. Proctor and J.S. Gunn
SBFWS/89/inf1A	Fishing mortality and survival to reproductive maturity of southern bluefin tuna off Australia: estimates from the 1983-84 tagging programme G.J. Eckert, W.S. Hearn and J. Majkowski

SBFWS/89/inf2A MULTIFAN a likelihood-based method for estimating growth parameters and age composition from multiple length frequency data sets with an application to southern bluefin tuna (*Thunnus maccoyii*) D.A. Fournier, J.R. Sibert, J. Majkowski and J. Hampton

5. Ninth meeting, 17-22 September 1989, CSIRO Marine Laboratories Hobart, Australia

SBFWS/90/5A A preliminary review of the 1989-90 Australian southern bluefin tuna season A.E. Caton and K. Williams

SBFWS/90/6A Assessment of the southern bluefin tuna stock using virtual population analysis G. Kirkwood and N. Klaer

SBFWS/90/7A Future projections of southern bluefin tuna biomass incorporating stochastic variation in the stock-recruitment relationship N. Klaer and G. Kirkwood

SBFWS/90/8A SBT growth change W.S. Hearn and J. Hampton

6. Tenth meeting, 23-29 September 1991, Fisheries Research Centre Wellington, New Zealand

SBFWS/91/1A The 1990-91 Australian southern bluefin tuna season A. Caton, K. Williams, P. Ward and C. Ramirez

SBFWS/91/4A Interpretation of recent changes in the longline catch rate of 4+ southern bluefin tuna K. Sainsbury, T. Polacheck and N. Klaer

SBFWS/91/5A Estimation of the average total mortality rate of southern bluefin tuna from tagging data W. Hearn and T. Polacheck

SBFWS/91/6A Assessment of the status of the southern bluefin tuna stock using Virtual Population Analysis – 1991 T. Polacheck and N. Klaer

SBFWS/91/7A Future projections of southern bluefin tuna biomass incorporating stochastic variation in the stock-recruitment relationship N. Klaer, T. Polacheck and K. Sainsbury

SBFWS/91/inf1A Report on tagging SBT off WA and SA in 1990/91 W. Hearn and W. Whitelaw

SBFWS/91/inf2A Estimation of southern bluefin tuna (*Thunnus maccoyii*) growth parameters from tagging data, using von Bertalanffy models incorporating individual variation J. Hampton

SBFWS/91/inf3A Estimation of southern bluefin tuna (*Thunnus maccoyii*) natural mortality and movement rates from tagging experiments J. Hampton

SBFWS/91/inf4A Southern bluefin tuna recruitment monitoring and tagging programme: Report on the Third Workshop CSIRO Conference Report 2.91

7. Eleventh meeting, 5-10 October 1992, National Research Institute Of Far Seas Fisheries Shimizu, Japan

SBFWS/92/3A The Australian 1991-92 southern bluefin tuna season A.E. Caton and K.F. Williams

SBFWS/92/4A Longline catch rates as indices of abundance of southern bluefin tuna R.A. Campbell, T. Polacheck and Y. Ishizuka

SBFWS/92/5A The application of general linear models to CPUE to obtain indices of SBT abundance W.S. Hearn, K.A. Haskard and T. Polacheck

SBFWS/92/6A Qualitative interpretation of recent changes in the longline catch rate of young (4-6 year old) southern bluefin tuna K. Sainsbury, T. Polacheck, M. Ryba, N. Klaer

SBFWS/92/7A Assessment of the status of the southern bluefin tuna stock using virtual population analysis T. Polacheck, K. Sainsbury and N. Klaer

SBFWS/92/8A Biological reference points for the spawning stock of southern bluefin tuna K. Sainsbury

SBFWS/92/9A Southern bluefin tuna stock and recruitment projections N. Klaer, T. Polacheck and K. Sainsbury

SBFWS/92/inf1A	Progress report on the collaborative joint CSIRO/NRIFSF analysis of fine scale longline catch and effort data for southern bluefin tuna T. Polacheck and R. Campbell
SBFWS/92/inf2A	Weight-length relationships from the RTMP T. Polacheck and M. Ryba
SBFWS/92/inf3A	An overview of the 1992 Australian observer component of the RTMP March-August 1992 W. Whitelaw
SBFWS/92/inf4A	Reject and export southern bluefin tuna caught by the Indonesian-Taiwanese longline fishery T. Davis
SBFWS/92/inf5A	Southern bluefin tuna length and weight relationships based on Australian observer data P.J. Ward, C.M. Ramirez and A.E. Caton
SBFWS/92/inf10A	Catches of southern bluefin tuna by non-trilateral countries A.E. Caton

8. Twelfth meeting, 13-19 October 1993, CSIRO Marine Laboratories Hobart, Australia

SBFWS/93/1A	Catch monitoring of fresh tuna caught by the Indonesian-based Indonesian/Taiwanese longline fishery. Report for the 1993 trilateral scientific assessment T.L.O. Davis
SBFWS/93/2A	Size at first maturity of southern bluefin tuna based on RTMP and AFZ observer sampling. Report for the 1993 trilateral scientific assessment T.L.O. Davis
SBFWS/93/3A	Preliminary data on the direct estimation of age and growth in SBT J. Gunn, N. Clear, A. Rees and C. Stanley
SBFWS/93/4A	Estimating SBT age-at-length relations for the 1960s and 1980/1990s W.S. Hearn and T. Polacheck
SBFWS/93/7A	The Australian 1989-90 to 1992-93 southern bluefin tuna seasons A.E. Caton, K.F. Williams and C. Ramirez
SBFWS/93/10A	Qualitative interpretation of recent changes in the longline catch rate of southern bluefin tuna K. Sainsbury, T. Polacheck, M. Ryba and J. Stander
SBFWS/93/11A	Oceanographic influences on the SBT fishery off SE Australia V. Lyne, J. Young and R. Gray
SBFWS/93/12A	Longline catch rates as indices of abundance of southern bluefin tuna – II R.A. Campbell and T. Polacheck
SBFWS/93/13A	Indices of SBT abundance by applying general linear models to CPUE W.S. Hearn and T. Polacheck
SBFWS/93/15A	A method of calculating alternative catch at age matrices from fine-scale Japanese longline catch and size data N. Klaer and T. Polacheck
SBFWS/93/16A	Assessment of the status of the southern bluefin tuna stock using virtual population analysis T. Polacheck K. Sainsbury and N. Klaer
SBFWS/93/18A	Southern bluefin tuna stock and recruitment projections N Klaer, T. Polacheck and K. Sainsbury
SBFWS/93/19A	Development of a stock rebuilding strategy for southern bluefin tuna K. Sainsbury and T. Polacheck
SBFWS/93/inf2A	An overview of the 1992/93 Australian observer component of the southern bluefin tuna real time monitoring program, March 1992-October 1993 W. Whitelaw
SBFWS/93/inf9A	Some preliminary fishing mortality rate estimates from the 1900/91 and 1991/92 SBT juvenile tagging programs T. Polacheck
SBFWS/93/inf10A	Effort in Australian SBT surface fisheries A.E. Caton and R. Campbell

9. Thirteenth meeting, 19-29 April 1994, Fisheries Research Centre Wellington, New Zealand

SBFWS/94/1A	An interim report on the Australian 1993-94 southern bluefin tuna season A. Caton, K. Williams and K. Colgan

SBFWS/94/2A	Catch monitoring of fresh tuna caught by the Indonesia-based Indonesian/Taiwanese longline fishery T. Davis and J.H. Farley
SBFWS/94/5A	Size at first maturity of southern bluefin tuna based on RTMP and AFZ observer sampling T. Davis
SBFWS/94/6N	Green weight - processed weight relations for southern bluefin *tuna (Thunnus maccoyii*) from observer data E. Bradford
SBFWS/94/7J	Data analysis of the aerial surveys (1991-94) for juvenile southern bluefin tuna in the Great Australian Bight S. Chen and T. Polacheck
SBFWS/94/8A	Qualitative interpretation of longline catch rate of southern bluefin tuna by age and area K. Sainsbury, M. Ryba, J. Stander and T. Polacheck
SBFWS/94/9A	The use of catch and effort data from the Japanese longline fishery to estimate indices of abundance for southern bluefin tuna R.A. Campbell
SBFWS/94/10A	Estimating indices of SBT abundance by applying general linear models to CPUE W.S. Hearn, T Polacheck and K.A. Haskard
SBFWS/94/13A	Models for estimating SBT age-at-length during the transition period W.S. Hearn
SBFWS/94/14A	Assessment of the status of the southern bluefin tuna stock using virtual population analysis – 1994 T. Polacheck, K. Sainsbury and N. Klaer
SBFWS/94/15A	Southern bluefin tuna stock and recruitment projections N. Klaer, T. Polacheck and K. Sainsbury

B. Papers Presented to the CCSBT Scientific Committee Meetings 1995 – 2002

1. First meeting, 10-19 July 1995, Shimizu, Japan

SBFWS/95/1A	The Australian 1989 - 90 to 1994 - 95 southern bluefin tuna seasons A. Caton, P. Ward and C. Colgan
SBFWS/95/2A	Catch monitoring of fresh tuna caught by the Bali-based Indonesian/Taiwanese longline fishery T. Davis and J. Farley
SBFWS/95/3A	Conversion of processed weight to whole weight A. Caton
SBFWS/95/8A	Age and growth of southern bluefin tuna J. Gunn, N. Clear, T. Carter, T. Rees, C. Stanley, J. Kalish and J. Johnston
SBFWS/95/9A	Size at first maturity of southern bluefin tuna T. Davis
SBFWS/95/10A	Recent changes in Japanese longline fishing gear and techniques which may effect CPUE . Whitelaw and M. Baron
SBFWS/95/11A	Qualitative interpretation of longline catch rate of southern bluefin tuna by age and area A.G. Betlehem, G. Tuck and T. Polacheck
SBFWS/95/12A	CPUE index of SBT parental abundance in the spawning ground W. Hearn, T. Polacheck and G. Tuck
SBFWS/95/13A	Applying General Linear Models to CPUE to estimate indices of SBT abundance W. Hearn, T. Polacheck and G. Tuck
SBFWS/95/14A	Indices of abundance for southern bluefin tuna from analysis of fine-scale catch and effort data R. Campbell, G. Tuck and T. Nishida
SBFWS/95/17A	Assessment of the southern bluefin tuna stock using Virtual Population Analysis - 1995. (with separate appendices) T. Polacheck, K. Sainsbury and N. Klaer
SBFWS/95/19A	Southern bluefin tuna stock and recruitment projections N. Klaer, T. Polacheck and K. Sainsbury
SBFWS/95/21A	Towards an agreed management procedure for SBT fishery K. Sainsbury and T. Polacheck
SBFWS/95/22A	Research to improve population monitoring and assessment T. Polacheck, K. Sainsbury, B. Hearn, N. Klaer and T. Davis
SBFWS/95/inf1A	Use of the bomb radiocarbon chronometer to determine age of southern bluefin tuna J. Kalish and J. Johnston

SBFWS/95/inf2A	Southern bluefin tuna in the Indonesian longline fishery: Historical development and catch statistics for 1993 T. Davis, S. Bahar and J. Farley
SBFWS/95/inf4A	Japanese longline seabird bycatch in the Australian Fishing Zone April 91 - March 94 N. Klaer and T. Polacheck
SBFWS/95/inf8A	Synopsis of SBT data files held at the NRIFSF G. Tuck, R. Campbell and T. Nishida
SBFWS/95/inf11A	Data analysis of the aerial surveys (1991-1995) for juvenile southern bluefin tuna in the Great Australian Bight A. Cowling, S. Chen and T. Polacheck

2. Second meeting, 26 August - 5 September 1996, Hobart, Australia

CCSBT/SC/96/5A	The Australian 1994-95 and 1995-96 southern bluefin tuna seasons A. Caton
CCSBT/SC/96/6A	Catch monitoring of the fresh tuna caught by the Bali-based longline fishery T. Davis, J. Farley and S. Bahar
CCSBT/SC/96/7	Southern bluefin tuna whole weight processed weight conversion E Bradford, A Caton and T Itou
CCSBT/SC/96/8A	The direct estimation of age in southern bluefin tuna J. Gunn, N. Clear, T. Carter, J. Farley, A. Rees and C. Stanley
Appendices 1 -3A	Direct validation of annual bands in the otoliths of juvenile SBT through a large scale mark-and-capture experiment using strontium chloride
	Use of the bomb radiocarbon chronometer to determine age of southern bluefin tuna (Thunnus maccoyii)
CCSBT/SC/96/9A	Direct comparison of age estimates between otolith ring counts and cohort slicing method for southern bluefin tuna caught in the 1990's W. Hearn, N. Clear, A. Betlehem, and J. Gunn
CCSBT/SC/96/10A	Preliminary estimates of the age structure of the southern bluefin tuna spawning stock (including a revised estimate of the age at first spawning) J. Gunn, T. Davis, J. Farley, N. Clear and K. Haskard
CCSBT/SC/96/11A	Estimation of natural and fishing mortality for juvenile southern bluefin tuna based on multi-year tagging of cohorts T. Polacheck, W. Hearn, C. Millar, W. Whitelaw and C. Stanley
CCSBT/SC/96/15A	Qualitative interpretation of longline catch rate of southern bluefin tuna A. Betlehem, G, Tuck and T. Polacheck
CCSBT/SC/96/16	Indices of abundance for southern bluefin tuna from analysis of fine-scale catch and effort data R. Campbell, G. Tuck, S. Tsuji and T. Nishida
CCSBT/SC/96/17	Synopsis of southern bluefin tuna data files for Japanese longliners G Tuck, R Campbell, S Tsuji, T Nishida
CCSBT/SC/96/18A	Spatial and temporal analyses of southern bluefin tuna fine- scale catch and effort data R. Campbell and G. Tuck
CCSBT/SC/96/19A	1996 Estimation of indices of southern bluefin tuna abundance by applying general linear models to CPUE W. Hearn and T. Polacheck
CCSBT/SC/96/20A	Use of quarters 2 and 3 versus use of all quarters in the standardised CPUE of southern bluefin tuna R. Campbell
CCSBT/SC/96/21A	Data analysis of the aerial survey (1991-1996) for juvenile southern bluefin tuna in the Great Australian Bight A. Cowling, T. Polacheck and C. Millar
CCSBT/SC/96/22A	Comparison of indices of abundance used in 1996 southern bluefin tuna stock assessments information paper presented at the 2nd CCSBT Scientific Meeting held August 26 - September 6, 1996, Hobart, Australia R Campbell
CCSBT/SC/96/25A	An approach for objective weighting of natural mortality vectors in the assessment of southern bluefin tuna T. Polacheck
CCSBT/SC/96/26A	Assessment of the status of the southern bluefin tuna stock using virtual population analysis – 1996 T. Polacheck, A. Preece, A. Betlehem and K. Sainsbury
CCSBT/SC/96/27A	Virtual population analyses with a cryptic component in the stock: An example based on southern bluefin tuna T. Polacheck

CCSBT/SC/96/28A Comparison of assessment and projection methods used in 1995 SBT analysis N. Klaer, A. Betlehem and A. Preece

CCSBT/SC/96/30A Southern bluefin tuna stock and recruitment projections N. Klaer, T. Polacheck, K. Sainsbury and A Preece

CCSBT/SC/96/31A A retrospective examination of southern bluefin tuna VPA and projection results 1982 – 1995 N Klaer, K Sainsbury and T Polacheck

CCSBT/SC/96/inf1A Feasibility of CPUE-based southern bluefin tuna abundance indices R. Campbell, K. Haskard and A. Millar

3. Third meeting, 28July – 8 August, 1997

CCSBT-SC9707/4 Catch Monitoring of the Fresh Tuna Caught by the Bali-based Longline Fishery Davis T., Bahar S., Naamin N., Farley J. and Le D.

CCSBT-SC9707/6 Australian 1995/96 and 1996/97 Southern Bluefin Tuna Fishing Seasons Ward P. J. et. al. (1997

CCSBT-SC9707/7 TAG Reporting Rates: Taking Age Structure into Account Hearn W. S. and Polacheck T.

CCSBT-SC9707/18 Estimating SBT Age at Length During the Transition Period Hearn W. S. and Polacheck T.

CCSBT-SC9707/19 Applying General Linear Models to CPUE to Estimate Indices of SBT Abundance – 1997 Hearn W. S. and Polacheck T.

CCSBT-SC9707/20 Estimation of the Historical Catch and Its Age Distribution for Southern Bluefin Tuna Polacheck T., Preece A., Betlehem A., Klaer N. & Hearn W. S.

CCSBT-SC9707/21 Data Analysis of the Arial Surveys (1991-1997) for Juvenile Southern Bluefin Tuna in the Great Australian Bight. 1997 Cowling A., Millar C. & Polacheck T.

CCSBT-SC9707/23 Estimates of Current and Historical Stock Sizes for Use in the Evaluation of the Impact of Experimental Fishing Programs on the Southern Bluefin Tuna Population. 1997. Polacheck, T., Betlehem A. and Preece A.

CCSBT-SC9707/24 Documentation of The Virtual Population Analysis Methods and Model Inputs Used for Estimating of Current and Historical Stock Sizes of Southern Bluefin Tuna Population. Polacheck, T., Betlehem A. and Preece A.

CCSBT-SC9707/25 Trends in Catch, Effort and Nominal Catch Rates in the Japanese SBT Longline Fisheries. 1997. Betlehem, A. and Polacheck T.

CCSBT-SC9707/26 Updated Estimates of Mortality Rates for Juvenile SBT from Multi-year Tagging of Cohorts. 1997. Polacheck, T. Hearn W. S., Miller C., Whitelaw W. and Stanley C.

CCSBT-SC9707/27 The Influence of Environmental Factors and Mitigation Measures on By-catch Rates of Seabirds by Japanese Longline Fishing Vessels in the Australian Region Klaer N. and Polacheck T.

CCSBT-SC9707/28 Assessment of the Probability of Recovery Under Different Catch Scenarios and the Effect of Resolving Uncertainties in SBT Assessment Klaer N., Polacheck T., Precce A., Betlehem A. and Davis T.

CCSBT-SC9707/29 A Procedure for Assigning Output to VPA Results Based on Diagnostic Tests for the Tuning Indices Polacheck T., Haskard K., Klaer N., Preece A. and Betlehem A.

CCSBT-SC9707/30 A pilot study investigating the feasibility of routine sampling of SBT otoliths from the Australian domestic surface fisheries - the basis for routine estimation of the age structure of the Australian catch John Gunn, Bill Hearn and Kevin Williams

CCSBT-SC97/Inf5 The Direct Estimation of Age and Growth of Southern Bluefin Tuna Gunn J., Clear N., Rees T., Stanley C., Farley J. and Carter T.

CCSBT-SC97/Inf32 Reproductive dynamics of Southern Bluefin Tuna, *Thunnus maccoyii*, in the Indian Ocean south of the Sunda Islands J. Farley and T. Davis

4. Fourth meeting, 3-6 August 1998

CCSBT-SC9807/4	Australia's 1996-98 Southern Bluefin Tuna Fishing Seasons Robins, C.M., Caton, A.E., Ward, P.J., Williams, K.F.
CCSBT-SC9807/5	Size Partitioning by Depth of Southern Bluefin Tuna on the Spawning Grounds Davis, T.L.O., Farley, J.H., Bahar, S.
CCSBT-SC9807/6	Catch Monitoring of the Fresh Tuna Caught by the Bali-Based Longline Fishery Davis, T.L.O., Bahar, S., Naamin, N., Le, D.
CCSBT-SC9807/7	Report on Japanese/Australian Review of SBT Catch Monitoring in Bali, 8-10 January 1998 Davis, T.L.O.
CCSBT-SC9807/8	Data Analysis of the Aerial Surveys (1991-1998) for Juvenile Southern Bluefin Tuna in the Great Australian Bight Cowling, A., Millar, C.
CCSBT-SC9807/9	Otolith analyses suggest that the growth rate of juvenile SBT began to increase in the late 1970's and that growth rates have continued to increase through the 1980's and 1990's. Gunn, J., Farley, J.
CCSBT-SC9807/10	Spatial Analysis of Southern Bluefin Tuna Catch Per Unit Effort Data: A Best Linear Unbiased Predictor Approach Toscas, P., Thomas, M.
CCSBT-SC9807/11	Preliminary Estimates of the Size Distribution of SBT Caught by Taiwanese SBT Longliners in the Indian Ocean, Based on Data Collected From Transhipments in Mauritius, October 1997. Gunn, J., Farley, J.
CCSBT-SC9807/12	Sample of Otoliths from the Australian Surface fisheries and New Zealand Joint Venture Longline Fishery, and Transfer of CSIRO Methods for Estimating SBT Age to the Japan NRIFSF John, G., Farley, J., Clear, N.
CCSBT-SC9807/14	Observation of SBT catch monitoring survey conducted by CSIRO/BPPL (RIMF) in Benoa fishing port, Bali, Indonesia Nishida, T.
CCSBT-SC9807/17	Assessment of the Status of the Southern Bluefin Tuna Stock Using Virtual Population Analyses – 1998 T Polacheck, A Preece and Neil Klaer
CCSBT-SC9807/18	Spatio-Temporal Analysis of Southern Bluefin Tuna Catch Per Unit Effort Data Ellis, N., Thomas, M., Polacheck, T.
CCSBT-SC9807/19	Trends in Catch, Effort and Nominal Catch Rates in the Japanese SBT Longline Fisheries, 1998 Polacheck, T., Bailey, R.
CCSBT-SC9807/20	Updated Estimates of Mortality Rates for Juvenile SBT from Multi-Year Tagging Cohorts Polacheck, T., Hearn, B., Millar, C., Stanley, C.
CCSBT-SC9807/21	Applying General Linear Models to CPUE to Estimate Indices of SBT Abundance-1998 Hearn, W.S., Polacheck, T.
CCSBT-SC9807/36	Estimation of the Historical Catch and it's Age Distribution for Southern Bluefin Tuna Preece, A., Polacheck, T., Klaer, N., Hearn, B.
CCSBT-SC9807/37	Documentation of the Virtual Population Analysis Methods and Model Inputs used for Estimating Current and Historical Stock Sizes of Southern Bluefin Tuna: Updates and Modifications 1998 Polacheck, T., Preece, A.
CCSBT-SC9807/38	Southern Bluefin Tuna Stock and Recruitment Projections
CCSBT-SC9807/39	The Age Distribution and Relative Strength of Cohorts of SBT on the Spawning Grounds Gunn, J., Farley, J., Clear, N.
CCSBT-SC9807/40	Fishery Indicators for the SBT Stock: An update of 12 indicators first used in 1988 plus additional indicators from the 1990's Gunn, J., Polacheck, T., Davis, T., Klaer, N., Cowling, A., Farley, J., Caton, A., Williams, K., Hearn, W., Preece, A., Clear, N.
CCSBT-SC/9807/Inf 1	Treatment of Data and Model Uncertainties in the Assessment of Southern Bluefin Tuna Stocks Polacheck, T., Preece, A., Betlehem, A., Klaer, N.
CCSBT-SC/9807/Inf 2	A Proposed Index for Weighting Results in Catch at Age Models based on Diagnostic Tests for Lack of Fit Polacheck, T., Haskard, K.A., Klaer, N., Betlehem, A., Preece, A.

CCSBT-SC/9807/Inf 5 Verification document submitted to the CCSBT on 1/4/98 Preece, A., Takeuchi, Y.

CCSBT-SC/9807/Inf 6 Reproductive dynamics of southern bluefin tuna, *Thunnus maccoyii* Farley, J.H., Davis, T.L.O.

5. Fifth meeting, 19-24 March, 2001 Tokyo, Japan

CCSBT-SC/0103/5 Comments on Development of a Scientific Research Program for SBT

CCSBT-SC/0103/6. Exploratory analysis of the SBT CPUE data using smoothing spines

CCSBT-SC/0103/7. Size distribution of southern bluefin tuna (*Thunnus maccoyii*) with depth on their spawning grounds in the Indian Ocean

CCSBT-SC/0103/8. Estimating long-term growth rate change of southern bluefin tuna from two episodes of tag-return data

CCSBT-SC/0103/9. A flexible maximum likelihood approach for fitting growth curves to tag-recapture data

CCSBT-SC/0103/10. Exploratory and Descriptive Analyses of Catch, Effort and Size Data for Southern Bluefin Tuna from Japanese Longline Vessels

CCSBT-SC/0103/11. Development and Evaluation of Management Strategies for the Southern Bluefin Tuna Fishery

CCSBT-SC/0103/18. Preliminary Results from Combined Analyses of Direct Aging and Tag-Recapture Data for Estimating SBT Growth Curves

CCSBT-SC/0103/19 Effects of Observer Coverage in the Estimation of Reporting and Fishing Mortality Rates in Tagging Experiments

CCSBT-SC/0103/20 Real Time Monitoring Program

6. Sixth meeting, 28-31 August, 2001, Tokyo, Japan

CCSBT-SC/0108/8 Spatio-Temporal Analysis of Southern Bluefin Tuna Catch Per Unit Effort Data: A Best Linear Unbiased Predictor Approach. by P.J. Toscas1, W.N. Venables and T. Polacheck

CCSBT-SC/0108/9 Where to with Modelling CPUE? Tom Polacheck, Ann Preece, Dale Kolody

CCSBT-SC/0108/10 Modelling Catch and Effort in the Southern Bluefin Tuna Fishery. Peter J. Toscas, William N. Venables and Mervyn R. Thomas

CCSBT-SC/0108/11 Catch Monitoring of the Fresh Caught Tuna by the Bali-Based Longline Fishery. Tim Davis and S. Nurhakim

CCSBT-SC/0108/12 Length at Age Distribution of Southern Bluefin Tuna in the Indonesian Longline Catch on Spawning Grounds.

CCSBT-SC/0108/13 Application of a Statistical Catch-at-Age and -Length Integrated Analysis Model for the Assessment of Southern Bluefin Tuna Stock Dynamics 1951-2000. Dale Kolody and Tom Polacheck

CCSBT-SC/0108/14 The effects of using cohort slicing to estimate age distributions. Paige Eveson and Tom Polacheck.

CCSBT-SC/0108/15 Proposal for Conventional Tagging Program within the Scientific Research Program of the Commission for the Conservation of Southern Bluefin Tuna. Tom Polacheck, John Gunn, Clive Stanley.

CCSBT-SC/0108/16 Size and Age at 50% Maturity in SBT: An integrated view from published information and new data from the spawning ground. Tim Davis, Jessica Farley and John Gunn.

CCSBT-SC/0108/17 Taiwanese SBT catches and their size distribution in the Indian and Atlantic Oceans based on catch monitoring in Mauritius and Cape Town. Jessica Farley, Shui-Kai Chang, John Gunn.

CCSBT-SC/0108/18 The Status of Southern Bluefin Tuna Relative to Fishing Mortality Reference Points. Tom Polacheck and Neil Klaer.

CCSBT-SC/0108/19 An Integrated Statistical Time Series Assessment of the Southern Bluefin Tuna Stock based on Catch at Age Data. Tom Polacheck and Ann Preece.

CCSBT-SC/0108/20 Assessment of the Status of the Southern Bluefin Tuna Stock Using Virtual Population Analysis – 2001. Tom Polacheck, Ann Preece and Dan Ricard.

CCSBT-SC/0108/21 Summary of the primary data inputs to CSIRO's 2001 stock assessment models. A. Preece, T. Polacheck, D. Kolody, P. Eveson, D. Ricard, P. Jumppanen, J. Farley and T. Davis.

CCSBT-SC/0108/22 Trends in Catch, Effort and Nominal Catch Rates In the Japanese Longline Fishery for SBT. Tom Polacheck and Dan Ricard.

CCSBT-SC/0108/23 Southern Bluefin Stock and Recruitment Projections - Neil Klaer, Tom Polacheck, Ann Preece, Dale Kolody, Dan Ricard.

CCSBT-SC/0108/25 Fishery Indicators for the SBT Stock. John Gunn, Tom Polacheck. Ann Preece, Dan Ricard, Paige Eveson, Tim Davis, Jessica Farley, Neil Klaer, Dale Kolody

CCSBT-SC/0108/26 Some Comments on CPUE Tuning Indices in Response to Questions from External Scientists. Tom Polacheck, Dale Kolody and Ann Preece.

CCSBT-SC/0108/27 A Statistical Catch-at-Age/Length Integrated Model for Southern Bluefin Tuna Stock Assessment. Dale Kolody and Tom Polacheck

CCSBT-SC/0108/28 Australia's 1999-2000 and 2000-01 Southern Bluefin Tuna Fishing Season. J.L. Foster, C.M. Robins and A.E. Caton and K.F. Williams.

7. Seventh meeting, 9-11 September, 2002

(Papers not yet given a CCSBT Document number)

Catch Monitoring of the Fresh Tuna Caught By the Bali-Based Longline Fishery in 2001: T.L.O. Davis and Andamari, R.

Length and age distribution of SBT in the Indonesian longline catch on the spawning ground: Farley, J.H. and Davis, T.L.O.

Trends in Catch, Effort and Nominal Catch Rates In the Japanese Longline Fishery for SBT – an update: Daniel Ricard and Tom Polacheck.

A Review of Recent Trends in Southern Bluefin Tuna Fishery Indicators :Dale Kolody, Ann Preece, Tom Polacheck, Tim Davis, Jessica Farley, Clive Stanley and John Gunn.

Further exploration of biomass dynamics models for SBT stock assessment: Daniel Ricard, Dale Kolody and Marinelle Basson.

Progress on a Simulation Study to Evaluate Stock Assessment Models for Fisheries Resembling Southern Bluefin Tuna: Dale Kolody, Ann Preece, Daniel Ricard, Paavo Jumpannen, Tim Jones, Scott Cooper and Tom Polacheck.

Estimating a CPUE Series for SBT using Enhanced Tree-based modelling methods: Venables, W.N and Toscas, P.J.

Modelling Catch and Effort in the Southern Bluefin Tuna Fishery: Toscas, P.J., W.J. Venables, M.R Thomas and T. Polacheck.

A method for determining relative weighting factors for length-frequency data: J. Paige Eveson and Tom Polacheck.

Issues and process and observation models to be considered for the SBT fishery operating model used to evaluate management procedures: Dale Kolody, Tom Polacheck, Marinelle Basson and Ann Preece.

An integrated analysis of the growth rates of southern bluefin tuna for use in estimating catch at age in stock assessments (Main report and the Appendix 9, 10). Polacheck, T., G.M. Laslett and J.P. Eveson

A pilot study to examine the feasibility of tagging of mature SBT in the western Tasman Sea

Some Additional Runs of the Initial Operating Model for Southern Bluefin Tuna Management Procedure

Australia's 2000-01 Southern Bluefin Tuna Fishing Season: Hender, J. and Findlay, J.

Information papers

Spatio-temporal Trends of Longline Fishing Effort in the Southern Ocean and Implications for Seabird Bycatch: Geoff N. Tuck, Tom Polacheck and Cathy Bulman.

Application of an age-structured production model (ASPM) to the Indian Ocean bigeye tuna (*Thunnus obesus*) resource: Daniel Ricard and Marinelle Basson

Further considerations on the analysis and design of aerial surveys for juvenile SBT in the Great Australian Bight: Mark Bravington.

Commercial Aerial Spotting for Southern Bluefin Tuna in the Great Australian Bight by Fishing Season 1982-2000: Neil Klaer, A. Cowling and Tom Polacheck.

Aerial survey indices of abundance: comparison of estimates from line transect and "unit of spotting effort" survey approaches: Farley, J. and Bestley, S.

C. Papers presented to meetings of the CCSBT'S Ecologically Related Species Working Group 1995-2002

1. First meeting, 18-20 December 1995, Wellington, New Zealand

CCSBT-ERS/95/2 ANCA 1995: Status of the international review of shark conservation issues.

CCSBT-ERS/95/13 Brothers, N. 1991: Albatross mortality and associated bait loss in the Japanese Longline Fishery in the Southern Ocean. Biological Conservation 55: 255-268.

CCSBT-ERS/95/14 Brothers, N. 1993: A mechanised bait throwing machine for longline fisheries - performance assessment of a test machine. Tasmanian Department of Environment and Land Management Internal Report (unpublished).

CCSBT-ERS/95/15 Brothers, N. 1994: Principles of birdline construction and use to reduce bait loss and bird deaths during longline setting. CCAMLR WG-IMALF-94/19.

CCSBT-ERS/95/16 Brothers, N. 1994: Catching fish, not birds - a guide to improving your longline efficiency. (Draft English text for multi-lingual handbook for fishers.)

CCSBT-ERS/95/17 Brothers, N. 1995a: Catch fish, not birds: a guide to improving your longline efficiency (Information leaflet produced by the Parks and Wildlife Service, Hobart, Tasmania.)

CCSBT-ERS/95/18 Brothers, N. 1995b: An investigation into the causes of seabird mortality and solutions to this in the Spanish system of demersal longline fishing for Patagonian toothfish, *Dissostichus eleginoides*, in the South Atlantic Ocean. CCAMLR WG-FSA-95/58

CCSBT-ERS/95/19 Brothers, N. and Foster, A. 1995: Seabird catch rates: an assessment of causes and solutions in Australia's tuna longline fishery.

CCSBT-ERS/95/20 Brothers, N., Foster A., and Robertson, G. 1995: The influence of bait quality on the sink rate of bait used in the Japanese longline tuna fishing industry: an experimental approach. CCAMLR Science Vol 2: 123-129.

CCSBT-ERS/95/31 Gales, R. 1993: "Cooperative Mechanisms for the Conservation of Albatross". Australian Nature Conservation Agency Review. Tasmanian Government Printer, Hobart. 132 p

CCSBT-ERS/95/32 Gales R. and Brothers, N. 1995: Characteristics of seabirds caught in the Japanese tuna longline fishery in the Australian region.

CCSBT-ERS/95/33 Hedd, A., Gales, R., Brothers, N., and Robertson, G. 1995: Diving behaviour of shy albatrosses (*Diomedea cauta*) in Tasmania.

CCSBT-ERS/95/35 Klaer, N. and Polacheck, T. 1995a: Japanese longline seabird bycatch in the Australian fishing zone April 1991-March 1994: catch and catch rates by area and evaluation of the effectiveness of mitigation measures. CSIRO Division of Fisheries Report. Hobart, Tasmania. 95 p.

CCSBT-ERS/95/36 Klaer, N. and Polacheck, T. 1995b: By-catch of albatrosses and other seabirds by Japanese longliners fishing in the Australian fishing zone from April 1994 to March 1995.

CCSBT-ERS/95/39 Pemberton, D., Brothers, N., and Gales, R. 1995: The significance of investigating hook sinking rates to seabird mortality and fishing efficiency in the longline fisheries for tuna. (Draft document.)

CCSBT-ERS/95/40 Polacheck, T. 1995: Summary tables of available information on seabird bycatch by Australian tuna longline vessels.

CCSBT-ERS/95/41 Polacheck, T. and Betlehem, A. 1995: Recent information related to seabird bycatch on the high seas.

CCSBT-ERS/95/42 Polacheck, T. and Tuck G. 1995: Trends in tuna longline fisheries in the southern oceans and implications for seabird bycatch.

CCSBT-ERS/95/44 Tuck, G. and Polacheck, T. 1995: A modelling framework for assessing the impact of fishery by-catches on albatross populations. CCSBT-ERS/95/46 Whitelaw, W. 1995: Some observations on seabird bycatch by Australian tuna longline fishing vessels.

CCSBT-ERS/95/47 Young, J. W., Lamb, T., and Whitelaw, W. 1995: Feeding ecology and interannual variation in diet of southern bluefin tuna (*Thunnus maccoyii*) from coastal and oceanic waters of eastern Tasmania.

2. Second meeting, 3-6 June 1997

Final Report on CSL Project No 95/9004 - Development of an underwater setting method for surface longliners, to minimise the accidental capture of seabirds.

CSL Contract 95/3004, part of 1995/96 CSL Project CSL 2A - An underwater setting method for surface longliners, to minimise the accidental / incidental capture of seabirds.

Klaer, N., Polacheck, T. (1997). The Influence of environmental factors and mitigation measures on bycatch rates of seabirds by Japanese longline fishing vessels in the Australian region.

Klaer, N., Polacheck, T. (1997). Japanese longline seabird bycatch in the Australian fishing zone April 1995 - March 1997.

Tuck, G., Betlehem, A., Polacheck, T. (1997). Recent information related to seabird bycatch on high seas: 1997 update.

Tuck, G., Polacheck, T. (1997). Trends in tuna longline fisheries in the southern oceans and implications for seabird bycatch: 1997 update.

Whitelaw, W. (1997). Some observation on seabird bycatch from Australian longline fishing vessels: 1994 - 1996.

3. Third meeting, 9-12 June 1998

Croxall, J.P. & Gales, R. in press. An assessment of the conservation status of albatrosses. In Albatross: Biology and Conservation; eds G. Robertson and R. Gales. Surrey Beatty and Sons, Chipping Norton.

Gales, R. in press. Albatross populations: status and threats. In Albatross: Biology and Conservation; eds G. Robertson and R. Gales. Surrey Beatty and Sons, Chipping Norton.

Stevens, J. Shark bycatch in tuna fisheries, with particular reference to the longline fishery for southern bluefin tuna (*Thunnus maccoyii*).

Brothers, N., Gales, R. & Reid, T. in press. The influence of environmental variables and mitigation measures on seabird catch rates in the Japanese tuna longline fishery within the Australian Fishing Zone, 1991-1995. Biological Conservation.

Brothers, N. Gales, R & Reid, T. in press. Seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988-1996 trends. Wildlife Report Series.

Brothers, N., Gales, R. Hedd, A. & Robertson, G. in press. Foraging movement of the shy albatross *Diomedea cauta* breeding in Australia: implications for interactions with longline fisheries. Ibis.

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Polacheck T, Methodological Limitations in the Current SBT Assessment Model and Suggested Improvements

Polacheck T and Eveson P, Comparison of Direct Aging Estimates with Those for Cohort Slicing for Southern Bluefin Tuna

Polacheck T, Suggested Guidelines for the Incorporation of New Information and Methods into SBT Stock Assessments

2. Scientific meeting for the development of an SRP for the CCSBT and overview of progress on stock assessment, 12-15 November 2000

Identified differences in projection methods

Tagging proposal for SBT fisheries – high seas and in zones

Development of SBT Scientific Research Program including a Scientific Fishing Component by the CCSBT External Scientists

Discussion Paper on the Design and Implementation of an Experimental Fishing Program for Southern Bluefin Tuna

3. First meeting of the Management Procedure workshop, 3-4 & 6-8 March 2002

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4. CPUE Modelling Workshop

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CCSBT-CPUE/0203/Info4	Trends in Catch, effort and nominal catch rates in the Japanese longline fishery for SBT. CCSBT-SC/0108/22
CCSBT-CPUE/0203/Info5	Exploratory and descriptive analyses of catch, effort and size data for southern bluefin tuna from Japanese longline vessels. CCSBT-SC/0103/10
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5. Tagging Program Workshop 2-4 October 2001, Canberra, Australia

CCSBT-TAG/0110/4	An update of qualitative results on southern bluefin tune movements from the 1990's CSRIO/NRIFSF Tagging program. RMWS/99/9. : Preece, A, and T. Polacheck. 1999.
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6. Meetings of the Experimental Fishing Program Working Group, 1999

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Implication of the Geo-statistical model in terms of a constant R being conservative.

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2. Documents/papers presented to Recruitment Monitoring Workshops 1993 - 2001

1. 1993 Recruitment Monitoring Workshop

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Stanley, C.A., Williams, K. and Whitelaw, W Summary of CSIRO/JAMARC SBT tagging operations 1992/93

Whitlelaw, W. Tag and sample recovery from the 1990-1996 CSIRO/JAMARC tagging program

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2. 1994 Recruitment Monitoring Workshop

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- Summary of SBT tagging operations 1995/96
- Tag and sample recovery from the 1990-1996 CSIRO/NRIFSF tagging program
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- Preliminary comparison of the growth rates of SBT in the 1990s compared with those in the 1980s and 1990s
- Data analysis of the aerial surveys (1991-1996) for juvenile SBT in the GAB
- The application of archival tags to study SBT migration, behaviour and physiology: progress report 1995/96
- Integrated Spatial analysis of SBT distribution and movements

4. 1996 Recruitment Monitoring Workshop

5. 1997 Recruitment Monitoring Workshop

- Tagging operations for 1990-97 CSIRO/NRISF Tagging program
- Tag and sample recovery from 1990-97 CSIRO/NRISF Tagging program
- Preliminary qualitative results on SBT movements from the 1990-1997 CSIRO/NRIFSF Tagging programs
- Preliminary comparison of the growth rates of SBT in the 1990s with those in the 1960s and 1980s
- Data analysis of the aerial surveys (1991-1997) for juvenile SBT in the GAB
- Report on the Archival Tag project report for 1996/97

- Integrated spatial analysis and GIS
- SBT recruitment monitoring and tagging program – workshop report 1999

6. 1998 Recruitment Monitoring Workshop

- Tag and sample recovery from the 1990-98 CSIRO/NRISF Tagging program
- Preliminary quantitative results on SBT movements from the 1990s CSIRO/NRIFSF Tagging programs
- Preliminary comparison of the growth rates of SBT in the 1990s with those in the 1960s and 1980s
- Data analysis of the aerial surveys (1991-1998) for juvenile SBT in the GAB
- Updated estimates of mortality rates for juvenile SBT from multi-year tagging cohorts
- Report on the Archival Tag project report for 1997/98
- Report on Integrated spatial analysis and GIS
- SBT recruitment monitoring and tagging program – workshop report 1999

7. 1999 Recruitment Monitoring Workshop

- Tag and sample recovery from the 1990-99 CSIRO/NRISF Tagging program (RMWS/99/2)
- An update of qualitative results on SBT movements from the 1990s CSIRO/NRIFSF Tagging programs
- An update of comparison of the growth rates of SBT in the 1990s with those in the 1960s and 1980s
- Data analysis of the aerial surveys (1993-1998) for juvenile SBT in the GAB
- Background to review of Aerial survey: 3rd draft
- 1998/99 Archival Tag project report
- Progress report 1999 Integrated analysis: a basis for improved annual estimates of SBT recruitment to the GAB
- SBT recruitment monitoring and tagging program – workshop report 1999
- Aerial survey design workshop report 1999

8. 2000 Recruitment Monitoring Workshop

- Report of the Aerial survey: Workshop, Port Lincoln Feb. 2000
- Data analysis of the aerial surveys (1993-2000) for juvenile SBT in the GAB
- Tag and sample recovery from the 1990-2000 CSIRO/NRISF Tagging program (RMWS/99/2)
- 1999-2000 Archival Tag project report
- 1999-2000 Integrated analysis: project report
- Relationships between SBT and Topography in the GAB
- Relationships between SBT and the Environment at topographical features in the GAB

- Surface 0riented behaviour for juvenile SBT in the GAB, and the impact of environment on surfacing rates

9. 2001 Recruitment Monitoring Workshop

RMWA/01/1Cowling, A.M. Further Data analyses of the aerial surveys (1993-2000) for Juvenile SBT in the GAB

RMWS/01/2Cowling AM Issues in the design and implementation of an aerial survey of a pelagic species

RMWS/01/4Gunn, JS and Patterson, T Archival Tagging of juvenile SBT in the GAB – update on 2000-01 field work and analyses

RMWS/01/3Stanley, C Tag and Sample recovery from the 1990-2002 CSIRO/NRIFSF Tagging Program

RMWS/01/6Hobday. A The influence of topography and environment on presence of juvenile SBT in the GAB

O'Reilly, J, A. Hobday , J. Gunn, A Cowling Surfacing behaviour of juvenile SBT in the GAB

RMWS/01/5 A. Hobday Determination of SBT residence time via acoustic monitoring along the southern WA Coast

Surfacing Behaviour of Juvenile SBT, *Thunnus maccoyii*, in the Great Australian Bight

Appendix 4 – Project costs

SBT research projects 1985 - 2002

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1984/56	CSIRO	Study of the reproductive biology of the SBT (*Thunnus maccoyii* (Castelnau)) off the east coast of Australia	BLH	32275														
1984/71	CSIRO	Direct otolith ageing of SBT *Thunnus maccoyii* (Castelnau) exploited by the Australian fishery	BLH	82528														
1985/17	Ulladulla Fishermens' Co-op.	Demonstration of the viability of a fishery for SBT and big eye tuna for the fresh sashimi market	EMC	115000														
1985/76	CSIRO	Otolith age determination of mature SBT	BLH	28470														
1986/111	Tas Fisheries & Aust. Tuna Fisheries Pty Ltd	Establish the viability of a longline SBT operation based in Tasmania and establish a quality control mechanism for the Australian longline industry	EMC	87800														
1986/52	BAE	Assessing the effectiveness of the SBT management scheme and its effect on those involved in the industry at the time of its introduction	EMC	62017														

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1987/113	CSIRO	Tag lottery for SBT	EMC	4710														
1987/15	CSIRO	Determination of the migration patterns of juvenile SBT and Jackass Morwong	BLH	172649								165703						
1988	BRR	A preliminary review of the 1987-88 Australian SBT season	EMC										100000					
1989	BRR	The 1988-89 Australian SBT season	EMC										100000					
1989/30	CSIRO	Age determination and assessment of variation in length at age of large SBT by means of analysis of otolith and vertebral chemical composition	BLH	186853								211440						
1989	BRR	Aerial survey pilot study	SA	59000														
1990	BRR	SBT: scientific background to the debate	EMC										20000					
1990	BRR	The 1989-90 Australian SBT season	EMC										100000					

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1990	ABARE	The value to Japan of access to the Australian Fishing Zone	EMC											Unknown				
1990	CSIRO	SBT sampling in Indonesia 1990/91	SA															8300
1990	CSIRO	Analysis of Shoyo Maru larval samples	BLH															35500
1990	CSIRO	Tagging of SBT in 1990/91	SA															213900
1990	CSIRO	Analysis of length frequency data	SA															28800
1990	CSIRO	Analysis of CPUE of WA surface fishery	SA															113700
1990	CSIRO	Frequency of spawning of SBT	BLH															55800
1990	CSIRO	Migration routes of SBT	BLH															15300

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1990	CSIRO	Conventional age determination for SBT	BLH															10400
1990	BRR	Scientific monitoring of fishing[4]	SA															102450
1990	BRR	Aerial survey pilot study	SA	59333														
1991	BRR	Feasibility of CPUE-based SBT abundance indices: identification and documentation of data held in WA	SA															Unknown
1991	La Trobe Uni.	Optimal Australian and Japanese harvesting of SBT	EMC															Unknown
1991	AFMA	Improved stock assessment of SBT	SA		88000													
1991	AFMA	Spawning strategy of SBT from catch monitoring off Indonesia	SA		123000													
1991	AFMA	Consolidation of SBT database	SA		80000													
1991	BRR	Scientific monitoring of fishing[4]	SA		115400													

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1992/031	CSIRO	Genetic analysis of the spatial structure within the SBT population	BLH	148967								320073						
1992/042	CSIRO	The direct estimation of age and growth of SBT	BLH	262260								514072						
1992/0437	WW Fisheries	Australia wide SBT fishery monitoring program 1992/93 and Eastern sector 1992/93 & 1993/94	SA						146300									
1992	AFMA	Spawning strategy of SBT from catch monitoring off Indonesia	SA		101800													
1992	BRS	Scientific monitoring of fishing[4]	EMC		349000													
1992	BRS	Status of Australian fisheries[4]	EMC		17382								10255					
1993/0058	CSIRO	Development of a fishery independent index for juvenile SBT 1992/93	SA		88000				34200			14400					59000	
1993/0060	CSIRO	Ultrasonic tagging to determine surfacing behaviour of SBT	BLH						32500									
1993/0061	CSIRO	Support for the high seas real time monitoring program 1991/92 - 1994/95	SA						67445			42438						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1993/0062	CSIRO	Japanese speaking liaison personnel to visit longline vessels in Sydney, Brisbane and Capetown	EMC						16000			86400						
1993/0063	CSIRO	Recruitment monitoring program 1993/94	SA						211800									
1993/0063	CSIRO	Support for the AFZ observer program 1991/92 - 1994/95[4]	LES					3975	19140			13909						
1993/0064	CSIRO	Research industry management liaison	LES						21000									
1993/0065	Unisearch	Japanese tuna fisheries to the year 2000[4]	EMC						17500									
1993/077	CSIRO	Quantitative interpretation of fine-scale catch -per-unit-effort for SBT off south eastern Australia	EMC	290692								1360981						136000
1993/109	ANU	Use of bomb radiocarbon chronometer to validate fish age[4]	BLH	12169														17145
1993	CSIRO	SBT assessment/meetings	SA		62000							264200						
1993	CSIRO	Recruitment monitoring program 1993/94	SA						123000			192400					629100	

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1993	AFMA	Consolidated SBT database	SA		90000							73800						
1993	AFMA	Monitoring SBT catches off Indonesia	SA		110000							19800						
1993	BRS	Scientific monitoring of fisheries[4]	SA		159500													
1993	BRS	Status of Australian fisheries[4]	EMC		14940								8815					
1994	ABARE	Use of individual transferable quotas in Australian fisheries	EMC											Unknown				
1994	ABARE	Benefits and costs of the venture agreement in the SBT industry	EMC											Unknown				
1994/149	CSIRO	Development of a fishery independent index of abundance for juvenile SBT	SA	53350								38000						325800
1994/150	CSIRO	Development of a database network for use in the assessment of the SBT fishery	SA	76650	90000							95000						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1994	BRS	Development of comprehensive and integrated methods for including key uncertainties in the management advice for the SBT fishery	EMC		52512													
1995	BRS	Status of Australian fisheries[4]	EMC		16577								9780					
1995	ADFA	Japan tuna fisheries[4]	EMC						20000									
1995/0096	CSIRO	An archival hard part collection - a basis for routine ageing of SBT 1993/94 & 1994/95	BLH						38400			30400						
1995/0386	CSIRO	A population modelling assessment of the effects of longline on seabird populations[4]	ERS						7500									
1995/0387	SARDI	Non destructive biomass estimation devices	EMC						10000									
1995/0460	TPWS	Status and conservation of albatross and their interactions with fisheries[4]	ERS					6750								7500		
1995/1012	Unitas	Trends in tuna fisheries; the republic of Korea and Taiwan consultancy proposal[4]	EMC		19351			20000										19351

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1995/1014	WW Fisheries	Fishery monitoring program for the eastern sector of the Australian fishery 1993/94 - 1996/97	SA						198300									
1995	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 1995/96	SA		60300													
1995	CSIRO	Scientific support for policy development and implementation for the CCSBT	EMC		54880													
1995	ABARE	Alternative methods for determining appropriate bilateral access fees	EMC		69741													
1995	BRS	Status of Australian fisheries[4]	EMC		18000								10620					
1995	BRS	Effects of fishing on non-target species 1995/96 and 1996/97[4]	ERS		40485													
1996/0212	CSIRO	SBT stock assessment 1995/96	SA				147630					147160						
1996/0448	CSIRO	SBT recruitment monitoring program 1995/96	SA		90000				111600								465000	
1996/0493	CSIRO	Age distribution of mature SBT on the NE Indian Ocean spawning grounds.	BLH						15000			8034						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1996/0593	TPWS	Seabird longline interactions[4]	ERS				7500											24543
1996/0772	CSIRO	SBT recruitment monitoring 1996/97	SA	175036				191960									465000	
1996/0827	CSIRO	Industry management workshop publication	EMC						19526			25000						
1996	BRS	Status of Australian fisheries[4]	EMC		18000								10620					
1997/4157	CSIRO	Scientific support for policy development and implementation for the CCSBT	EMC		199978													
1997/9633	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 1997/98	SA		74980							29508						
1997/0166	CSIRO	Monitoring the longline catch of SBT landed in Indonesia and Taiwan 1996/97	SA				75299					17971						
1997/0167	CSIRO	SBT stock assessment	SA				161364					165046						
1997/0401	CSIRO	The effects of longlining on seabird populations: by catch estimation and population modelling assessment[4]	ERS					4486				1294						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1997/111	CSIRO	Catch-at-age, age at first spawning, historical changes in growth, and natural mortality of SBT: an independent study of key uncertainties	BLH	211338								209991						
1997/1423	WW Fisheries	SBT fishery monitoring program for the eastern sector of the Australian fishery 1997/98	SA						79800									
1997/1466	TPWS	Albatross longline interaction - seabird interactions with longline fishing in the AFZ: 1996 seabird mortality estimates and 1988-1996 trends[4]	ERS				2250									1800		
1997/1481	CSIRO	The effects of longlining on seabird population: by catch estimation, archival tagging & population modelling assessment[4]	ERS					1340										
1997/1483	CSIRO	SBT recruitment monitoring	SA	178892				136748				173565					388888	
1997/1484	CSIRO	Archival hard part collection - a basis for routine ageing of tuna & billfish 1998/99[4]	BLH						8436	8435		17952						
1997/1491	TPWS	Construction & evaluation of underwater setting device to prevent accidental capture of seabirds[4]	ERS					4140										1080
1997	CSIRO	SBT Scientific quotas						32446										

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1997	BRS	Foreign longline data: its quality and relevance to stock assessment	SA		42400													
1997	BRS	Status of Australian fisheries[4]	EMC		19404								11448					
1997	BRS	Scientific support for the development of international policy for Commonwealth fisheries 1998[4]	EMC		51030								30618					
1998/0009	CSIRO	Assessment of acoustics as a research tool to determine the distribution, biomass and behaviour of SBT schools and their prey in the GAB	BLH						53252									
1998/0700	CSIRO	Development of a design and implementation program for a fisheries observer program to monitor seabird bycatch rates in domestic longline fisheries[4]	ERS					1688										
1998/1350	WW Fisheries	SBT monitoring program for the eastern sector of the Australian fishery 1998/99	SA						55000									
1998/9684	ABARE/DEST	SBT conservation and trade	EMC		132231											10000		
1998	CSIRO	SBT FAG 1998/99	SA				185992											

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1999/0024	TPWS	Seabird by-catch assessment in the AFZ & further mitigation measure development for longline fisheries[4]	ERS					1391										
1999/0025	TPWS	Training video for longline fishermen[4]	EMC					1063										
1999/0171	CSIRO	Archival hard part collection - a basis for routine ageing of tuna & billfish 1999/2000[4]	BLH					16551				18977						
1999/0172	CSIRO	SBT recruitment monitoring program 1998/99	SA	185027					166685			179136					207317	
1999/0376 & 1498	CSIRO	Evaluate a surface abundance index based on commercial spotting data for juvenile SBT in the GAB	SA						48318			12648						
1999/104	CSIRO	An integrated analysis of the growth rates of SBT	SA	154400								158608						
1999/105	CSIRO	Improved fishery independent estimates of SBT recruitment through integration of environmental, archival tag and aerial survey data	SA	141152								136731						122949
1999/106	CSIRO	Size at first maturity and recruitment into egg production of SBT	BLH	146094								87560						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1999/1496	CSIRO	SBT recruitment monitoring program 1999/00	SA	78200					199607			165827					356140	
1999/1497	CSIRO	Archival hard part collection: a basis fo routine ageing of tuna and billfish 2000/01[4]	BLH						8101	12152		14784						
1999/1499	CSIRO	A pilot study to examine the potential for using pop up satellite transmitting archival tags	SA						26904		15000	11160						
1999/1655	WW Fisheries	SBT fishery monitoring program	SA						5000									
1999/2172	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 1998/99	SA		69890							25657						
1999/2174	BRS	Status of Australian fisheries[4]	EMC		15946								7133					
1999/2177	CSIRO	Examining Taiwanese fishing activities and catches of SBT	SA		37882							9586						
1999/5384	CSIRO	SBT research/industry/management workshop	LEC		18392			25093										
1999/7045	BRS	Scientific support for the development of international policy for Commonwealth fisheries 1999[4]	EMC		28980								17388					

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
1999/7580	CSIRO	Monitoring Chinese Taipei fishing activities and catches of SBT in the Indian and Atlantic Oceans during 1999-2000	SA		46629							10913						
1999/2000	CSIRO	SBT FAG 1999/2000	SA				186555											
2000	FAB et al	Indonesian/Australian workshop on shark and tuna including SBT	EMC															11531
2000/10710	Dominion Consulting/ABARE	Conservation and optimum utilisation of SBT	EMC		183850									20000				
2000/10827	BRS	Status of Australian fisheries[4]	SA		18699								7490					
2000/10833	BRS	Scientific support for the development of international policy for Commonwealth fisheries[4]	EMC		50540								85610					
2000/1181	University of WA	Validation of accuracy of measurement of SBT	EMC						59561									
2000/1182	CSIRO	SBT recruitment monitoring program 2000/01	SA						194743			314376					357235	
2000/336	CSIRO	SBT FAG 2000/01	SA				191573					238685						

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
2000/406	Protec Marine Pty Ltd	Collection of SBT otolith and length data by Protec Marine for archiving by CSIRO	BLH						9200									
2000/469	Nigel Brothers	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries[4]	ERS					1103			113					1285		
2000/773	CSIRO	Archival hard part collection - a basis for routine ageing of tuna and billfish[4]	BLH						9782	9781								
2000/786	CSIRO	Determining the feasibility of using pop-up satellite archival tags to determine the movement and habitat preferences of adult SBT	SA						85808		55000	20298						
2000/833 & 2001/2138	CSIRO	Evaluation of complex population models used for the assessment and management of migratory fish stocks[4]	SA		97579				45000			105938						
2000/983	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 1999/2000	SA		92831							12653						
2001/0254	Nigel Brothers	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries[4]	ERS					800		247	247							

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
2001/0600	Nigel Brothers	A scientific appraisal of the suitability of underwater setting chute technology as a seabird mitigation measure for Australian tuna longline fisheries[4]	ERS		2188													
2001/0934	CSIRO	Ecological risk assessment for Commonwealth fisheries[4]	EMC												29884			
2001/0999	CSIRO	Best practice reference points for fisheries[4]	EMC									3601			2275	1500		
2001/1144	CSIRO	SBT FAG 2001/02	SA				196907					382150						
2001/1158	CSIRO	Archival hard part collection - a basis for routine ageing of tuna and billfish[4]	BLH						10536	10536		5610						
2001/1298	CSIRO	SBT recruitment monitoring program 2001/02	SA						189980			300261					352627	
2001/1299	University of WA	Stereo video - the validation of the accuracy and precision of length measurements of SBT	EMC				112900											40000
2001/1300	WW fisheries	SBT size monitoring for NSW longline fishery 2002/03	SA						6000									

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
2001/2190	BRS	Scientific support for emergent international priorities (2001)[4]	EMC		162400								97790					
2001/2192	BRS	Status of Australian fisheries[4]	EMC		21495								18291					
2001/2194	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 2000/2001-2001/2002	SA		108141	38167						67333						
2001/2197	CSIRO	The nature of SBT bycatch in the ETBF and determining the extent of mortality in SBT released alive: an integrated research and monitoring program	EMC		50000	91342			21209	120183	150000	64485						
2001	CSIRO	Juvenile SBT Tagging	SA															
2001	CSIRO	CCSBT tagging program[5]	SA															202696
2002/0067	CSIRO	SBT FAG 2002/03	SA				153607					245285						51202
2002/0163	CSIRO	CCSBT tagging for SBT[6]	SA			100000			150000						100000			
2002/4774	CSIRO	Monitoring the longline catch of SBT landed in Indonesia 2002-2003	SA		40000	55573						49990						155326

Number/ Year	Research by	Title	Cat.[2]	Funding ($, nominal)														
				FRDC[1]	FRRF	SRP[6]	ARF	Bi-lat	SBT MIRF[3]	Other MIRF	Industry	CSIRO	BRS	ABARE	AFMA Reserve	EA	Foreign	Other
2002	CSIRO	SBT Recruitment Monitoring	SA						199269			213565						300,865
TOTAL				3,004,862	3,494,332	285,082	1,421,577	449,534	2,741,401	161,333	220,360	7,349,353	645,858	20,000	132,159	22,085	3,280,307	1,992,638

1. Projects funded prior to 1992/93 were funded by the Fishing Industry Research and Development Council

2. Key to Categories: Biology/Life history (BLH) Ecologically related species (ERS); Economics/management/communication (EMC); Stock assessment (SA)

3. SBTMAC had established a separate research fund prior to the formal establishment of MIRFs in most other fisheries. The term SBTMIRF has been used to describe research funds contributed by the SBT industry throughout the review period.

4. Funding represents partial attribution to SBT

5. Funds from CCSBT SRP

6. Funds from Australia's SRP funds administered by AFFA

Appendix 5 – Research priorities

A. Southern Bluefin Tuna Management Advisory Committee Research Priorities for 2003-2004[31]

1. Assessment and Management

Priority 1: Catch and effort data collection system

- Maintain, improve and validate the catch, length, weight, effort data and bycatch in all fisheries catching SBT (both commercial and recreational) with regard to the relative impacts of different fisheries
- Provide qualitative information from the domestic fishery on fishery development and recruitment trends
- Monitor fish going into farms
- Provide information on discards
- Maintain an updated integrated SBT database required for stock assessments and related analyses
- Develop and maintain systems for sampling of otoliths and routine ageing of all components of the commercial catch

Priority 2: Provision of SBT stock assessment for CCSBT

- CPUE standardisation and interpretation
- Population assessment
- Stock projections
- Management strategy/procedure development and evaluation - particularly the development and evaluation of decision rules
- Evaluation of biological reference points for SBT management
- Develop and apply objective methods for weighting alternative hypotheses and models for uncertainties in stock assessment
- Collaborative analysis of Japanese fine scale catch and effort data

Priority 3: Monitoring and biological sampling of the Indonesian, Taiwanese and Korean SBT catch

- Understanding Indonesian fishery development and obtain catch/effort, size and otolith data
- Obtaining samples for research on SBT spawning strategy
- Develop collaborative sampling of SBT catch of Taiwanese, Korean and other fleets
- Development of sampling and survey capacity on spawning grounds

Priority 4: Support of the collaborative Australia/Japan research project to develop a fishery independent index of abundance for young SBT

- Aerial survey off South Australia as an indicator and/or as a quantitative measure of recruitment trends
- Conventional tagging to determine movements, growth, natural mortality and fishing mortality rates
- Archival tagging to determine movements, behaviour
- Acoustic survey
- Integrated analyses (combining sighting, environmental and behavioural data)
- Liaison and promotion to facilitate tag recovery
- Evaluation of Japan's acoustic survey and its potential to provide a recruitment index

[31] www.afma.gov.au

Priority 5: Analysis, design and evaluation of tagging programs for improving the SBT stock assessment

Priority 6: Determination of SBT biological parameters needed for the SBT stock assessment

- Determination of the age of maturity including determination of the age composition of fish on the spawning grounds
- Determination of the current and historical age/length relationship to use in the stock assessments
- Estimation of natural mortality rates

Priority 7: Spatial dynamics of SBT and implication for assessment and management, including the use of pop-up archival tags

Priority 8: Domestic science/industry/management/conservation groups workshop

- Hold a meeting of researchers, industry and managers
- Exchange of views, information, plans and results

Priority 9: Role of SBT in GAB ecosystem

- Interaction of SBT and predator/prey species

Priority 10: International Stakeholder Liaison

- Re-institute previous liaison meetings between international stakeholders
- Develop and distribute material in appropriate languages (Japanese, English, Korean, Taiwanese, Indonesian) describing and providing information on recent advances in SBT

2. Collaborative Research Programs

The following ERS related priorities have been identified separately due to the ongoing reduction of longlining in the SBT fishery associated with the very high proportion of catch being purse seined for use in tuna farms. SBTMAC acknowledges, however, that while any longlining for SBT occurs there is concern for its impact on ERS and is prepared to consider collaborative ERS projects with the other tuna fisheries, namely the Eastern and the Southern and Western Tuna and Billfish Fisheries. Other relevant ERS priorities have been included in the principle set given above.

Priority 1: Assessment of the level of bycatch in the AFZ, including seabirds, sharks and other species

Priority 2: Development and assessment of mitigation measures to avoid seabird bycatch including assessing the implications for fishers and promoting adoption where appropriate

- night setting
- line weighting
- bird scaring lines
- underwater setting
- artificial baits/lures

Priority 3: Population assessment and modelling of impacts of seabird and shark interactions

B– Priority areas of the CCSBT Scientific Research Program[32]

1. Characterisation of the SBT catch

Characterisation of the SBT catch taken by all fleets is fundamental to the stock assessment process. The information that should be collected to characterise the SBT catch includes:

A. Longline fisheries

1. Details of effort, including:

- Number of hooks set
- Position of set and haul
- Date and time of set and haul

2. Details of the catch, including:

- Catch composition (number and length or weight for SBT, other tuna and tuna like species)
- Catch retained and discarded

3. Length, weight, sex and other biological data for SBT

4. Otoliths of SBT for age determination

5. Any tags recovered

6. Environmental data that may influence SBT CPUE (sea surface temperature, wind direction and speed, etc.)

B. Purse seine fisheries

1. Details of effort, including:

- Size of net (length and depth)
- Position of haul
- Date and time of set and haul
- Utilization of any spotting devices including aerial spotters
- Information on schools spotted (number of schools, school size, etc.)

2. Details of the catch, including:

- Catch composition (number and length or weight for SBT, other tuna and tuna like species)
- Catch retained and discarded
- Number and weight of dead fish during fishing activity
- Number and weight of dead fish during towing process to cages

3. Length, weight, sex and other biological data for the SBT at time of capture

4. Otoliths of SBT for age determination

5. Any tags recovered

[32] CCSBT Scientific Committee (2001) Report of the Scientific Committee to CCSBT on the Scientific Research Program, Fifth Annual Meeting, 18-21 April 2001

6. Environmental data that may influence SBT CPUE (sea surface temperature, wind direction and speed, etc.)

C. Pole and line fishery

1. Details of effort, including:

- Number of poles (automatic and manual)
- Position at start and end of poling activity
- Date and time of start and end of poling activity
- Utilization of any spotting devices including aerial spotters
- Information of schools spotted (number of schools, size of schools, etc.)

2. Details of the catch, including:

- Catch composition (number and length or weight for SBT, other tuna and tuna like species)
- Catch retained and discarded

3. Length, weight, sex and other biological data for SBT

4. Otoliths of SBT for age determination

5. Any tags recovered

6. Environmental data that may influence SBT CPUE (sea surface temperature, wind direction and speed, etc.)

D. Other fisheries (e.g. Trolling, handlining, etc.)

1. Details of effort, including:

- Number of hooks set or appropriate effort measure
- Position at start and end of fishing activity
- Date and time of start and end of fishing activity

2. Details of the catch, including:

- Catch composition (number and length or weight for SBT, other tuna and tuna like species)
- Catch retained and discarded
- Time of catch

3. Length, weight, sex and other biological data for SBT

4. Otoliths of SBT for age determination

5. Any tags recovered

6. Environmental data that may influence SBT CPUE (sea surface temperature, wind direction and speed, etc.)

Programs to collect this information to characterise the catch should comprise a combination of the following approaches:

1. Reporting of information on catch and effort by the fishing fleet using a logbook system

2. Monitoring and sampling of landings by port samplers

3. Monitoring and sampling of catches at sea by scientific observers

4. Verification procedures through mechanisms such as the Trade Information Scheme

There is obvious overlap between this component of the proposed SRP and some of the other proposed components, such as the scientific observer program. The following guidelines should govern the collection of these data

1. Member countries will be responsible for collection of these data for their own flag vessels.

2. CCSBT shall prepare quality standards for the data that are collected

3. The CCSBT data manager shall work with member countries to assure that the data collected by member countries is integrated into the CCSBT database with the spatial resolution of the data transmitted to CCSBT determined by agreement.

4. Where existing bi-lateral agreements with non-member countries exist for collection of catch data, the data obtained from these bi-lateral agreements shall be transmitted to the CCSBT data manager for integration into the CCSBT data base so long as this is within the framework of the bi-lateral agreement. If the bi-lateral agreement does not permit transmission to other parties every effort should be made to develop such an arrangement.

5. Where there are no existing arrangements for determination of catch from a non-member state, the CCSBT Secretariat shall take a lead role in securing such data collection.

6. The CCSBT data manager shall take responsibility for assembly and maintenance of data regarding non-member catch.

7. National confidentiality requirements may limit the detail of data transmitted to CCSBT, and CCSBT will need to develop confidentiality protocols for release of data stored by CCSBT.

2. CPUE Interpretation and Analysis

The general objective of CPUE Interpretation and Analyses is to reduce the uncertainty in historical trend in stock size and thus the uncertainty in current assessments, and to provide a reliable index to monitor future trends in stock size to be used as a part of a decision rule to set TAC.

Experimental Fishing Programs conducted in the past were conceived in the context of the two extreme interpretations of CPUE trends represented by the Constant –square (CS) and the Variable-square (VS) models. The data available indicate that the VS interpretation of CPUE trends is not valid; there are many fish in areas not now being fished by Japanese longliners. This is demonstrated, at a large spatial scale, by the distribution of effort by other parties and, at a local scale, by results of past Experimental Fishing Programs. One potential problem with the CS interpretation is that some of the CPUE rise since 1990 in younger ages may be due to the contraction in the area fished, and not exclusively to increases in abundance.

Thus previous CCSBT stock assessments that used VS and CS as bounds have overestimated the uncertainty in the CPUE trend and the Scientific Committee recommends that all parties further explore methods intermediate between these two.

For fine-scale analysis, the B-ratio method (Campbell et al. SBFS/95/, SBF/96/10) seems appropriate as a lower bound, because it assumes excellent ability of vessels to target high catch rate areas. We believe the geostatistical method merits further work as well as other methods for fitting spatial and temporal trends.

The following guidelines should govern the development of CPUE analysis methods in the future:

- A complete algebraic formulation and input data base for all methods should be available so that any party can replicate the method once it is tabled
- Before a CPUE analysis method is used in an assessment, all interested parties should have the computer code to replicate the method
- Before a CPUE analysis method is used in an assessment, the CCSBT protocols for introduction of new information or a new method will be followed.

The SC does not believe it will be practical to meet the above standards in time for an assessment in July-September 2001 using Bratio or geostatistical approaches, and the SC will need to adopt some interim CPUE time series for the 2001 assessment as guided by the Advisory Panel

Once one or more CPUE analysis methods are developed, it will then be possible to evaluate the need for and design of a CPUE interpretation experiment.

3. Scientific Observer Program

Scientific Observer Programs are internationally accepted as an essential component in any fisheries management system and will be a key element of a SRP for CCSBT.

Information that should be collected by scientific observers includes:

1. Details of effort to aid the interpretation and standardisation of CPUE data, including:

- Amount of gear used and technical details of gear
- Position of fishing activity
- Date and time of fishing activity

2. Details of the catch, including:

- Catch composition (number and length or weight for SBT, other tuna and tuna like species)
- Catch retained and discarded

3. Length, weight, sex and other biological data for SBT

4. Otoliths of SBT for age determination

5. Monitoring of tag recoveries

6. Environmental data that may influence SBT CPUE (sea surface temperature, wind direction and speed, etc.)

7. Research duties – qualified observers may collect detailed reproductive samples, and tag fish as practical and appropriate etc.

The following principles should govern the implementation of an observer program for CCSBT:

1- The SC recommends an observer coverage of 10% for catch and effort monitoring as a target level.

2- The appropriate level of observer coverage for estimation of tag returns will depend on the scale of the tagging program and the tag recovery rate. The trade-off between more intensive observer coverage and more intensive tagging will need to be explored in planning the tagging program.

3- CCSBT shall prepare standards for training of observers, operation of observer programs and the data to be collected including the forms to be used.

4- The CCSBT Secretariat shall work with observer coordinators in member countries to assure that the data collected becomes part of the CCSBT data base as agreed in CCSBT protocols.

5- Member countries will be responsible for operation of observers in high seas and domestic EEZ fisheries on their flag vessels.

6- All fleet components should be observed and target levels of observer coverage should be the same for all fleet components.

7- In the interests of maintaining consistency between fleets and increasing mutual trust in the results of the observer program, exchange of observers between countries on a regular basis and recruiting some observers from non-member nations should be encouraged.

4. Conventional tagging program

The primary objectives of the tagging program are considered to be:

- To provide age-specific estimates of fishing mortality and natural mortality with associated estimates of uncertainty, for as many SBT cohorts as possible;
- To provide additional information on SBT migration and distribution patterns which may be useful in elucidating mixing rates of tagged fish; and
- To provide direct estimates of growth rates of tagged and recaptured fish. (CCSBT, 2001)

In defining these objectives, and in designing the program to meet them, it was recognised that the focus of the program would develop from initial short-term requirements towards longer-term objectives. The program is focussed on tagging activities to be conducted and objectives to be met over the 2002-2006 program. It will be fully reviewed in 2006 or sooner if information indicates the need for revision of objectives and tagging activities. A large scale tagging program commenced in 2002 off South Australia and Western Australia as intended.

Stock assessment models are to some degree, predicated on fishing and perform best under contrast due to catches. Simulation studies have shown that the ability of depletion-type methods to correctly estimate abundance trends is particularly limited during population recovery (since catch is not a major factor in explaining the trend in stock size). In other words, declining populations are estimated somewhat more accurately than increasing ones. Therefore, the SC feels that a tagging program can provide important additional information on natural and fishing mortality rates to improve the ability to estimate changes in stock size. Such age-specific information on tag-recapture rates can be important since it is relatively independent from other abundance indices.

To minimise problems on assumptions about mixing rates the SC recommends that tagging occur over a broad geographic area. While it is clearly most cost effective to tag young fish, a tagging program must make every effort to tag all components of the SBT stock. In addition, to provide good estimates of recovery and reporting rates, this component of the SRP should be linked to appropriate observer coverage.

A well designed and conducted conventional tagging program will provide information that supplements abundance indices from CPUE trends and aerial surveys. This additional information will help achieve the overall objective of an SRP of “providing statistically significant data for reducing the levels of uncertainty in stock assessments made by the Commission and to identify directions for future research”. A well designed tagging program will yield estimates of fishing mortality rates, which, when combined with estimates of the catch, provide estimates of the stock size.

The SC recommends that a conventional tagging program should be conducted using the following approaches:

1. Use of a dedicated pole and line vessel to tag juvenile SBT off the coasts of Australia during the summer months. The target number to be tagged annually is 10,000 to 15,000 fish. This appears to be the most cost effective way of releasing tags into the SBT population.

2. Concerns have been raised about the subsequent mixing of juveniles tagged off Australia into the SBT population. The SC recommends that where other sources of juvenile SBT can be identified, tagging in these areas also be initiated.

3. Ideally tagging would occur across all ages and locations of the SBT population. In order to achieve this, a well balanced tagging program would include some combination of chartered longline tagging and voluntary tagging from commercially operating longliners by onboard observers. The details of this mix will need to be determined in the final design stages of the program.

4. CCSBT should explore the possibility of using some form of cryptic tag such as PIT tags to assist in determining the tag return rate of the traditional visible tags, and possibly as a replacement for visible tags. A number of possible problems have been identified with cryptic tags, primarily relating to impacts on the marketability of the fish. This problem is not unique to SBT and should be further explored.

5. As tag recovery is often one of the most problematic components of a tagging program, CCSBT should establish strong incentives for both effective tagging and returning recaptured tags

6. Any tagging programs will be co-ordinated by CCSBT and the data retained and managed by CCSBT and available to all members.

There is obvious overlap between this component of the proposed SRP and some of the other proposed components, specifically the scientific observer program. The determination of where, how, and by whom a tagging program should be conducted is the responsibility of the Commission to decide upon advice from the SC. Some tagging programs may best be conducted by the individual parties, while others may best be conducted using a centralised approach.

The SC believes that the results from a well-designed conventional tagging program that provides estimates of fishing mortality rate and therefore current stock size offers an opportunity to reduce the current uncertainty in the stock assessment. The SC recognizes that for a tagging program to provide a relative index of stock size assumptions about tag reporting rates, tagging mortality, tag shedding and mixing must all be met. The SC therefore recommends that the Commission addresses the issues of where, how, and by whom a tagging program should be conducted with some urgency to ensure that the information is obtained as soon as possible for input into future assessments.

Acronyms

ABARE	Australian Bureau of Agricultural and Resource Economics
ACIAR	Australian Centre for International Agricultural Research
ADFA	Australian Defence Force Academy
AIMS	Australian Institute of Marine Science
AFFA	Agriculture, Fisheries and Forestry - Australia
AFMA	Australian Fisheries Management Authority
AGVP	Average Gross Value of Fisheries Production
ANCA	Australia Nature Conservation Agency
ANU	Australian National University
AOP	Annual Operational Plan
ARC	AFMA Research Committee
ARF	AFMA Research Fund
AFZ	Australian Fishing Zone
BAE	Bureau of Agricultural Economics
BAS	British Antarctic Survey
BRR	Bureau of Rural Resources
BRS	Bureau of Rural Sciences
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CEBC	Centre d'Etudes Biologiques de Chizé
CITES	Convention on the International Trade of Endangered Species of Wild Fauna and Flora
CNRS	Centre National de la Recherche Scientifique
CPUE	Catch per unit Effort
CS	Constant-Square
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIE	Department of Primary Industry and Energy
EA	Environment Australia
ECTBOA	East Coast Tuna Boat Owners Association
EFP	Experimental Fishing Program
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
ERS	Ecologically Related Species
ERSWG	Ecologically Related Species Working Group
ETBF	Eastern Tuna and Billfish Fishery
ETMIRF	Eastern Tuna MAC Initiated Research Fund
FAB	Fisheries and Aquaculture Branch
FAG	Fisheries Assessment Group
FIRDC	Fishing Industry Research and Development Council
FRDC	Fisheries Research and Development Corporation
FRRF	Fisheries Resources Research Fund
GAB	Great Australian Bight
GIS	Geographic Information System
IOTC	Indian Ocean Tuna Commission
ITQ	Individual Transferable Quota
JAMARC	Japan Marine Fisheries Resources Research Centre
MAC	Management Advisory Committee
MIRF	MAC Initiated Research Funds
MSE	Management Strategy Evaluation
NBED	Non-destructive Biomass Estimation Devices

NRIFSF	National Research Institute of Far Seas Fisheries
PAT	Pop-up Archival Tag
RFMO	Regional Fisheries Management Organisation
RIMF	Research Institute of Marine Fisheries
RMP	Recruitment Monitoring Program
RSC	Research Sub-Committee
RTMP	Real Time Monitoring Program
SAG	Stock Assessment Group
SAPUE	Surface Abundance Per Unit of Effort
SARDI	South Australian Research and Development Institute
SBT	Southern Bluefin Tuna
SBTMAC	Southern Bluefin Tuna Management Advisory Committee
SBTMIRF	Southern Bluefin Tuna MAC Initiated Research Funds
SCALIA	Statistical Catch-At-Age/Length Integrated Analysis
SOI	Southern Oscillation Index
SRP	Scientific Research Program
SSB	Spawning Stock Biomass
TAC	Total Allowable Catch
TBOA	Tuna Boat Owners' Association
TPWS	Tasmanian Parks and Wildlife Service
UWA	University of Western Australia
VFA	Virtual Population Analysis
VS	Variable-Square
WTMIRF	Western Tuna MAC Initiated Research Funds